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Neolithic perforated hammer axes from Belgian Limburg and adjacent parts of the Netherlands, Flemish Brabant and Liège

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1. Introduction

Perforated stone percussion tools, commonly referred to as hammer axes, are clearly identifiable objects of great age that played an important role in prehistory and in subsequent periods. Their distinctive shape and execution have made them easy to spot for finders and collectors, which largely explains why the context in which they functioned can no longer be traced for many of the specimens found. It is likely that some other artefacts in the vicinity of these hammer axes failed to attract attention, or were simply not recovered.

For convenience, we use the word 'hammer axe' in the sense of a perforated stone percussion tool, but we also include in this group *Geröllkeulen* (or mace heads), which are oval to round stones with an hourglass perforation, and *Scheibenkeulen*, which – as the name suggests – are perforated stone discs.

The study of stone hammer axes has always enjoyed immense interest. We know of overview publications from Germany, the Netherlands, Belgium and other European countries (*e. g.* Biermann, s. d.; Brandt, 1967; Addink-Samplonius, 1968; Hoof, 1970; van der Waals, 1972; Achterop & Brongers, 1979; Beuker *et al*., 1992). Since the 1980s, however, hammer axes from the area discussed here have appeared rarely, if at all, in overviews.

Since the 1990s, we have received repeated reports of perforated stone hammer axes, or hammer fragments, from Belgian Limburg and neighbouring areas. In addition, several museums have acquired collections containing such hammers. As the list of find reports grew, we felt that an overview of these finds would contribute to the study of the Neolithic and the Metal Age in our region. This prompted us to bring together a number of unpublished finds, as well as finds that were published cursorily or locally. We also knew of the existence of privately owned finds, or finds made by non-professional archaeologists. Lastly, we checked the Central Archaeological Inventory (CAI) for Belgian Limburg and the adjacent municipalities of Flanders; these finds are also included in our inventory.

Most specimens are stray finds with no excavation or other context. Although this makes cultural attribution, dating and interpretation more complicated, we recognised the importance of collecting, describing and including all these scattered finds in a catalogue. It would allow others to become acquainted with these rather obscure specimens, many of which were hard to access. Our aim was not to achieve completeness, which is often unrealistic, but to document as many as possible of the perforated stone tools that were known to us personally or passed on to us by others. We believe that the collection we have assembled is a welcome addition to the specimens that are already well documented. They afford us a better overview of the occurrence of this artefact category in the region

under discussion. Tracking down and documenting all relevant finds is a job that still needs to be done. We suspect that there are more perforated hammer axes in various collections, albeit ones that are by and large fragmented and incomplete. They could certainly shed new light and give us a better understanding of the Neolithic in the region. We hope nevertheless that this initial overview will help to lay a solid foundation.

In this article, we first describe our method. We then briefly present our most important data and results for each period. This is followed by a detailed look at the raw materials used and a discussion of the finds within their time period. We then present our main conclusions and we end with the catalogue, organised by period.

When discussing artefacts from our catalogue in the running text or citing them for purposes of comparison, we give their serial number in bold (e. g. **27**) so that readers can look them up in the Catalogue and Appendices (Sections 9 and 10).

2. *Method*

Clearly, our involvement in the work of the Gallo-Roman Museum in Tongeren, the Cultuurhistorisch Museum in Asselt and the Limburgs Museum in Venlo has meant that we could include the perforated hammer axes from the collections of those museums in our study. Thanks to good collegial relations, we have also been able to obtain temporary loans from public collections, including the Royal Museums of Art and History in Brussels, the Grand Curtius in Liège, the Musea Maaseik and the municipality of Kinrooi.

Our primary area of study was Belgian Limburg. We have also included several finds from adjoining areas to the south – the Liège part of the Jeker catchment area (municipality of Bassenge) – and to the north – from Netherlands Limburg and North Brabant (just one find in this latter case). This northern area extends up to the Meuse and no further north than roughly the line between Weert and Roermond. Finally, we included two more finds (Webbekom and Geetbets/Rummen) that were discovered just west of the border between Limburg (B) and Flemish Brabant (Fig. 1a & b).

We wished to determine the rock types as accurately as possible so that that information could be integrated into what we already knew about the use and provenance of perforated hammer axes. All the specimens that we collected were determined macroscopically (*i. e.* with the aid of a magnifying glass or hand lens) by Roland Dreesen and Éric Goemaere, our team geologists, in 2004, 2011, 2017 & 2020.

This determination was certainly not optimal since we were not permitted to chip or cut pieces from the samples in order to create thin sections (*i. e.* ultra-thin cross-sections) for further analysis using a polarisation microscope. Even with a destructive study of that kind – petrographic analysis – it would not always be possible to unambiguously determine the exact provenance of the raw materials unless further geochemical analysis were undertaken. Determining the exact provenance would only be possible with a thorough, comparative petrographic-geochemical analysis, based on reference material from all known or suspected outcrops and exposures. A successful example of this is the combined petrographic, geochemical and statistical analyses carried out on Roman millstones of basalt lava in Germany, France and Belgium (Gluhak & Hofmeister, 2009, 2011). In our study, a small number of objects could not be determined because they were made available to us for only a short time. We use a simplified petrographic terminology to identify the rock types from which the hammers were made. In particular, this allows us to make comparisons with the information in the literature. We refer the reader to the discussion on terminology later in this article.

Fig. 1 a & b – Some of the perforated hammer axes in the 2017 study at the Gallo-Roman Museum Tongeren (© Gallo-Roman Museum).

For the typological classification of artefacts from the Early Neolithic, we mainly made use of somewhat older, though still relevant, publications (Brandt, 1967; Hoof, 1970; van der Waals, 1972). Three overview studies (Brandt, 1967; Bakker, 1979a, 1979b) were very useful for the Middle Neolithic and Funnelbeaker period (TRB). For the Late Neolithic, we used those of Brandt (1967), Addink-Samplonius (1968), Drenth & Lanting (1991), Beuker *et al*. (1992), Butler & Fokkens (2005) and Drenth (2005).

Period	*Quantity*
Mesolithic and Early Neolithic	17
Middle Neolithic	2
Late Neolithic	16
Metal Ages	2
Undetermined	2
Total	*39*

Tab. 1 – Overview of the number of finds in each period.

In all, we were able to determine 37 perforated stone percussion tools that we could assign to four main periods (Early, Middle and Late Neolithic and the Metal Ages; a further specification within these periods was sometimes possible (Tab. 1). Two artefacts could not be classified because we had doubts about their authenticity and/or because the find location was either not known or unreliable, bringing the inventory total to 39 perforated hammer axes or hammer fragments.

Finally, a comment on how we determined the hammer axe dimensions. Wherever possible, we give the length (L), width (W) and thickness (T), together with the diameter of the shaft hole; these are maximum values in each instance.

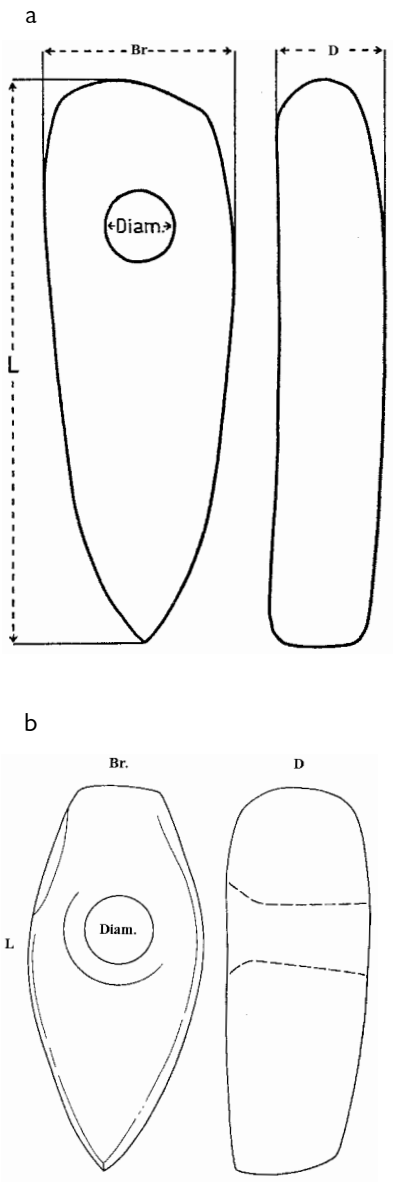

Fig. 2 – Measurement conventions used in this article (length, width, thickness).
a. Early Neolithic (after van der Waals 1972, with adjustments);
b. Late Neolithic and other periods.

To ensure a uniform method in our study, we have given height measurements as widths (W), in contrast to van der Waals, who – based on the measurements of *Linearbandkeramik* (LBK) or Linear Pottery Culture adzes – gives the width as the height in his study of Rössen broad wedges (van der Waals, 1972: Abb. 65). To avoid confusion, we have avoided the term 'height' as much as possible and have instead used 'thickness' (T). For us then, the thickness is the measurement parallel to the perforation and the width is the measurement perpendicular to the perforation, irrespective of the period under discussion (Fig. 2).

3. Perforated hammer axes per period: notes on the inventory

3.1. Mesolithic and Early Neolithic

Although perforated adzes and hammer axes first made their appearance in the late LBK and early Rössen phase, we have included two possible Mesolithic *Geröllkeulen* in our study because this category of artefact continued in use in the Neolithic. This brings the total number of artefacts in our oldest group to 17.

3.1.1. Mesolithic

The two *Geröllkeulen* come from Kinrooi-Ophoven, specifically from Hezerheide 1 & 2 (cat. 8 & 9). Artefacts of this kind are not exclusive to the Mesolithic. They have also been found in an Early Neolithic context, which makes an exact dating impossible. In addition, Mesolithic *Geröllkeulen* seldom occur in our region: they are much more numerous in the north.

The shaft holes were made using the pecking technique, whereby stone was shattered through prolonged hammering, resulting in an hourglass-shaped shaft hole.

The function of these tools remains somewhat unclear. They have been interpreted as hammerstones, as weapons, and in part as prestige objects marking the owner's status. In that respect, there appears to be an interesting parallel with *Spitzhauen* (see below) (Drenth & Niekus, 2008 & 2009; Claßen & Zimmerman, 2015).

3.1.2. Linearbandkeramik (LBK)

We include four artefacts in the late LBK period: a *Scheibenkeule* from Geetbets-Rummen (4), three perforated adzes, or *Plättbolzen* – one from Kinrooi-Hezerheide ('Geerkens') (10), one from Kinrooi-Raam (11) and one from Tongeren (15).

In accordance with Lanting & van der Plicht's (2000/2001) chronology, the Neolithic began with the LBK in the Meuse Valley and the Belgian loess belt after 5300 BC and continued until about 5000 BC. They place the Rössen phase between 4600 and 4300 BC. Hinkelstein and Grossgartach occurred between these times, roughly between 5000 and 4700 BC, although not generally in our region. There are no traces of LBK settlements in the northern part of Belgian Limburg, whereas they are known on the eastern bank of the Meuse.

3.1.3. Rössen

We have placed the largest group of Early Neolithic artefacts in the Rössen period. There are 11 specimens, all from the territory of Belgium: Bocholt (1), Borgloon-Jesseren (2), Dilsen-Elen-Station (3), Genk-Zwartberg (5), Kinrooi/Geistingen-Steenberg (6), Kinrooi-Molenbeersel (7), Kinrooi-Ophoven (12), Lanaken/Rekem-Hangveld (13), Maasmechelen-Olenderheide (14), 's Gravenvoeren (16) and Sint-Pieters-Voeren (17).

3.2. Middle Neolithic

Only a very small number of hammer axes can be assigned to the Middle Neolithic. This is because the cultural groups of that time, especially Michelsberg and Seine-Oise-Marne/Stein, did not produce hammer axes themselves. However, imported pieces occur to a limited extent, mainly from the Funnelbeaker region (TRB) in the north. There are only two such artefacts and both are fragments of knob-butted axes. The first comes from the Hoefkamp site (18) in Dilsen-Stokkem (Limburg, Belgium). Other artefacts possibly relating to the TRB culture have also been collected from that site. Because of their importance in interpreting the site, they are listed in the Appendices that follow the catalogue. The artefacts in question are two broken flint axes with a rectangular cross-section (40 & 41). This type of axe is a rarity south of the Rhine and Meuse rivers, making this a special site in this respect. Since traces of TRB habitation do not occur south of the major rivers in the Netherlands, these finds point to contacts and influences from the north. The second knob-butted axe, also broken, comes from Neeritter in the municipality of Leudal (19). It is a stray find with no further context.

3.3. Late Neolithic

The largest group of hammer axes can be dated to the Late Neolithic, although some types still may have been in use during the Bronze Age. In this latter instance, they normally are referred to in the German literature as *Arbeitsäxte*.

In total, we were able to attribute 16 specimens to this period. All instances involve stray finds. Not a single specimen can be directly related to the burials with which these finds are traditionally so closely associated. It is conspicuous that many hammer axes are fully intact, with almost no traces of use or other damage.

The hammer axes come from Bassenge-Bassenge/Wonck (Liège) (20), Bekkevoort-Assent (Flemish Brabant) (21), Bilzen-'Munsterbilzen' (?) (Limburg, Belgium) (22), 'Diepenbeek' (Limburg, Belgium) (23), Dilsen-Stokkem-Driepaalhoeve/Driebeukenbos (Limburg, Belgium) (24), Dilsen-Stokkem Hoefkamp (25), Dilsen-Stokkem-Lanklaar/'Virveld'

(Limburg, Belgium) (26), Kinrooi-Hagendoren/Batven (Limburg, Belgium) (27), Kinrooi-Geistingen-'In de Ooe' (Limburg, Belgium) (28), Kinrooi-Ophoven (Limburg, Belgium) (29), Leudal-Hunsel (Limburg, Netherlands) (30), Leudal-Neeritter (Limburg, Netherlands) (31), Lommel (Limburg, Belgium) (32), Maaseik–Opoeteren-Dorne/'Dornerheide' (Limburg, Belgium) (33), Maasmechelen-Leut (34) and Oudsbergen-Gruitrode-Campstraat (Limburg, Belgium) (35).

3.4. Metal Ages

Two hammer axes can be placed in the Bronze and/or Iron Age (Fig. 5). The first originates from Dorne ('Zandgroeve') in Opoeteren, municipality of Maaseik (36). The second is a hammer axe of Muntendam type I, found beneath a farmhouse roof in Cranendonk-Soerendonck (37) in North Brabant. This latter find situation is no doubt linked to an old popular belief that such objects afforded protection from lightning strikes.

The number of hammer axes from this period is conspicuously small. They are found in larger numbers in the northern part of the Netherlands – not in graves –, but frequently in a settlement context (Achterop & Brongers, 1979; Beuker *et al.*, 1992).

3.5. Hammer axes of uncertain origin and/or age

Finally, there are two hammer axes that we have not been able to assign to any of the above periods, either because no further details are known about the find circumstances or because the artefact is so atypical as to raise doubts about its authenticity as a prehistoric object. The first is a hammer axe that is said to have come from the Jeker Valley (38), but which in all probability – judging by its shape, certain details and raw material (limestone) – is not an original artefact from prehistoric times. The second, a *Spitzhaue* (pick), lacks any find data (39). It is probably a purchase from abroad that ended up in a private collection some seventy years ago.

Both items are included in the catalogue. We also looked at the type of rock used in their manufacture.

4. Discussion of the rock types used

4.1. Terminology

The terms used in the archaeological literature to describe the material (rock) from which adzes and perforated hammer axes were manufactured are often confusing and sometimes simply wrong. Different lithological terms are often used interchangeably for the same type of rock. In addition, little – and often no – mineralogical-petrographic analyses have been carried out using techniques such as optical microscopy (of representative thin sections) or geochemical analysis.

This is also the case for the group of heavy, hard, black or blackish-green to green crystalline rocks that formed the raw material for the bulk of the axe hammers (often referred to as 'battle axes' in the past) that we examined and that are described in the literature. The following names are commonly given to these rocks: basalt, gabbro, metagabbro, diabase, dolerite, meta-dolerite, amphibolite, amphibolite schist, serpentinite, etc. The differences in terminology often relate to the country in question or to the language used. On the other hand, it is difficult (if not impossible) to identify, unambiguously and with scientific accuracy, the different types and variants of the closely related group of basalt, gabbro, diabase, dolerite, amphibolite and other associated rock types solely on the basis of observations made with the naked eye or through macroscopy (using a hand lens or

magnifying glass; Fig. 3). The internationally accepted method for classifying igneous rocks (plutonic rocks) is the QAP ternary diagram (IUGS Classification of igneous rocks, based on Streckeisen, 1974: https://web.archive.org/web/20110930102012/http://geology.csupomona.edu/alert/igneous/igclass.htm), based on the mineralogical composition of the rock (with visible mineral grains of quartz, alkaline feldspar and plagioclase). For effusive (volcanic) rocks in which the individual minerals cannot be distinguished with the naked eye, the chemical composition is commonly used (TAS classification diagram, with relative proportions of $Na_2O + K_2O$ versus SiO_2).

4.2. The gabbro-diabase-dolerite-amphibolite group

Basalt, gabbro, diabase and dolerite are very hard, dark (black or dark-grey to blackish-green) igneous rocks with an almost identical chemical composition. Weathering causes a greyer and browner colouration. The differences are mainly of a textural nature (differences in the proportions and appearance of the components) and can be attributed to different ways in which the basic or mafic magma has cooled. Mafic magma is rich in magnesium and iron and poor in quartz; the silica content is between 48 and 52 %.

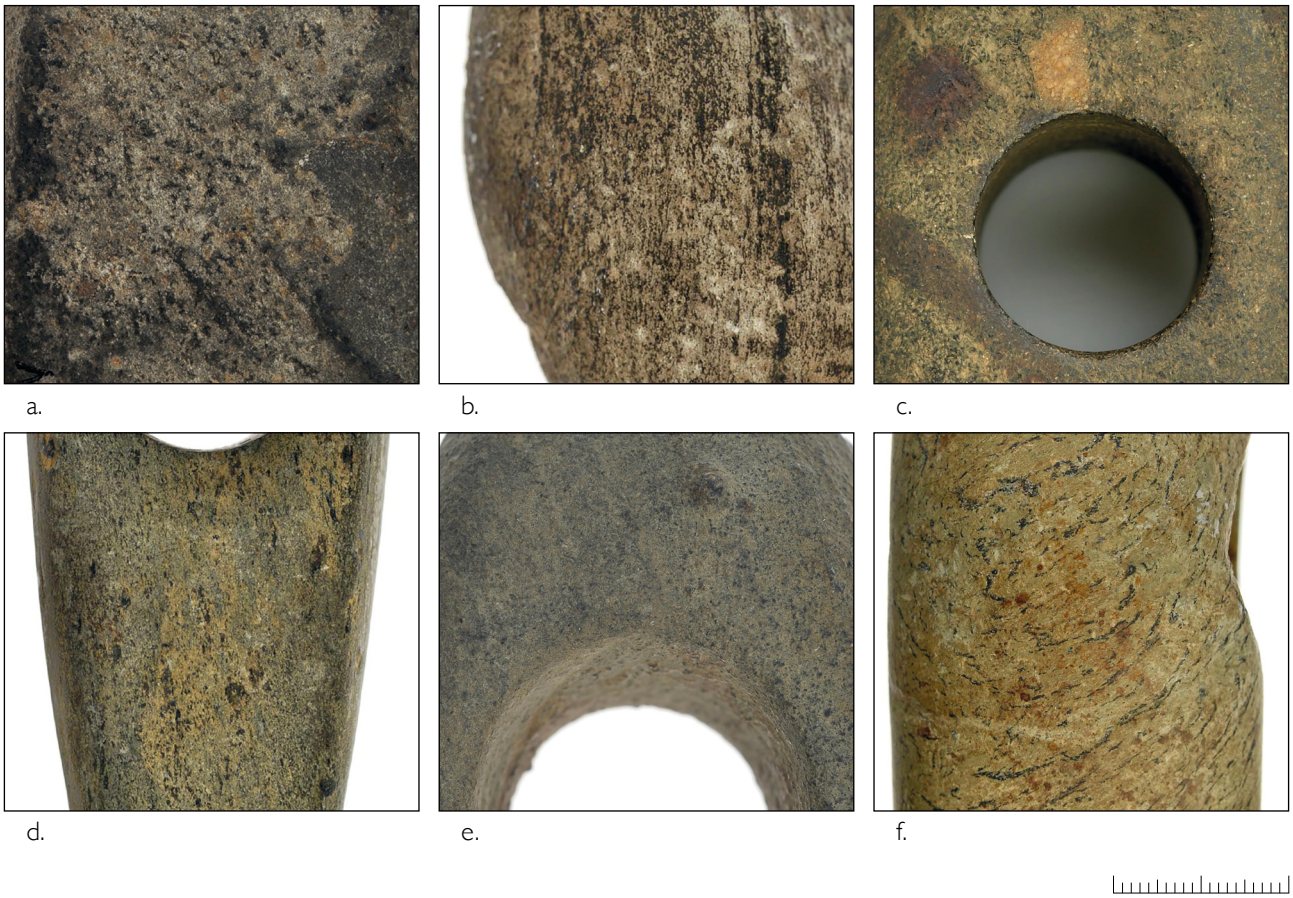

Fig. 3 – Macrophotographs of perforated hammer axes with details of selected rock types (various lithologies): a. basalt, showing fine-grained, dark-grey to black groundmass with small dispersed phenocrysts of black ferromagnesian minerals; b. fine-grained, greenish-grey amphibolite showing conspicuous foliation due to the preferential orientation of black ferromagnesian minerals; c. green diabase (metagabbro) displaying an ophitic texture related to the irregular orientation of small lath-shaped feldspar crystals (plagioclase) with surrounding black-green pyroxene; d. fine-grained, green amphibolite showing conspicuous foliation and large black porphyroblasts; e. dark-grey, weakly stratified and weakly sorted, coarse-grained greywacke-type sandstone; f. light-green serpentinite displaying a greasy or waxy lustre and streaks of dark-grey to black ferromagnesian minerals (© Gallo-Roman Museum).

Gabbro is a coarse-grained, dense and heavy, dark-green to black basic plutonic rock and is completely crystalline (comprising a mosaic of crystals: black pyroxene, white plagioclase and to a lesser extent black amphibole and green olivine). Basalt represents the corresponding effusive rock (volcanic or eruptive rock) and is composed of a dark, fine-grained groundmass often containing firstlings or phenocrysts (*e. g.* augite or olivine), which gives it a porphyritic texture. Diabase is generally more coarse-grained than basalt and can be considered the gabbro dike rock: it occurs in dikes and sills in volcanic areas. However, there are a whole range of transitional rocks between gabbro, basalt and diabase, and which also have different grain sizes. The main constituent minerals in this group are plagioclase, olivine, biotite, amphibole and augite. Diabase and dolerite are often used as synonyms in the literature; the term 'dolerite' is more commonly used in the United Kingdom, while 'diabase' is the preferred term in Germany and the Netherlands.

Diorite is a black-and-white crystalline rock that falls midway between (dark) gabbro and (paler) granite in chemical and mineralogical terms. It contains more silica (52-63 %) than gabbro.

For some authors, diabase differs from dolerite in terms of its ophitic texture, a characteristic texture of crisscrossed white feldspars (plagioclases) enclosing black minerals (augite, magnetite). The colour and texture of this rock resemble snakeskin, hence the name 'ophite' (or 'snakestone') that is sometimes given to this diabase (from the Greek word *ophis* for snake). If the rock also contains yellow-green olivine, it has a more blackish-green colour. This ophitic texture is not exclusive to diabase, however.

The term 'ophiolite' is sometimes used in the literature for certain gabbro- and diabase-like rocks. Strictly speaking, this term is incorrect since it refers not to one but to an entire complex of successive mafic and ultramafic rocks (basalt, gabbro, peridotite and serpentinite) that are characteristic of ocean crusts. Perhaps 'ophiolites' refers here instead to 'ophitic' rocks or 'ophites' (see, for example, Beuker *et al*., 1992).

In chemical and mineralogical terms, amphibolite is closely related to all the above-mentioned dark, basic igneous rocks, but it represents a metamorphic rock (the main components being amphibole and plagioclase with little or no quartz). They are usually very dark rocks with a high (heavy) and a weakly stratified texture or with coarse grain sizes, the light flecks of feldspar (plagioclase) among the dark amphiboles give the rock a speckled appearance. 'Foliation' (from *folia*, leaves) is another name given to this pronounced preferential orientation of the constituent minerals (including the more stalk-like amphiboles); these are then foliated rocks. This foliation can lead to preferential cleavage ('schistosity'). If there is a very pronounced preferential orientation, this can give rise to amphibolite schist and actinolite-hornblende schist (a schist whose main component is actinolite, a specific metamorphic type of hornblende). They both belong to the broad group of amphibolites. Some authors also refer to this latter rock type as 'amphibolite-like rock' (Beuker *et al*., 1992). Rocks with a pronounced schistosity cannot be used as axe hammers because they would split along that orientation; their function was probably solely symbolic. On the other hand, compact rocks with no preferential orientation and rocks with metamorphic banding were potentially functional, as well as looking attractive and having a symbolic use.

Serpentinite is a typically pale green to yellowish rock, but it can also be quite dark to almost black. It is composed of serpentine minerals (and other minerals such as chlorite, magnetite, brucite and talc). The rock is usually compact but sometimes has a more fibrous or even flaky structure. It belongs to the above-mentioned ophiolite complexes and is often formed as a result of hydrothermal metamorphism from ultramafic plutonic

rocks (such as dunite), although it can sometimes also form from gabbros. Weathering causes reddish-brown flecks in serpentinite that give it a snakeskin-like appearance, hence its name. In the literature on hammer axes, the term 'serpentinite' has probably also been used (incorrectly?) for intensely green amphibolites or actinolite-rich schists. The term 'greenstone', which is too vague, will also have been used for rocks of this type.

The terms metagabbro and meta-dolerite are used for gabbros and dolerites that exhibit an incipient metamorphism, such as schistosity or the preferential orientation of minerals.

4.3. Petrological evidence and potential regions of provenance

Thorough petrographic determinations (including illustrations of micrographs) of materials for stone hammers from the Early to Late Neolithic and LBK can be found, for example, in Schwarz-Mackensen & Schneider (1983, 1986), Bakels (1987) and Christensen & Ramminger (2004). Other studies, such as those by Addink-Samplonius (1968) and Beuker *et al.* (1992), utilise the expertise of geologists or other experts, but with no documented evidence.

The regions of provenance of the raw materials for the Neolithic perforated hammer axes and adzes from the northern foothills of the Harz (Braunschweig area, northern Germany) are clearly linked to the migration of farmers from the Danube region during the Early Neolithic, whereby 'exotic' material (such as actinolite-hornblende schist) was brought from the Balkan Mountains and Western Carpathians (Schwarz-Mackensen & Schneider, 1986). The lydites (or '*Kieselschiefer*'), greywackes and diabases, which were regarded as 'local' materials and frequently used during the later phases of the Neolithic, most probably came from the Devonian and Lower Carboniferous rocks belonging to the Variscan bedrock, such as the Harz, while the basalts came from southern Lower Saxony and North Hesse. The majority of granite-diorites and quartzites, on the other hand, were of 'local' origin, more specifically from erratic boulders selected from till deposits (terminal moraines) of the Saalian Glaciation (Schwarz-Mackensen & Schneider, 1986).

The results of the material analysis of stone axes and hammer axes held in the Drents Museum were published at the time (without scientific evidence) on the basis of determinations by non-professional geologist A. P. Schuddebeurs, an expert on northern Dutch erratic boulders (Beuker *et al.*, 1992). A broad lithological spectrum of raw materials was identified: alongside local material selected from the erratic boulders in the Saalian till, there is also imported material, including mainly amphibolite and amphibolite-like rocks, which are identical to the above-mentioned rock type from the Western Carpathians or Balkan Mountains. In the latter case, these are mainly Early Neolithic specimens. Research generally shows that amphibolite occurs to a lesser extent in the Late Neolithic. It is assumed that most perforated hammer axes during this period were manufactured from erratic boulders from the northern Dutch and northern German till. In our table (see below), the group of amphibolites (five artefacts for the Late Neolithic, one for the Metal Ages, as against eight for the Early Neolithic) is somewhat overrepresented compared with various other studies. As mentioned above, we have opted to include metagabbro-amphibolite, amphibolite schist, amphibolite, metagabbro and metadolerite. We assume that, in contrast to the Early Neolithic, amphibolite (in the broad sense) was mainly quarried locally during the Late Neolithic and the Metal Ages, in this case in the northern Netherlands and northern Germany.

In the study of Neolithic axe hammers from the central Netherlands (Addink-Samplonius, 1968), the materials were identified by geologist Paul H. de Buisonjé. His determinations are based on combined macroscopic and microscopic examinations. The axe hammers were found to be made of lydite, diabase, porphyry, amphibolite, quartzite and quartz-

amphibole-micaschist. However, 30 of the 40 axe hammers were manufactured from diabase ('*Grünstein*') with a characteristic ophitic structure. These diabases were coarse-grained, fine-grained and porphyritic in texture. According by geologist Paul H. de Buisonjé, they would all have been imported, but he also correctly points out that it is difficult to accurately determine the provenance without a thorough comparative petrographic analysis in the Netherlands and in the areas where diabase appears on the surface, such as the Rothaar Mountains in Germany. Interestingly, he identified several of the deep-black rocks, which archaeologists had interpreted as lydite, as metamorphic diabase.

Bakels' (1987) study revealed amphibolite to be the principal raw material for LBK adzes from northwestern Europe. The term 'amphibolite' is used here in the broadest sense of the word: a fine-grained, hard rock usually displaying banding or foliation. The rock consists mainly of pale blue-green actinolite-hornblende in association with opaque minerals (such as ilmenite), plagioclase and/or quartz, biotite, chlorite, epidote and titanite as less frequent or accessory constituents. A second main group of raw materials is that of basalts. These are fine-grained, compact porphyritic rocks, in which olivine, titanium augite, dark-brown hornblende, magnetite and, to a lesser extent, biotite and plagioclase appear as phenocrysts. Finally, quartzitic rocks and lydites make up a third group of materials. These would have been imported as finished or semi-finished products. Bakels refers here to the results of older research (Arps, 1978), which showed that amphibolites could not have come from southeast Belgium or from Rhine or Meuse gravels, but instead from the Central European Variscan bedrock, such as the Spessart, the Harz, the Bohemian Massif and the Carpathians (Arps, 1978). Bakels also rightly points out that in order to give a well-founded answer to the question of geological provenance, all potential findspots for this material first need to be sampled and compared. The origin of the basalts is less problematic: the evidence here points to the Siebengebirge and the Vulkaneifel.

The provenance of the remaining raw materials in Bakels' study is more complex. This is a heterogeneous group of fine-grained, compact, very hard and mainly dark-coloured sedimentary rocks. Material originating from fluvial terraces (rolling stones) is usually considered to be the provenance of the quartzitic sandstones. In the same group are black fine-grained rocks, including the '*grès à micas de Horion-Hozémont*' and phthanite from Céroux-Mousty. Both rock types are indigenous to Belgium and their mineral composition and geological provenance have been subjected to petrographic analysis (Toussaint & Toussaint, 1982; Caspar, 1984; Toussaint, 2012). Toussaint & and Toussaint describe the presence of basalt (or lava) and amphibolite in very general terms, based on the study of thin sections. However, they provide no detailed descriptions or illustrations of their microstructures or mineralogical/geochemical analyses, making comparisons with materials from the east impossible. The authors have simply made a rough classification in which they derive possible provenances on the basis of data from the literature. We therefore need an archaeometric study of these rock groups for Belgium, one that would have to examine both geological and archaeological materials from areas east of our region.

The above-mentioned fine-grained, black sedimentary rocks were recently re-examined (Goemaere *et al*., 2019) using various complementary analysis techniques: in addition to the microscopic examination of thin sections, EDX analysis with a scanning electron microscope (SEM) and Raman microspectroscopy were also employed successfully. The '*grès à micas de Horion-Hozémont*' (micaceous sandstone) is not a true sandstone and the micas cannot be identified macroscopically. In petrographic terms, this rock is a very fine-grained, black pyrite-rich siltstone with sponge spicules, of Lower Namurian age. The phthanite from Céroux-Mousty, on the other hand, is a very fine-grained, black, silica-rich sedimentary rock with a conchoidal fracture that may contain radiolarians,

and is of Cambrian age. The black colouring is due to finely distributed organic carbon. Raman microspectroscopy (Goemaere *et al.*, 2019) in particular allows us to distinguish between these macroscopically very similar black, fine-grained rocks, especially between the phthanites of Cambrian age and the phthanites and above-mentioned silicified siltstone of Namurian age ('*grès à micas de Horion-Hozémont*'), based on differences in coalification degree (graphitic carbon).

A recent petrographic-geochemical study (Christensen & Ramminger, 2004) revealed amphibolite to be the main raw material for the manufacture of LBK adzes and perforated hammer axes from Hesse (Wetterau). The results of that comparative study point not only to imports (making up the bulk of the material, such as actinolite-hornblende schist from the Balkans, Carpathians or the Fichtel Mountains) but also to local regions of provenance (albeit limited and originating from the Spessart and Odenwald complexes).

For her PhD thesis, Kegler-Graiewski (2007) studied the raw materials for Neolithic artefacts, including *Dechsel-*, *Beil-* and *Axtklingen*, from findspots in North Hesse. Geologists, including Christensen mentioned above, carried out the macroscopic and microscopic identifications and the geochemical analysis (trace element analysis using XRF). These revealed a marked predominance of amphibolite and/or actinolite-hornblende shale (52.7 %) and basalt (28.4 %). Neighbouring regions (Spessart, Odenwald, Kyffhäuser) were identified as regions of provenance for the amphibolites. However, 64 % of the 'Rössen *Keile*' from North Hesse were made from actinolite-hornblende shale (Ramminger, 2007). These would have been imported as finished products from the same regions of provenance referred to above. That an Early Neolithic trade route (and Middle Neolithic in the German chronology) for these amphibolite axes really did exist has also been shown by combined petrographic, geochemical and Pb-Sr isotope analyses of known Neolithic adzes and axes in present-day Germany (Christensen *et al.*, 2006). One particular region was emerged as a strong candidate for provenance, namely that of Jistebsko (Jizera Mountains) in the Czech Republic, where there are also indications of prehistoric amphibolite extraction.

The terminology in the summary table below (Tab. 2) has been simplified as follows for the sake of readability:
Diabase: *diabase; metagabbro with ophitic texture*;
Diorite: *diorite; microdiorite*;
Amphibolite: *metagabbro-amphibolite; amphibolite schist; amphibolite; metagabbro; metadolerite*.

	Mesolithic/ Neolithic	*LBK*	*Rössen*	*TRB*	*Late Neolithic*	*Metal Ages*	*Total*
Quartzitic sandstone	2						2
Phthanite		2					2
Hornfels		1					1
Amphibolite		1	7		5	1	14
Greywacke			1				1
Basalt			1		1		2
Diabase				1	2		3
Gabbro			1	1	2		4
Diorite					3	1	4
Serpentinite					1		1
Undetermined			1		2		3
Total	*2*	*4*	*11*	*2*	*16*	*2*	*37*

Tab. 2 – Overview of the rock types used (numbers) in each period (LBK: Linearbandkeramik; TRB: Funnelbeaker culture).

4.4. Discussion of the rock types used in each period

4.4.1. Early Neolithic

A large proportion of the LBK adzes were made from indigenous or 'exotic' rock. Amphibolite was by far the most widely used, along with basalt, diorite (rarely), quartzitic rocks and, for example, *grès à micas* (micaceous sandstone) and lydite/phthanite (Bakels, 1987: 66-69. It was traditionally assumed that most amphibolites came from the Sobótka region of Polish Silesia (van der Waals, 1972: 158; Brongers & Woltering, 1978: 45). This seems to be incorrect, however (Fig. 4). The raw material, identified as *Aktinolith-Hornblendeschiefer* ('*greenschist, prasinite, meta-tuff*'), comes from the Western Carpathians (Slovakia) or the Balkan Mountains (Bulgaria) (Schwarz-Mackensen & Schneider, 1983: 173-175, 1986, 1987). Associated mines and workshops have recently been discovered in Jistebsko, northeast of Prague, in the Jizera Mountains (Bohemia). Amphibolites also occur in Bavaria, albeit to a much lesser extent, and in the form of fluvial deposits (Verhart, 2012: 8). The rocks mentioned above were predominant until the Middle Neolithic, when they were gradually replaced by indigenous raw materials.

Basalt generally came from the Siebengebirge, the Eifel and Westerwald. A number of late LBK adzes are made of *grès à micas* (Horion-Hozémont) or phthanite (Céroux-Mousty, Ry-Angon valley = the latter contain lenses of cryptocrystalline quartz with rutile crystals) (Caspar, 1984; Bakels, 1987: 68). The phthanite *Plättbolzen* from Kinrooi-Ophoven (10 & 11) discussed in our study belong to the latter group.

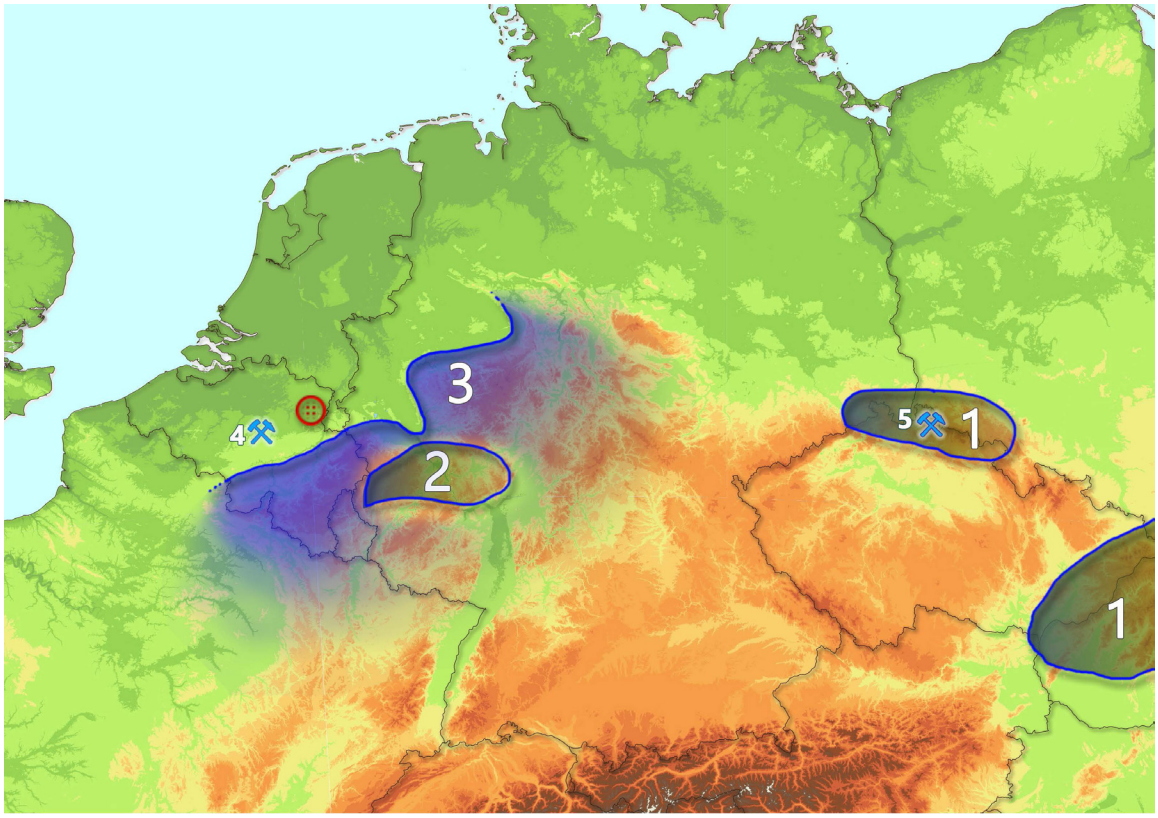

Fig. 4 – Presumed regions of provenance for exotic and supra-local raw materials for the Early Neolithic perforated hammer axes discussed here.
1. Amphibolite – Bohemia, Western Carpathians, central Balkans; 2. Basalt – Eifel, Siebengebirge, Westerwald; 3. Greywacke; 4. Phthanite – Céroux-Mousty; 5. Amphibolite – Jistebsko quarry (Jizera Mountains, Bohemia) (© Vicky Verscheijden, GIS Service, City of Tongeren).

Most of the Rössen perforated adzes are also made of amphibolite, or more precisely *Aktinolith-hornblendeschiefer.* As mentioned above, this rock comes from the western side of the Carpathian mountains or from the central Balkans. Some years ago, Bavaria was named as a further source, which suggests that local sources may also have played an important role. At present, however, studies on the provenance of these raw materials do not paint a unanimous picture. Greywacke, diabase, granite, basalt – and in exceptional instances gneiss – occur alongside amphibolite as raw materials for the Rössen *Keile* (Verhart, 2009, 2012). In Drenthe, two out of 15 specimens are made from gneiss, possibly from the local till deposits. The remainder are made from amphibolite or amphibolic-like rocks (Beuker *et al.*, 1992: 114-117 & 134, tab. 10).

Our inventory also includes a *Spitzhaue* (Verwilghen) (39), which we have classified as a problematic find because we believe it to be an archaeological find from the northern Netherlands. Artefacts of this type do not normally occur in our region; the item was probably purchased by Jo Verwilghen. It is made of diorite, a common raw material for this type of tool, alongside (primarily) diabase and amphibolite, which were mainly quarried locally in Drenthe (Beuker *et al.*, 1992: 131-133).

Of the 11 Rössen *Keile* on our list, seven are made of amphibolite (Bocholt (1), Dilsen-Elen (3), Genk-Zwartberg (5), Kinrooi-Molenbeersel (7), Kinrooi-Ophoven (12), Lanaken-Rekem Hangveld (13), Voeren-Sint Pieters Voeren (17), one of (meta)gabbro (Voeren-'s Gravenvoeren) (16), one of basalt (Borgloon-Jesseren) (2), one of greywacke (Maasmechelen-Olenderheide) (14), and one of an unknown volcano-sedimentary rock (Geistingen-Steenberg) (6). Thus, the amphibolite specimens also clearly predominate in the region under discussion.

4.4.2. Middle Neolithic

Adzes and perforated stone adzes or *Keile* ceased being used in the Middle Neolithic, beginning with the *Bischeimer Kultur* in North Rhine-Westphalia, and then the Michelsberg and related groups, as well as in the south of the Low Countries (Heinen & Stapel, 2016). Polished axes were now being manufactured, first from hardstone, and later also from flint, although perforated felling tools continued in use in the north. The latter were widely used in the Funnelbeaker culture. However, the exchange networks that had existed now collapsed. Whereas amphibolites from Central Europe had previously predominated, other types of stone were now in use throughout northwestern Europe (Beuker *et al.*, 1992: 132-133). Diabase predominated in the rock types of 16 TRB West Group perforated axes that were determined in 1979 (accounting for nine to ten specimens, plus two of porphyritic diabase). One specimen was made of amphibolite, one of granular granite containing a large quantity of feldspar and one of a crystalline rock that was not further specified (Bakker, 1979a, 1979b). Tables from the Drenths Museum (Assen) also show that amphibolite was no longer used as a raw material and had been replaced by diabase, gabbro or diorite and ophiolite (Beuker *et al.*, 1992: 132-133, tab. 7). In what was then the TRB area, the raw materials could be gathered throughout the moraine plains and ice-pushed ridges, where they had been transported by land ice as erratic boulders, mainly from Scandinavia (Fig. 5). Whereas the erratic boulders collected from the surface were usually too weathered to be made into axe hammers, those present in the till were fresh. Highly usable stones could also be found in streams and erosional gullies.

Diabase is the raw material for the knob-butted axe from Dilsen-Hoefkamp (18) on our list. The one from Leudal, Neeritter is made of gabbro (19). For a discussion of the flint types for the northern-type polished axes from Dilsen-Hoefkamp (Schleswig-Holstein/ Lousberg) (40 & 41), we refer the reader to Appendix 1 (see below).

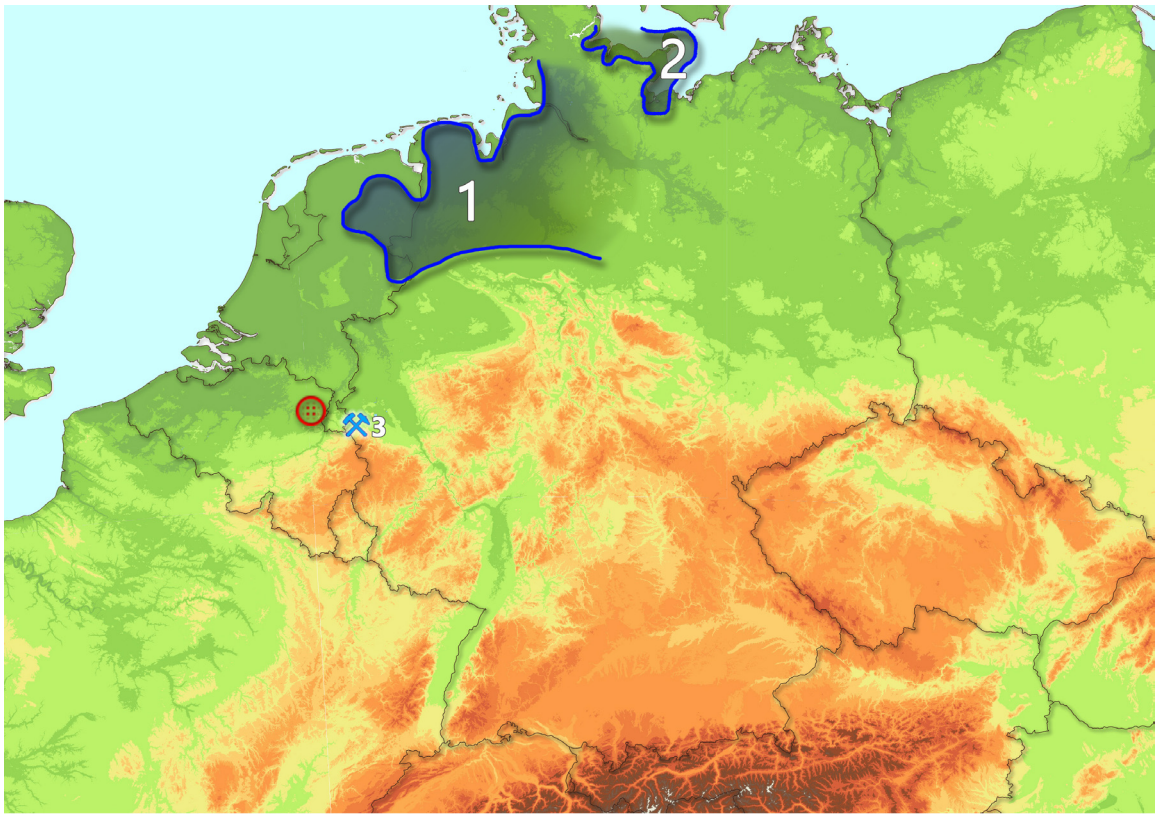

Fig. 5 – Presumed regions of provenance for exotic and supra-local raw materials for the Middle Neolithic perforated hammer axes and the two polished flint axes with a rectangular cross-section discussed here.
1. Till, northern Netherlands & northern Germany – various rocks; 2. Schleswig-Holstein, coastal areas – flint;
3. Lousberg (Aachen) – flint (© Vicky Verscheijden, GIS Service, City of Tongeren).

4.4.3. Late Neolithic

'Indigenous' rocks such as diabase, greywacke, northern amphibolite (glaciofluvial material) and, for example, basalts were mainly used during the Late Neolithic in north-western Europe (Schwarz-Mackenzen & Schneider, 1983). Rocks such as serpentinite were probably still being imported, from the Wroclaw/Sobótka region for example (Schwarz-Mackenzen & Schneider, 1983: 313; (Fig. 6). As shown in the discussion of the rock types used during the Middle Neolithic, very hard, basic 'black' igneous rocks such as diabase, gabbro/diorite or (local) amphibolite were the preferred materials for the production of perforated hammer axes in the northern Netherlands (Addink-Samplonius, 1968: 236-238; Beuker *et al.*, 1992: 114-117 & 134, tab. 10). They have a high mechanical strength, which made them suitable for tools that had to absorb heavy shocks (Drenth, 2005: 341). They could be used as tree-felling tools and for splitting and fashioning wood. Quartzitic sandstones are also relatively common. The cleavage helped determine the choice of rock, as was the case, for example, with the hornblende crystals in amphibolite, which almost always run parallel to the artefact's longitudinal axis. In places, the erratic boulder assemblages of Drenthe and the Hondsrug contained sufficient suitable rocks, such as amphibolites, diabases and gabbro-like rock, to produce axes or hammers. These rocks were used for this purpose during the Middle and Late Neolithic, although we cannot rule out the possibility of imports.

A large proportion of the hammer axes in the north that were subjected to petrological analysis are made of diabase, a rock that was also used for many of the Middle and Late Neolithic axes. Diabase can be coarse-grained, fine-grained or porphyritic (containing

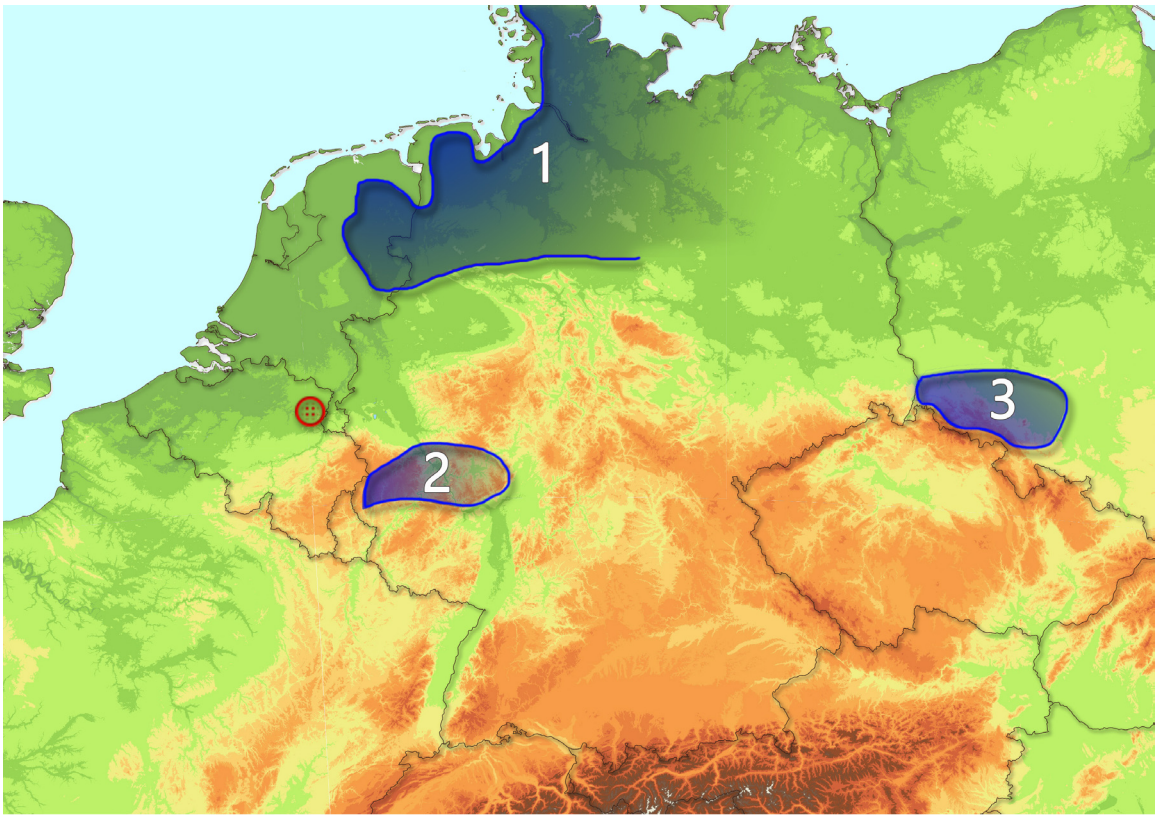

Fig. 6 – Presumed regions of provenance for exotic and supra-local raw materials for the Late Neolithic and Metal Age perforated hammer axes discussed here.
1. Till, northern Netherlands & northern Germany – various rocks; 2. Basalt – Eifel, Siebengebirge, Westerwald; 3. Serpentinite – possible region of provenance (Wroclaw/Sobótka) (© Vicky Verscheijden, GIS Service, City of Tongeren).

large crystals) (Addink-Samplonius, 1968: 236; Brongers & Woltering, 1978: 45). The ophitic structure gives the rock a strong cohesion and an equal resistance in all directions, properties that make it highly suitable for use as a hammer. Diabase, also called *Grünstein*, is one of the most common northern erratic boulder-rocks in the Netherlands. Although they may still have had a fresh core, diabases found on the surface were rendered unsuitable for the manufacture of axes through weathering. However, diabases embedded in the till were hardly weathered at all and were an excellent material for the manufacture of axes. It is therefore fairly certain that, with the exception of the faceted group, the majority of Dutch hammer axes were made from northern erratic boulders. A further strong argument to support this is that the types of diabase used make up too heterogeneous a group to have come from a limited number of mining centres in Scandinavia or the Rhine region (Brongers & Woltering, 1978: 45, who quote G. J. Boekschoten, Geological Institute, University of Groningen, 'oral information'). These rocks were easily found in the till of the northern coastal cliffs of the Netherlands, as well as in Jutland and Schleswig-Holstein. They may also have been dug up from till outcrops.

We were able to determine 14 of the 16 Late Neolithic specimens on our list. The large group of amphibolites – five specimens – is also best represented in the Late Neolithic [Dilsen-Lanklaar-Virveld (26), Kinrooi-Hagendoren (27), Kinrooi-Geistingen-Ooe (28), Leudal-Neeritter (31), Lommel 32)]. In addition, there are one of basalt [Dilsen-Hoefkamp] (25), two of diabase [Leudal-Hunsel] (30) and Maasmechelen-Vucht (34), two of gabbro [Bassenge-Wonck (20) and Dilsen-Driepaalhoeve (24)], and three of diorite [Bilzen-Munsterbilzen (22), Kinrooi-Ophoven (29) and Maaseik-Opoeteren-Dornerheide (33)]. The perforated hammer axe from Bekkevoort (21), which is a Late Neolithic artefact,

is manufactured from serpentinite. The raw material for this specimen, which features an imitation casting seam, possibly comes from the Wroclaw/Sobótka area (Schwarz-Mackenzen & Schneider, 1983: 313). Serpentinite also occurs in places in northern glacier material, from Drenthe northwards. As mentioned above, the amphibolite group in our table (five artefacts for the Late Neolithic) seems rather overrepresented when compared with various other studies. We should point out, however, that this is of limited statistical significance for a group of just 14 artefacts. It is also possible that our study involves a broader group of rocks within the amphibolite class than what is customary in other studies. Most existing studies do not state which rocks are included or excluded in the amphibolites. As mentioned above, we have opted to include metagabbro-amphibolite, amphibolite schist, amphibolite, metagabbro and metadolerite. We assume that, in contrast to the Early Neolithic, amphibolite (in the broad sense) was mainly quarried locally, in this case in the northern Netherlands and northern Germany.

4.4.4. Metal Ages

The study of Metal Age perforated hammer axes in the Netherlands shows that diabase, gabbro, diorite, basalt and dolerite were the most commonly used raw materials (Achterop & Brongers, 1979: 265-268).

Our list contains two specimens: one of diorite [Maaseik-Opoetern-Zandgroeve (36)] and one of amphibolite [Cranendonk-Soerendonck (37)]; (Fig. 6).

5. Discussion of the find material: archaeology

The bulk of the artefacts in the above inventory are chance finds, with the exception of the one from Lanaken-Rekem Hangveld. In virtually all cases, the context is missing. It is important to bear this in mind in the discussion of the finds.

5.1. Early Neolithic

We can place a sizeable number of hammer axes and other perforated artefacts in the Early Neolithic (Fig. 7). A few of these date from the LBK period, but actual traces of LBK settlements have thus far not been demonstrated at the findspots in question. The situation is similar for the succeeding Rössen culture, for which we have more finds. Here, too, there is no evidence of settlements.

5.1.1. Linearbandkeramik (LBK)

The *Scheibenkeule* from Geetbets-Rummen (4) is a unique find as *Scheibenkeulen* are rare in our region. Like the *Plättbolzen*, they mainly date from the final phase of the LBK, although they also occur in the *Älteste* (earliest) LBK, for example in Schwanfeld (Hessen) (Verhart, 2012). They may have continued in use for a short time after the LBK.

They have mainly been found in Central Europe and southeast Germany (e. g. Grosskölnbach, Landau, in serpentinite) and central/eastern Germany (for North Hesse, Kegler-Graiewski, 2007, mentions two *Scheibenkeulen* from the LBK-Rössen site of Grebenstein 1, one of amphibolite and one of basalt; and one amphibolite specimen from Grebenstein 7, a surface site). They also occur in the Middle Elbe-Saale region (Behrens, 1973: 37, fig. 11d; Biermann, s. d.), as well as in the west, although in smaller quantities. We know, for example, of a specimen from Langweiler 9 on the Aldenhovener Platte (Farruggia, 1977: 277, tab. 72). It is made of amphibolite and is about the same size as the one from Rummen. Specimens are known to us from the Eifel, for example from

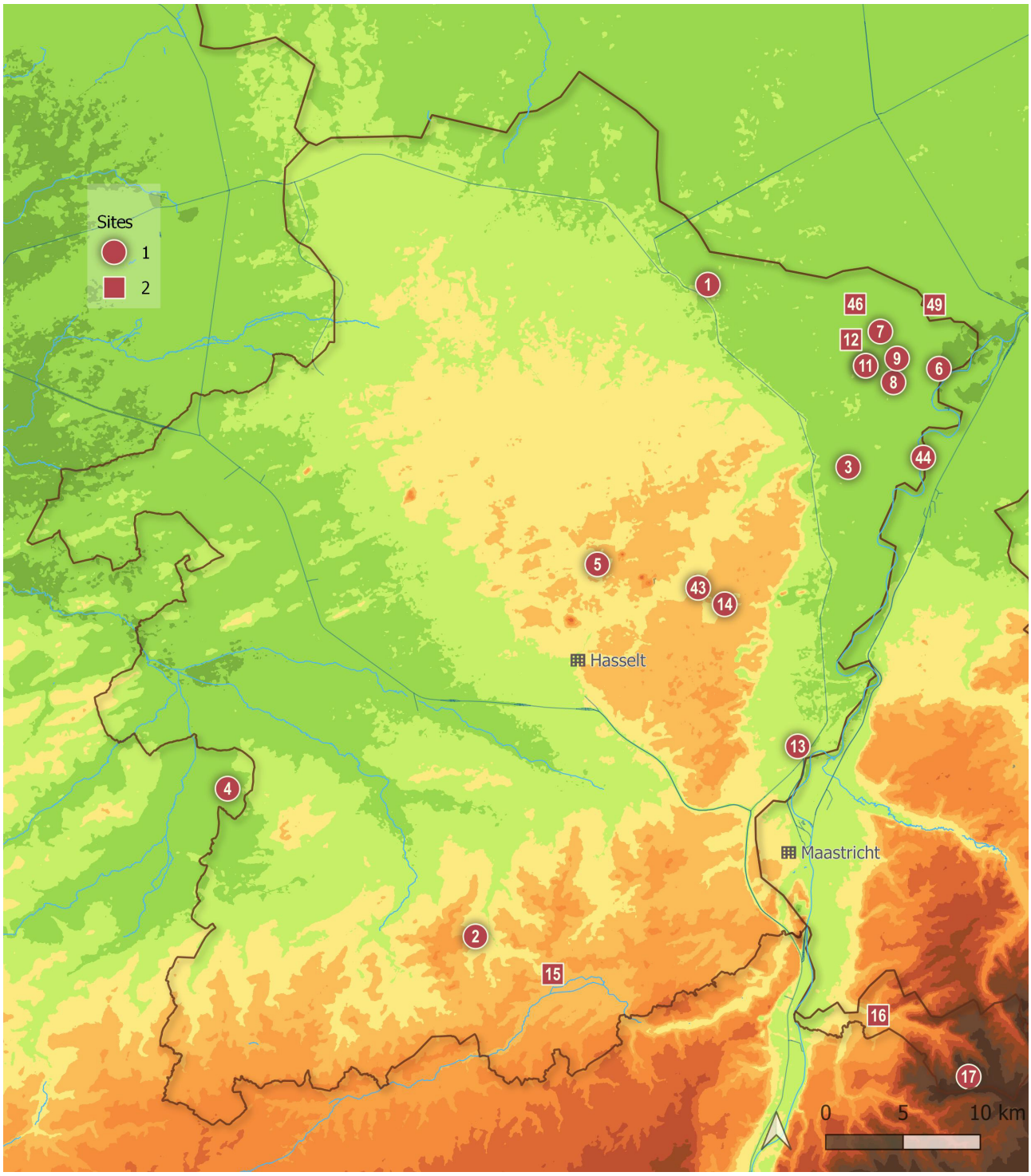

Fig. 7 – The dissemination of the Mesolithic and Early Neolithic finds discussed in this article. 1. Exact findspot known; 2. Exact findspot unknown (© Vicky Verscheijden, GIS Service, City of Tongeren).

Muddersheim (Schietzel, 1965: 44), and there is a fine-grained quartzite specimen from Heinsberg-Geilenkirchen near the Dutch-German border (Hoof, 1970: 213, no. A82, tab. 15, 131). Following the Pfalzdorf find (south of Kleve, about 20 km east of Nijmegen on the left bank of the Rhine), Weiner brought together the *Scheibenkeule* found west of the Rhine (Weiner, 2002a: 34-35. See also Claßen & Zimmerman, 2015). There are five in all, including the ones listed above. Most are of amphibolite (in the broad sense). One is of vulcanite and, like most amphibolites, its provenance should be sought in southern Central Europe; one is of '*graugrüner Granit*'.

Two specimens are known to us from Netherlands Limburg. One is from Stein, possibly from an LBK settlement, and the other is an isolated find from Buchten (Beuker & Drenth, 2015: note 5).

As is the case with perforated hammer axes and *Plättbolzen,* various theories about their function have been developed over time: they have been interpreted as weapons, melee weapons, digging stick weights, the wheels of stone drills, insignia or prestige objects. In view of the long distances over which this (prestigious) raw material was transported – no doubt in the form of finished products – and in the absence of traces of use on artefacts of this type, Weiner interprets them as insignia of important tribal members. They can also be regarded as prestige objects, by analogy with ethnographic examples. It is worth noting that several of these finds have been found well outside the traditional LBK area. Some may have been exchanged with local Mesolithic hunters, who perhaps viewed them as prestige objects. Another possibility is that they were stolen from LBK people.

Perforated flat adzes, or *Plättbolzen*, occur in our region from the end of the LBK. They generally have a straight perforation. They continued in use in the Grossgartach and Rössen phases, but their shape gradually changed (Verhart, 2012: 7). Perforated and unperforated adzes occur together.

The two specimens from Kinrooi-Hezerheide (10) and Kinrooi-Raam (11) are made of phthanite, a common raw material during the LBK. The specimen from Kinrooi-Raam has a straight perforation, while the one from Kinrooi-Hezerheide has a biconical perforation that is atypical for the LBK. This is possibly a local attempt to modify an imported artefact using indigenous techniques. *Geröllkeulen* also have a biconical shaft hole, but this is achieved using a different technique – that of pecking. However, there are no pecking marks on the adze from Kinrooi-Hezerheide, which suggests that an LBK background is the most likely.

According to the inventory of the Grand Curtius, one *Plättbolze* comes from the vicinity of Tongeren (15). Both ends of the tool are blunt. There is no cutting edge and the perforation is conical.

The distinctive perforated and unperforated LBK adzes are also found outside their traditional distribution area. However, *Plättbolzen* are rare west of the Meuse. We know of a fragment in brown quartzite (?) from Ezemaal (Flemish Brabant), from a surface site yielding both Mesolithic and Early Neolithic finds (Lodewijckx, 1988: 57).

Several unperforated adzes have also been documented on the Kempen Plateau in North Limburg (B), for example at Bree, Dilsen (various sites), Gruitrode and Rotem (various sites) (Creemers & Carolus, 1992). They are often viewed as products of exchange between the indigenous Mesolithic population and the LBK newcomers from Haspengouw and the Meuse valley in Netherlands Limburg. Perhaps the adzes were prestige objects for the indigenous Mesolithic population. On the other hand, the LBK people of the Graetheide plateau may well have sought pastureland in the Meuse valley and in the smaller adjacent stream valleys to the west. Such 'cattle camps' have also been found north of the Graetheide on the right bank of the Meuse, but they were probably used by people from the German hinterland, for example from the Aldenhovener Platte (Verhart & Schmitz, 2017). This is how artefacts ended up on the left bank of the Meuse and on the Kempen Plateau and circulated in hunter-gatherer exchange networks (Verhart, 2012: 11-12). A final possibility is that groups that underwent a 'different' neolithisation were responsible for these exchanges or for the presence of such artefacts on the left bank of the Meuse (La Hoguette/Limburg: see *e. g.* Vanmontfort *et al*., 2010).

Perforated and unperforated adzes of the LBK type, especially the high adzes, also appear in Rössen contexts, which means they are not necessarily LBK (Bakels & Hendrix, 1999: 320-322). What sets Kinrooi and nearby Ophoven apart is the fact that, in addition to the two above-mentioned *Geröllkeulen* from Hezerheide 1 & 2 (8 & 9), quite a few different artefacts typical of the LBK through perhaps to the early Rössen phase (perforated *Plättbolzen*, high adzes and a *Breitkeil*) have been found in a fairly small area at Hezerheide, Raam and Hagendoren, as well as at Molenbeersel, only 1.5 km north of Hezerheide. For Hezerheide, Raam and possibly Hagendoren, this raises the question as to whether we are dealing here with a single, large late LBK site, or slightly different sites across time and space.

5.1.2. Rössen

Rössen *Keile* are remarkably common in the Rhine-Meuse region but do not have a homogeneous distribution. They are rare in the west, and also very scare in the loess belt, the traditional LBK area. The find from Sint-Pieters-Voeren (17), and possibly the one from 's Gravenvoeren (16), can be linked to flint quarrying in Rullen; the same is true for Sint-Geertruid, where a Rössen *Keil* was also found (van der Waals, 1972: 170). Flint quarrying in Rullen was possibly initiated by the Rössen people, but there has been insufficient research on flint quarrying at that site. There is just a single dating that we can confidently say establishes a direct link to the quarries and which falls later – in the Middle Neolithic (4580 ± 40 BP) – concurrent with the attested quarrying in Lousberg, whereas the use of Rullen flint is characteristic of a Rössen context on the Aldenhovener Platte (Rullen: Creemers *et al*., 1998; Vermeersch *et al*., 2005; also containing a discussion of the 14C dating p. 319, 324 & 327. For the chronology of the Neolithic, see Lanting & van der Plicht, 1999/2000). Our study appears to partlgy confirm the traditional distribution picture for Rössen *Keile*. Most (five specimens) come from the Meuse valley [Dilsen-Elen (3), Kinrooi-Geistingen-Steenberg (6), Lanaken-Rekem (13), Kinrooi-Molenbeersel (7), Kinrooi-Ophoven (12). Three *Keile* come from the Kempen region [(Bocholt (1), Genk (5), Maasmechelen (14)] and two artefacts are from Haspengouw [Borgloon-Jesseren (2) and Tongeren (15)]. They may have circulated and functioned within indigenous, Mesolithic communities that still resided there.

We are still waiting for evidence of the first Rössen settlements on the left bank of the Meuse. They have since been attested on the right bank, in Netherlands Limburg, by excavations at Maastricht-Randwyck (Lochterveld) and Well-Aijen and by a series of stray pottery sherds, including in Grathem, Neer, Sint-Odiliënberg, Echt and Siebengewald (Bloemers, 1972; Brounen, 1985, 1988a: 389-392; Verhart, 2016b).

In the final phase of the LBK, perforations were made using a specific technique, namely drilling. A fundamental change occurred in the *Grosgartach* phase, when adzes were perforated parallel to the cutting edge. These were *hohe durchlochte Schuhleistenkeile*, or perforated high shoe-last adzes (van der Waals, 1972: 155; Verhart, 2009). Finally, and still in the Rössen phase, perforated adzes assumed a more symmetrical shape, namely, *Breitkeile* or perforated *Schuhleistenkeile* (Brandt, 1967; van der Waals, 1972: 155). This is the most common type, and usually features a conical shaft hole. The adzes were fabricated in the form of semi-finished products while still at the quarry and probably acquired their final form in the settlements, where production waste and these semi-finished products have been found, for example at Maastricht-Randwyck (e. g. Verhart, 2012: 14). The hole was drilled using a hollow wooden or bone drill (e. g. Probst, 1999: 238; specimen from Vanola-Schaan, Liechtenstein), after a hollow had first been 'pecked' into the body. This hollow is sometimes still visible on the pecked and smoother sides. The diameter of the conical drill holes ranges from 11-15 mm to a maximum of 32-35 mm, which is rather

small in relation to the body. It is not clear whether all axes were intended for use. Some specimens are heavily worn; they have become truncated as the cutting edge was sharpened or re-polished, sometimes producing axes that were 'more shaft hole than body'. There are two kinds of secondary perforation: the usual drilled perforations and perforations created by pecking. Interestingly, this latter technique has only been established for *Breitkeile* originating from the Mesolithic territory.

It used to be thought that *Breitkeile* were used as axes, although they would be inefficient for that purpose. The current thinking is that they were used for a range of woodworking purposes, in particular as wood-splitting wedges. This would also explain the many traces of use at the hammer end (Brongers & Woltering, 1978: 43; Verhart, 2012: 15). The dimensions of the *Breitkeile* in Belgium and the Netherlands are smaller than those in German axe hoards. The average length is 15 cm, but the main group are between 12 and 14 cm long. Their height and width suggest that the original length usually exceeded 20 cm; in other words, most have been intensively used and 'worn'.

They must have functioned as prestige objects within Mesolithic communities. The pecking technique was used to create new shaft holes in broken axes in the Mesolithic area. This raises the question of whether Mesolithic communities initially used complete specimens, or whether the Rössen communities gave them inferior, broken or heavily worn specimens in exchange which were then further adapted on site. These secondarily worked specimens cannot have been particularly functional, which would suggest a prestige element.

The *Keile* may also have played a role in social, and perhaps ritual, activities (Verhart, 2009). A functional use need not entirely rule this out. Over and above their use in woodworking, they may have played a complementary role as clubheads in hunting and fighting. Adzes are typical artefacts in the 'male' domain. They are often made from precious exotic rocks, a further argument for an interpretation as prestige objects (Verhart, 2012: 24-25).

This was certainly the case in Central Europe. A perforated serpentinite hammer (a *Doppelaxt*) was excavated at Cham on Lake Zug, with the shaft still preserved (Horisberger *et al.*, 2000; Hochuli, 2003). It dates from the period just after Rössen. The ash shaft was 120 cm long and was carefully wrapped in birch bark and decorated with small perforations at regular intervals. The shaft was fitted into the body with birch tar. The cut marks on the body indicate use as a melee weapon rather than as a work axe. It would have been a showpiece, a sceptre, and may also have possessed a ritual significance. The artefact dates from the Cortaillod/Egolzwiller Kultur, which occurred a little after Rössen. The hammer axe shows eastern influences from the Lengyel Culture.

Perforated stone adzes became increasingly common in the post-LBK phase, but gradually changed shape from the Hinkelstein and Grossgartach phases, evolving into the typical, higher Rössen *Keile*. Two types now developed (van der Waals, 1972: 154-158; Raemaekers *et al.*, 2011; Verhart, 2012: 12). The *Breitkeil* came into vogue a little later, after the *Hohe Schuhleistenkeil*, which it gradually replaced. Both types fell out of use with the advent of the Michelsberg culture, which traditionally marks the beginning of the Middle Neolithic in our region. In the north, among the Swifterbant in the Netherlands, as well as in northern Germany and southern Scandinavia, they seem to have remained in use for somewhat longer.

A specific category that displays similarities to the Rössen *Keile* are *Spitzhauen*, or picks. They are locally found rollingstones in which a biconical perforation has been made using the pecking technique; the artefacts were shaped through bush-hammering and polishing

(Hulst & Verlinde, 1976, 1979; Verhart, 2009). Despite being hammered, they show few or no traces of use, sometimes just a little on the cutting edge or butt. The biconical, hourglass-shaped perforation probably argues against a functional use. Nevertheless, many were broken during use. There are a number of similarities with the Mesolithic-Neolithic *Geröllkeulen* (Drenth & Niekus, 2008, 2009). Perhaps they also functioned as local imitations of Rössen *Keile*.

A *Spitzhaue* ('Verwilghen') (39) also appears in our inventory. The findspot is not known. We have classified the artefact with the hammer axes of uncertain origin and age because we assume that it was purchased and originally comes from the northern Netherlands.

5.1.3. The site complex of Kinrooi Raam, Hezerheide and Hagendoren

Two sites in the former municipality of Ophoven, namely Hezerheide and Raam, have yielded perforated artefacts. They are located barely 1.5 km apart and are separated by the Lossingbeek. The Meuse is less than 4 km away. A phthanite *Plättbolze* was found at the Raam site (11) and two quartzitic sandstone *Geröllkeulen* (8 & 9) and a phthanite *Plättbolze* (10) were found at Hezerheide.

In addition to the *Plättbolzen* from Hezerheide and Raam, a third interesting artefact – a phthanite high LBK adze with no perforation – was found in the vicinity. Dursin describes the artefact as a "*ciseau poli en roche noire, probablement en phtanite. Le corps de l'outil est à section carrée, l'un des bouts se termine en un biseau court, l'extrémité opposée est plate et ce talon est fortement écrasé par suite de percussions répétées*". Dursin (1931: 128) gives the findspot, which yielded numerous other prehistoric finds, as the hamlet of Kinrooi-Hagendoren, close to the Itterbeek near Deunsven, Balven and Jaagven. Judging by this description, the findspot is located west of the Neeroeteren-Kinrooi road, just north of the Itterbeek. Whatever the case, it is located several hundred metres at most from Kinrooi-Raam (see below). Geerkens (1950: 52) also found an adze – which he called a "*lissoir*" (polishing stone) – in black-blue stone, intersected by white veins, probably on the same site in Hagendoren. One side was convex, the other flat (82 x 39 mm). At 'Raam', he found an adze ("*lissoir*") in black-grey rock (102 x 26 x 25 mm) with a flat side and a curved side. The Hagendoren site also yielded a large number of flakes, scrapers, polished axe fragments, polished axes and arrowheads, including four polished axes that were in the Philips collection. This was probably the site where Gerard Segers also conducted prospections. The finds from that site are held in the Musea Maaseik. At the same site he found a fragment of a hammer axe (27) (see below) and an axe of Lousberg flint. Finally, from Kinrooi-Molenbeersel, there is an adze with a perforation perpendicular to the two cutting edges (46), which is held at the Royal Museums of Art & History (Hoof, 1970: 307, no. 75).

The older literature therefore suggests that there were at least three clusters in Kinrooi at the time within a range of less than three kilometres from east to west, and with concentrations marking the region's transition from the Mesolithic to the Neolithic (Dursin, 1931; Geerkens, 1948, 1950). More recent inventory work by Danny Keijers, however, has shown that numerous artefacts have also been found between the Raam and Hezerheide clusters (Keijers, 2000: 41-43, 48-49 & 50-52). The finds from those sites have ended up in various private collections and museums, including in Asselt, the Royal Museums of Art and History in Brussels, the Grand Curtius in Liège, the Musea Maaseik and the Gallo-Roman Museum in Tongeren. We believe that future investigations of this complex of sites (or concentrations) would be very worthwhile. In our view, the complex is worth an interesting and significant case study that would enhance our understanding of Neolithisation in the region.

5.2. Middle Neolithic

5.2.1. General discussion

In general, perforated hammer axes were no longer manufactured during the Middle Neolithic, from the Michelsberg culture on, south of the Meuse and the Waal. They continued in vogue in the north, in the Funnelbeaker culture. The younger 'branch', the TRB West Group is currently placed c. 3400/3350-2800/2750 BC (Brindley, 1986; Lanting & van der Plicht, 1999/2000: 32 & 60).

Two fragments of TRB knob-butted axes date from this period: one from Dilsen-Hoefkamp (18) and one from Leudal-Neeritter (19) (Fig. 8).

The TRB West Group is characteristic of the northern Netherlands and northwest Germany west of the Hase and the Hunte. In the northern Netherlands, it extends to the North Sea and the north bank of the Rhine-Lek, and in the Ruhr region to the Elscher. J. A. Bakker, who has lent his assistance for this part of the article, compiled an inventory for this area of some 45 butt-headed axes from horizons 4-5 (Bakker, 1979a: 96-108; 1979b: 140-145).

Bakker believes that these fairly rare, often meticulously finished axe hammers were probably ceremonial weapons. The knob-butted axes from our list are certainly exceptional for the area south of the Meuse and the Waal, where only eight specimens are known. Apart from a specimen from Bladel-Kriekeschoor, they are all fragments. Based on personal information provided by J. A. Bakker (2003), they are: (1) a complete hammer axe of layered quartzite, Museum Valkhof, Nijmegen, findspot unknown; (2) Leudal, Ittervoort (Limburg, Netherlands), fragmented, black rock; (3) the hammer axe from Leudal-Neeritter discussed here (Limburg, Netherlands) (19), at the border with Kinrooi, Kessenich (B), boundary post 143, fragmented, black rock, basalt-like, probably gabbro-like material; (4) Heeze-Leende, Leende, Leender Heide (North Brabant), fragmented, diabase; (5) Bladel, Kriekeschoor (North Brabant), complete specimen, diabase; (6) a unique variant from Margraten-Sint-Geertruid (Limburg, Netherlands), fragmented (Brounen 1988a, 1988b) from weakly metamorphic amphibolite with greenschist fractions; (7) the specimen discussed here from Dilsen – Stokkem – Hoefkamp (Limburg, Belgium) (18), fragmented, from diabase; (8) Florenville, Sainte-Cécile (Lux.), a complete specimen from the Semois valley.

It is intriguing that some 15 % of the known specimens of this TRB type occur south of the actual TRB West Group cultural area. In all likelihood, the knob-butted axes were imported from the TRB area itself. This is supported by the fact that at least two specimens are made of diabase. The goods for which they were exchanged were not necessarily made of perishable material. Other possibilities include southern flint axes with a lenticular cross-section, which have been found as far afield as Drenthe, in the TRB territory, although they are also very rare there. It seems plausible that they were mainly transported there via the Meuse and the Nijmegen-Arnhem region. The northern ceremonial weapons could then have found their way south via an exchange network and have mainly circulated in the Meuse valley, in the flint quarry area (Rijckholt-Sint-Geertruid, Rullen) and north of there. With the exception of a specimen from Florenville, Sainte-Cécile, situated some 130 km south of the flint quarries of Rijckholt-Sint-Geertruid and Rullen (Voeren) as the crow flies, the distribution area of the southern knob-butted axes is remarkably compact. It is clearly linked to the stretch of the Meuse between Eijsden and Nijmegen. Little if anything is known about the people who used of the knob-butted axes on the southern sandy soils and the loess belt.

The Vlaardingen-Stein group used a tool made of antler and flint that can perhaps be understood as the equivalent of an adze or stone hammer axe. Transecting the 40-50- cm-long wooden shaft at the top was a '*transversely perforated antler socket for a flint axe' (gaine à perforation latérale)*', a straight piece of antler with a shaft hole in the middle and a small flint axe, hafted into a socket at the front. In the less finished specimens, the butt of the piece of antler was rounded or truncated or it consisted of part of the pedicle and part of the deer skull. The implement as a whole can be viewed as an adze. The specimens that were finely finished to varying degrees are best known from the areas of the Vlaardingen-Stein group and SOM culture, for example from Vlaardingen (van Regteren Altena *et al.,* 1962-1963), the Kattendijkdok in Antwerp (Mariën, 1952: fig. 152), Betekom (Flemish Brabant) (Mariën, 1952: fig. 153; De Laet, 1979: 289, fig. 123), Trou des Blaireaux in Vaucelles (Namur) (Mariën, 1952: fig. 148-150), a collective burial cave with a skeletal burial of the SOM culture that includes pottery and a Buren axe, numerous other findspots of the SOM culture, from northern France (e. g. Mariën, 1952: fig. 146) to Chalain in the Jura (Chastel, 1985: fig. 16-17) or even further south. The specimens from Antwerp and one from Chalain (Chastel, 1985: fig. 17a) are well put-together, with a ring at the hammer end; the Chalain specimen is carved diagonally.

The biography of the knob-butted axe from Leudal-Neeritter (19) shows a complex history of use. It is a specimen that was broken in antiquity, with a missing cutting edge. There are grinding marks on the sloping fracture, an indication that the cutting edge was later retouched. The question is where this occurred: in the TRB area or in the vicinity of Neeritter? A further question is whether the fracture occurred in the north or the south. If in the north, and if the repair to the cutting edge were made in the south, this would mean that a broken specimen that still had value elsewhere was included in the exchange network. The same would then apply to other fragments as well, such as the Dilsen fragment (18). The Neeritter hammer axe was eventually broken once again, this time almost along the full length.

Another explanation is that the local Neolithic population manufactured the knob-butted axes themselves, in the same way that people within the Vlaardingen group copied decorated and undecorated baking plates with multiple perforations in identical fashion to the TRB culture. Northern erratic boulders, including diabase, could be gathered left of the Rhine on the ice-pushed ridge of Nijmegen-Kleef-Xanten-Krefeld.

However, a better understanding of this issue clearly requires more research into the too-little-known Middle Neolithic groups in the southern Netherlands, Belgium and the Rhineland.

5.2.2. The Dilsen-Hoefkamp find complex

Further to this discussion, it is worth noting that there were two flint axes with rectangular cross-section at Dilsen-Hoefkamp. Given their importance, the finds are discussed in the Appendix (see below). One axe is clearly made of white flint from more northerly regions (40), probably from the coasts of Schleswig-Holstein or perhaps southern Denmark (Beuker, 2005, 2010: 28-29), and has been polished to a glossy sheen over its entire surface, including in the reduction surfaces. These 'Scandinavian'-type flint axes are largely unknown south of the Meuse and the Waal. The second axe is made of local flint – Lousberg flint in view of the colour and the cortex on both surfaces (41) – and has far fewer polishing marks across its surface. It appears to have been used less intensively. It may be a locally manufactured axe, but of the northern type. This raises questions as to the identity of the settlement inhabitants. Were they local people who possessed a

northern-type axe that they copied using flint quarried in their region, or were they in fact TRB people who lived here temporarily or permanently? Although Lousberg axes do occur in the TRB area, they are very rare (Gronenborn, 1992; Schreurs, 2005; Schuyle, 2016). Lousberg flint has a similar distribution to flint from Rijckholt-Sint-Geertruid, but is generally in use in a more recent period, corresponding to the Vlaardingen/Stein/

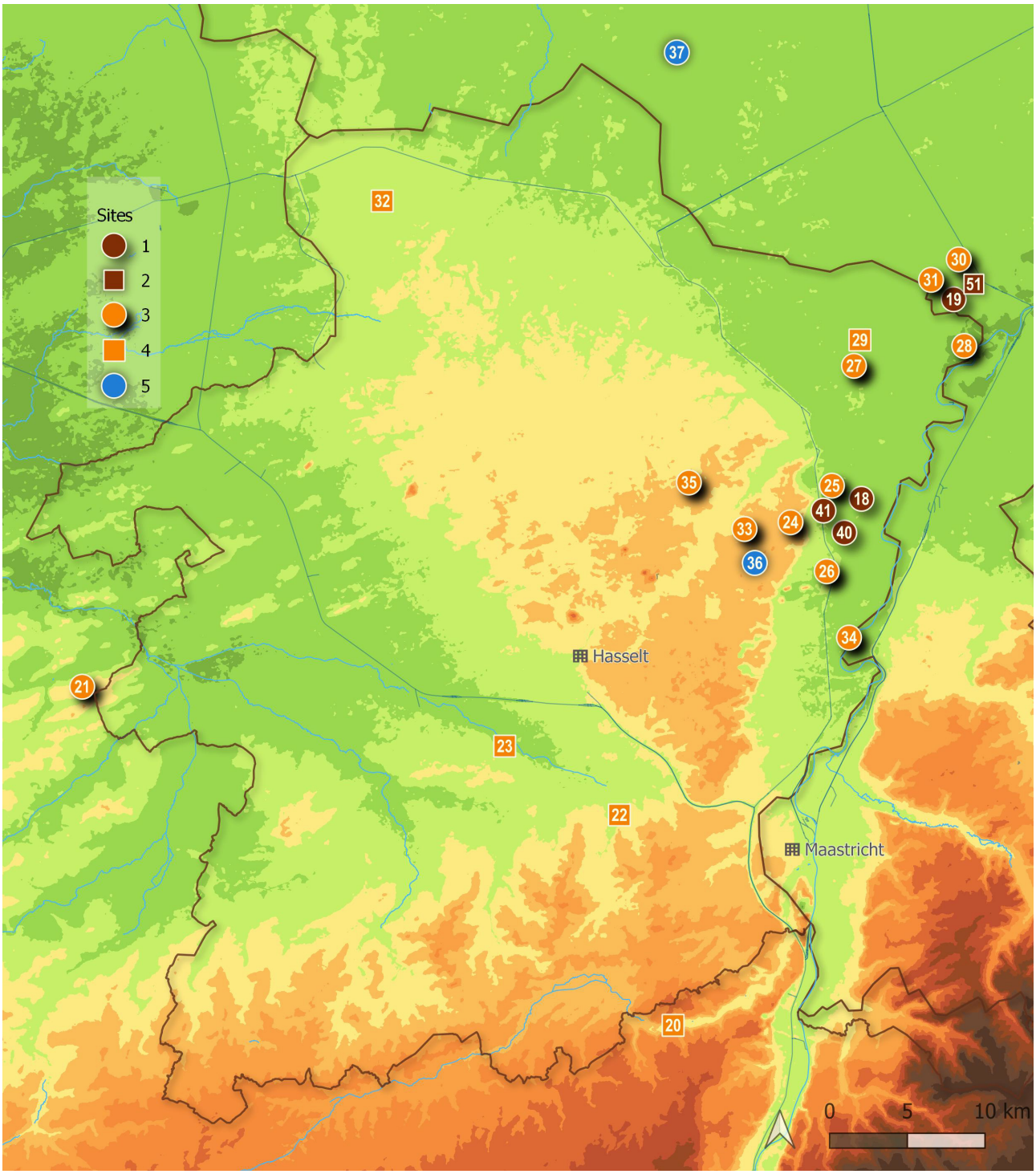

Fig. 8 – Distribution of the finds discussed in this article from the Middle Neolithic, Late Neolithic and the Metal Ages. 1. Middle Neolithic – exact findspot known; 2. Middle Neolithic – exact findspot unknown; 3. Late Neolithic – exact findspot known; 4. Late Neolithic – exact findspot unknown; 5. Metal Ages – exact findspot known (© Vicky Verscheijden, GIS Service, City of Tongeren).

Seine-Oise-Marne period (Modderman, 1980). However, the 14C dates for Lousberg – like those for 'Rullen' – permit a dating within the TRB (Vermeersch *et al*., 2005: 327. Lousberg 4850 ± 90/4580 ± 140, Rullen 4850 ± 40 BP).

Was the Dilsen settlement a link in the trade network between the Vlaardingen/Stein/Seine-Oise-Marne area and the TRB area? Were they TRB people, given that the axe from Lousberg was already a final product, manufactured in the style of the TRB people? These are intriguing questions that are difficult to answer at present. This site is probably worth further exploration in the future, also in view of the presence of some later elements – a sherd of an All-Over-Ornamented/Bell Beaker and a fragment of a Late Neolithic hammer axe. According to Bakker, who divides the TRB into seven different phases, knob-butted axes of the Western TRB type occurred in phases 4-5. The final phase must have ended around 2800/2750 BC, which means that there could have been a brief overlap of some 50 years with the Single Grave Culture (Brindley, 1986; Lanting & van der Plicht, 1999/2000). However, the beaker sherd probably comes from an All-Over-Ornamented or Bell Beaker and is therefore a later artefact, and we can assume that the fragment of the Late Neolithic hammer axe probably belongs in that phase as well. We must therefore conclude that the site was occupied during at least two different periods in time.

5.3. Late Neolithic

The Late Neolithic 'battle axes' were, besides this, burial gifts. Our inventory includes 16 perforated hammer axes and fragments of such axes. Because of their atypical or fragmentary character, several perforated hammer axes – those from Diepenbeek (23), Dilsen-Driepaal (24), Dilsen-Hoefkamp (25), Kinrooi-Batven (27), Kinrooi-Ophoven (29) and Maasmechelen-Vucht (34) – cannot be assigned with greater chronological accuracy than to the Late Neolithic; further specification is not possible. Some could also be slightly more recent. This could be the case with nine specimens (Drenth & Lanting, 1991; Butler & Fokkens, 2005: 394-395; Drenth, 2005: 349). Two specimens – Leudal-Hunsel (30) (A-hammer) and Oudsbergen-Gruitrode (35) (B-hammer) – can be assigned to the group of early hammer axes (2900/2800-2800/2700 BC); they fall within the Single Grave Culture.

The other seven specimens probably fall within the later All-Over-Ornamented/(maritime) Bell Beaker (2600–2450 BC): Bassenge-Wonck (20), Bilzen-Munsterbilzen (22), Dilsen-Virveld (26) (R/S group), Kinrooi-Geistingen (28) (faceted hammer axe), Leudal-Neeritter (31) (P-group), Lommel (32) (G-group) and Maaseik Dornerheide (33) (faceted hammer axe) (Fig. 8). The Bekkevoort hammer axe (21) may be somewhat more recent (2000-1800 BC).

Finally, there is the hammer axe from Dilsen-Elen (3), a reworked Rössen *Keile* that also belongs in the late group within the Late Neolithic (R/S): it is included among the Rössen *Keile* in the inventory.

With regard to chronology, Lanting & van der Plicht put the start of the Late Neolithic with the Single Grave Culture a little later than do Fokkens & Butler, namely around 2800 BC. The Neolithic ends with the Bell Beaker group. For Lanting & van der Plicht, the Early Bronze Age begins with the Bell Beaker-Barbed Wire transition around 1875 BC (Lanting & van der Plicht, 1999/2000: 41). Butler and Fokkens (2005: 395) put the end of the Neolithic at 2000 BC.

As shown below, hammer axes from phases G-R/S (2600-2450) are mainly found in Limburg. This phase falls largely within the All-Over-Ornamented /(maritime) Bell Beaker culture.

The find density is of course much lower than north of the Meuse and Waal. Apart from a handful of beaker sherds, other relics such as burial mounds and settlements have so far barely been documented, if at all, in Belgian Limburg, although the region does appear to have been more densely inhabited than what the (published) finds suggest. A similar picture is revealed in the neighbouring southern Netherlands.

We should probably no longer interpret the hammer axes dating from after the Single Grave Culture as true tools, but possibly as weapons instead (Butler & Fokkens, 2005: 395).

5.4. Metal Ages

We have placed two perforated hammer axes in the Metal Ages (Fig. 8). The hammer axe from Bekkevoort (21) probably still dates from the Late Neolithic (c. 2600-2000 BC), partly in view of the broadening at the shaft hole, which is why we have assigned it to the Late Neolithic hammer axes. We believe it to be an imported (older) specimen from Central Europe, in part because it has an imitation casting seam and is made of serpentinite. However, it also has characteristics of the Zuidvelde-type hammer axes (2000-1800 BC) (Butler & Fokkens, 2005: 395). Lanting (1973: 298, fig. 39a) thinks that a similar specimen from Rhoden (Halberstadt) could perhaps be assigned to the *Flache Knaufhammeräxte vom südwestdeutsch-schweizerischen Typ*. The hammer axe from Maaseik-Dorne ('Zandgroeve') (36) is probably closer to the classic Zuidvelde type due to the absence of a broadening at the shaft hole. However, it is too fragmented to draw many conclusions. Secondly, there is a hammer axe from Soerendonk (North Brabant) (37), found near the Belgium border, which can readily be classified under the Muntendam I hammer axes (Achterop & Brongers, 1979), giving it a late dating, c. 1000-400 BC. There is a fascinating folkloric association with this hammer axe, which was found among the roof battens of a 19th-century farmhouse in North Brabant. It can probably be interpreted as a 'thunderbolt.' We will elaborate on the folkloric meaning of this artefact in the catalogue (see also Verhart *et al.*, 2021, for a comprehensive discussion of the folklore associated with this find).

In the course of the early Bronze Age, axe hammers no longer appeared as grave goods. We find similar artefacts in settlement contexts from that time on (Butler & Fokkens, 2005: 395). The hammer axes are now often less sophisticated than the 'battle axes' of the Late Neolithic. They are usually referred to by the German term *Arbeitsaxt* and are assumed to have functioned as work axes. Bronze weapons gradually took over the function of axe hammers. The late types, such as the Muntendam type, are sometimes interpreted as tools. Some, both used and unused, probably ended up in the soil as depositions (van den Broeke, 2005: 666-667). Achterop & Brongers (1979) have pointed out that many of the shaft holes are too small to have been functional. These may be hafted adzes, where the haft simply served to hold the adze in place for woodworking, and where striking was done with a wooden hammer. They may also have been used in iron ore working. An unequivocal interpretation remains problematic, however, not least because some of the axes appear to have never been used (Achterop & Brongers, 1979: 273-277). They occur in conspicuously small numbers in our regions.

5.5. Other finds

We have not been able to assign two finds to any of the above time periods. We do not regard the hammer axe from the Jeker valley (38) as an authentic prehistoric object because it is made of limestone and has a divergent morphology.

The second artefact is a *Spitzhaue* from an unknown findspot (39). We suspect that it did not originate from Limburg.

6. Conclusion

It goes without saying that our inventory of finds is not complete. Nor was that our intention at the outset. What we have primarily tried to do is draw attention to a number of perforated hammer axes that are either undocumented or insufficiently documented, to classify them chronologically and typologically, and to provide an accurate determination of the rock type. In addition, our inventory provides the first overview of the occurrence of perforated hammer axes in Limburg. It is important that this inventory be supplemented at some future date. Some of the artefacts in question can be easily located in the well-known literature cited above.

What has emerged is that perforated hammer axes were much more widely distributed during the Early, Middle and Late Neolithic and the Metal Ages than previously thought. The Meuse valley (and the adjacent, eastern part of the Kempen Plateau) must have been an important corridor of contact and exchange. What also stands out for us is the small number of hammer axes from the Metal Ages.

We believe that several sites merit a more detailed investigation in the future (Fig. 8). The Kinrooi Hezerwater-Raam complex, with the addition of Hagendoren, is a large and important site, or cluster of sites, from the end of the LBK or perhaps in part even later. It is a unique site for the Belgian-Limburg Meuse valley, and if part of it does prove to be post-LBK, it is simply unique. We feel it is imperative that the find material be studied and evaluated in detail.

The same can be said of the Middle Neolithic site of Dilsen Hoefkamp, which has yielded incontestable TRB finds. The presence of TRB artefacts and the background of the exchange network is worthy of further study.

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Abstract

This paper gives an overview and shows the results of the investigation of prehistoric perforated hammer axes from Belgian Limburg and from the adjacent areas. Such a comprehensive study on this subject has never been published in Belgium before. This study is not a complete inventory, but it contains all the findings that were accessible to the authors. Besides an extensive typo-chronologic study, this paper focuses on the macroscopical petrographical characteristics and the provenance of the used rock types. It is striking that the raw material of many early-neolithic specimens has a Central-European provenance, whereas that of the late-neolithic specimens has rather to be searched for in the boulder clay (glacial erratics) of the northern Netherlands and northern Germany. Moreover, it is remarkable that most of the perforated hammer axes – and this is true for all periods in which they occur – have been found in the Meuse valley and in the adjacent part of the Campine Plateau. Most of the specimens' date from either the Early Neolithic (LBK & Rössen) and the Late Neolithic period. In this last period, the latest phase is especially well represented. A few Middle-Neolithic fragmentary (Funnelbeaker) specimens of knob-butted axes are conspicuous, as well as a few findings from the Metal Ages.

Keywords: Neolithic, perforated hammers, hammer axes, petrography, typology, provenance, LBK, Rössen, Funnelbeaker, Einzelgrab Culture, Bell-Beaker Culture.

Samenvatting

Dit artikel presenteert een catalogus en de resultaten van het onderzoek van doorboorde prehistorische hamers uit Belgisch Limburg en het aangrenzend gebied. Het is voor het eerst dat een dergelijke uitgebreide studie over dit onderwerp in België gepubliceerd wordt. De studie is geen volledige catalogus, maar omvat wél alle vondsten die voor de medewerkers van het onderzoek toegankelijk waren. Naast een uitgebreid typo-chronologisch onderzoek wordt veel aandacht besteed aan de petrografie en de herkomst van de gesteenten. Dit onderzoek gebeurde macroscopisch. Hierbij valt op dat de grondstof van vele vroeg-neolithische exemplaren een Centraal-Europese herkomst heeft, terwijl de herkomst van de laat-neolithische exemplaren veeleer in de keileem (zwerfstenen) van Noord-Nederland en Noord-Duitsland moet gezocht worden. Verder is het opvallend dat de meeste doorboorde hamers – en dit geldt voor alle perioden waarin ze voorkomen – gevonden werden in de Maasvallei en het aangrenzende deel van het Kempisch Plateau. De meeste exemplaren dateren uit hetzij het vroeg-neolithicum (LBK & Rössen) en uit het laat-neolithicum. In deze periode is vooral de late fase goed vertegenwoordigd. Opvallend zijn ook enkele midden-neolithische (fragmenten) van knophamerbijlen (Trechterbekercultuur) en enkele vondsten uit de metaaltijden.

Trefwoorden: Neolithicum, doorboorde hamers, hamerbijlen, petrografie, typologie, herkomst gesteenten, LBK, Rössen, TRB, Enkelgrafcultuur, Klokbekercultuur.

Résumé

Cet article présente un catalogue et les résultats des recherches sur les haches-marteaux perforées du Limbourg belge et des environs. Une étude aussi complète sur ce sujet pré- et protohistorique n'a jamais été publiée en Belgique auparavant. Elle n'est pas un catalogue exhaustif et définitif, mais elle contient tous les artefacts qui étaient accessibles aux auteurs. Outre une étude typo-chronologique approfondie, cet article se concentre sur les caractéristiques pétrographiques à l'œil et en macroscopie, ainsi que sur la provenance des types de roches utilisées. Il est frappant de constater que la matière première de nombreux spécimens du Néolithique ancien provient d'Europe centrale, alors que celle des spécimens du Néolithique tardif doit plutôt être recherchée dans les argiles à blocaux erratiques et glaciaires du nord des Pays-Bas et de l'Allemagne. De plus, il est remarquable que les endroits de découverte de la plupart des haches-marteaux perforées – et cela s'applique à toutes les périodes – ont une équivalence dans la vallée de la Meuse et dans la partie contiguë du plateau de la Campine. La plupart des spécimens datent du Néolithique ancien (LBK & Rössen) ou du Néolithique final. La dernière phase est particulièrement bien représentée. Quelques spécimens fragmentaires de « hache de combat » du Néolithique moyen (Culture des

vases à entonnoir, *Trichterbecherkulturen,* TRBK) sont remarquables, ainsi que quelques découvertes datant de l'âge de Bronze / âge du Fer.

Mots-clés : Néolithique, âge du Bronze / âge du Fer, Culture de la Céramique linéaire ou Rubané (LBK), Rössen, Culture des Vases à entonnoir (Trichterbecherkultur, TRBK), Culture de la Céramique cordée (Einzelgrab Kultur, EGK), Culture de la Céramique campaniforme (Glockenbecherkultur, GBK), haches-marteaux perforés, typologie, pétrographie, lithologie, provenance.

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Catalogue

Conventions
L: length
W: width
T: thickness

Mesolithic and Early Neolithic

1. *Bocholt (Limburg, Belgium) – Neerkreiel*

Coordinates: x = 236.3; y = 208.5
Collection: Heemkundige Kring Kaulille

L: 180.5 mm
W: 77 mm
T: 56.9 mm

Period: Rössen

This fragment of a perforated hammer axe was found in about 1983 when a farmyard channel was dug to supply water from a farmhouse to a stable opposite. The find was made by Jacobs Jaak, owner of the property. The findspot is located in the hamlet of Neerkreiel, just east of the Zuid-Willemsvaart in the municipality of Bocholt. The altitude 40-m contour line runs through the property.

The shaft hole is partially preserved. The artefact is in a fragmented state, with the tail end missing from the shaft hole down. The specimen, for which the perforation diameter could no longer be determined, has an asymmetrical cutting edge. The surface is smoothly polished. The surface is rougher in places, partly due to the somewhat coarse-grained layers that appear on the surface. This is a *hohe durchlochte Schuhleistenkeil* (perforated high shoe-last adze) with an asymmetrical, slightly adze-shaped cross-section. This *Keil,* together for example with those of Kinrooi-Geistingen-Steenberg (6) and Wekeren (Gelderland) (van der Waals, 1972: 174, tab. 41), must have been one of the larger specimens. Assuming that the shaft hole was one-third of the way down from the hammer end, the specimen would have been about 27 cm long.

Rock type: green-black, hard, fine-grained foliated amphibolite with thin lenticular white foliae, probably composed of plagioclase and quartz (?).

2. *Borgloon, Jesseren (Limburg, Belgium)*

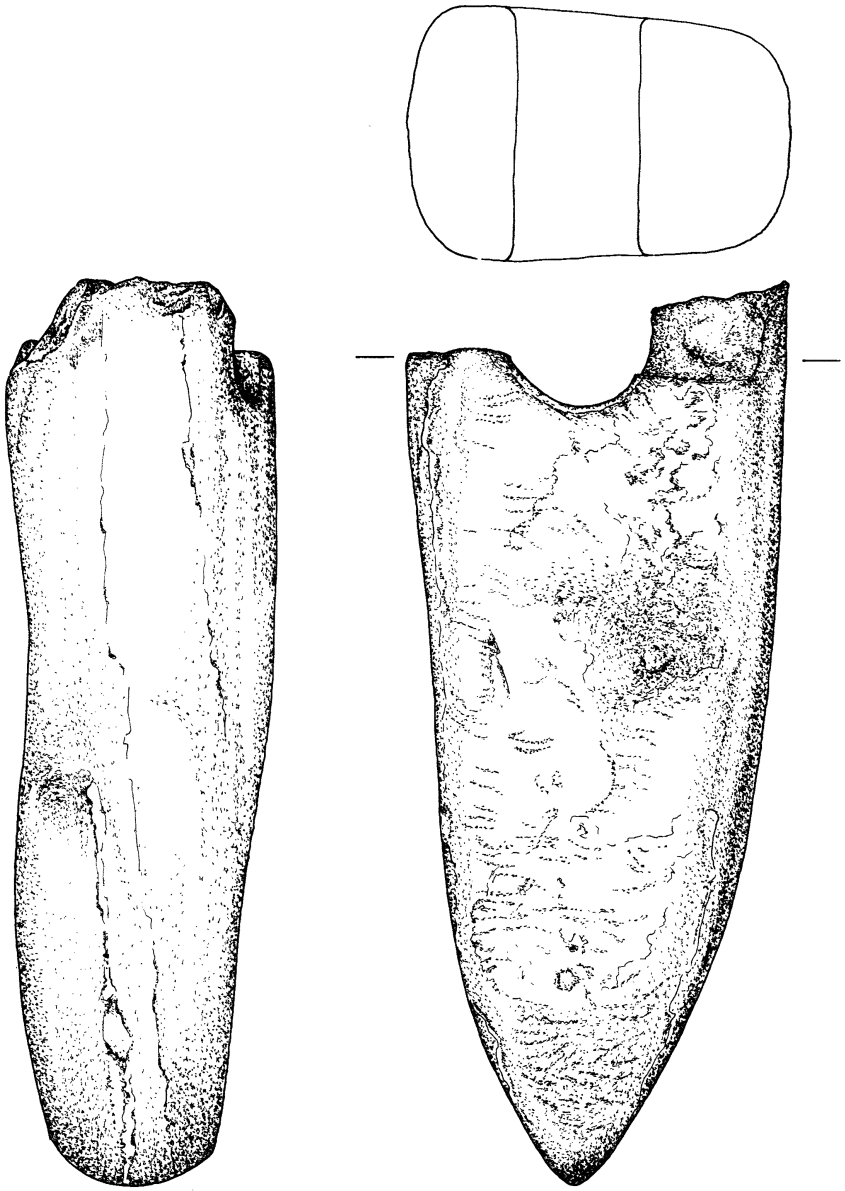
Coordinates: x = 222; y = 166.5
Collection: Grand Curtius, Liège. Inventory number: MDP 6695

L: 125.4 mm
W: 50.3 mm
T: 49.5 mm
Shaft hole: 26.2-22.2 mm, straight

Period: Rössen

Like De Puydt *et al.*, 1911 and Hamal-Nandrin & Servais 1913, the Grand Curtius inventory reports the findspot as '*Jesseren près de l'église par Huybrigts'*. Not far from the '*tumulus*' (De Puydt *et al.*, 1911: 104; Hamal-Nandrin & Servais, 1913: 17; Bauwens-Lesenne, 1968: 135). The artefact was discovered by François Huybrigts and ended up in the Curtius Museum via Marcel De Puydt. The original label reads '*Jesseren près de l'église par Huybrigts 20.XI.191*' (this must be 1910, or 1911 at the

1.



latest). Among the Neolithic artefacts, Huybrigts 1899 (Huybrigts, 1899: 34) mentions a '*pierre à aiguiser, en granit de 15,5c longueur et de 5c de largeur, trouvée à Jesseren au tumulus*' from his own collection. Even though the lengths do not match and he does not mention the perforation, we believe it to be the artefact discussed here.

Durchlochte Breitkeil. Irregular *Keil*, shaped through intense use. It has an eccentric, conical perforation. The cutting edge is damaged. Pieces have also splintered off the rounded hammer part and the flat side near the cutting edge. The flat side has been completely polished through intensive working. For Hamal-Nandrin & Servais, who follow the interpretation of the finder, François Huybrigts, it was first a 'weapon' and then a polishing stone. Hoof describes it as an irregular *Arbeitsaxt* with 'diluted' contours, an irregular rectangular cross-section and a rounded neck (Hoof, 1970: 305).

Rock type: black-green basic intrusive rock (basalt?) with phenocrysts of plagioclase and pyroxene.

References
DE PUYDT *et al.*, 1911: 104, 106 & pl. VI, 2
HAMAL-NANDRIN & SERVAIS, 1913: 17
SERVAIS & HAMAL-NANDRIN, 1929: 124, fig. 126
BAUWENS-LESENNE M., 1968: 135
HOOF, 1970: 305

3. Dilsen-Stokkem, Elen – Station (Limburg, Belgium)

Coordinates: x = 245.5; y = 197 (vicinity)
Collection: Cultuurhistorisch Museum Asselt (municipality of Roermond). From the Philips collection Bought by Philips from Pierre Paspont. Inventory number: CP3

L: 123 mm
W: 49 mm
T: 46 mm
Shaft hole: 24-25 mm

Period: Rössen & Late Neolithic

Found between Elen station and Neeroeteren (Philips catalogue, Cultuurhistorisch Museum Asselt) (van der Waals, 1972: 178), on the heath near Elen station. Dursin (Dursin, 1931: 123) reports that the '*hache marteau*' was found on marshy soil '*entre Rothem et Neeroeteren... au lieu dit Schoots*'. This must refer to the water meadows area. Taken together, these various sources of information have enabled us to pinpoint the vicinity of the findspot fairly accurately.

The artefact probably belongs in two different periods: the Early Neolithic (Rössen), when it was manufactured, and the Late Neolithic, when it was reused and modified further. *Durchlochte Breitkeil.* It is an atypical specimen (van der Waals, 1972: 178), probably because it was later reworked into an irregularly-shaped hammer axe (type R/S) that was not broader at the shaft hole; the butt is irregular and asymmetrical. The shaft hole is not centrally positioned and is on an angle, with turning grooves visible inside. The polished surfaces are partially weathered.

Based on the rock type, this is possibly an original *Breitkeil* that was later reworked.

Rock type: dark-grey foliated amphibolite.

References
DURSIN, 1931: 123
HOOF, 1970: 308, no. 79 (near Neeroeteren)
VAN DER WAALS, 1972: 178, tab. 44

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4. *Geetbets – Rummen (Flemish Brabant) – Warande*

Coordinates: x = 205.9; y = 175.8
Collection: private

W: (diameter): 111-114.5 mm
T: 34 mm
Shaft hole: 24.5-22 mm, conical

Period: Linearbandkeramik

The artefact, an isolated find, was found during the potato harvest in about 1960. It is a perfectly intact LBK *Scheibenkeule*, which is evenly polished over its entire surface. The perforation is conical, with rounded edges. It is a unique specimen for our region, where *Scheibenkeulen* are rare. Like the *Plättbolzen*, they probably mainly date from the final phase of the LBK, but they also occur in the *Älteste* LBK, for example in Schwanfeld-Hessen (Verhart, 2012). It is possible that they continued in use shortly after the LBK. Specimens have been found in Central Germany, for example in Landau (Grosskölnbach, a serpentinite artefact) and North Hesse (for North Hesse, Kegler-Graiewski, 2007, mentions two *Scheibenkeulen* from an LBK-Rössen site in Grebenstein 1: one of amphibolite and one of basalt; and one amphibolite specimen from Grebenstein 7, a surface site). They are also more common in East Germany, for example in the Middle Elbe/Saale region (Behrens,1973: 37, fig. 11d), as well as further to the west, for example on the Aldenhovener Platte, in Langweiler 9 (Farruggia, 1977: 277, tab. 72) – the specimen from Langweiler 9 is made of amphibolite and is about the same size as the one from Rummen), the Eifel, in Muddersheim (Schietzel, 1965: 44) and in Heinsberg-Geilenkirchen, close to the Dutch border (Hoof, 1970: 213 no. A82, tab. 15, 131 – a specimen in fine-grained quartzite). Prompted by the find in Pfalzdorf (south of Kleef, on the left bank of the Rhine some 20 km east of Nijmegen), Weiner gathered together the *Scheibenkeulen* found west of the Rhine (Weiner, 2002a: 34-35; see also Claßen & Zimmerman, 2015). There are five in all, including the ones listed above. Most are of amphibolite (in the broad sense) but there is also one vulcanite specimen, whose provenance – as with the amphibolites – should be sought in southern Central Europe, and one of '*graugrüner Granit*'.

Rock type: pale green, finely laminated hornfels: contact metamorphic, originally fine-grained and finely laminated sedimentary rock (siltstone-mudstone, with bioturbations?) showing light green and red neoformed minerals (including ilmenite?).

5. *Genk, Zwartberg (Limburg, Belgium)*

Coordinates: x = 229.5; y = 190.5 (vicinity)
Collection: Grand Curtius, Liège. Inventory number: MDP *6696*

L: 96 mm
W: 50.8 mm
T: 29.3 mm
Shaft hole: 21.2-20 mm

Period: Rössen

The artefact was found in 1911 by Lieutenant-general Thorn on his 'Luciebos' estate, near the border between Meeuwen and Houthalen. The index card at the Curtius Museum states '*De Puydt – Genck (près Lacqbois?)*'. Luciebos has been part of the municipality of Oudsbergen, formerly Meeuwen-Gruitrode, since 2019. The toponym 'Zwartberg' is interesting in that it could indicate one or more prehistoric burial mounds. Marcel De Puydt also found several worked flint artefacts on the large estate. It was De Puydt himself who acquired the object: he made several trips to Genk between 1890 and 1910, and probably later too, in search of prehistoric finds (Dieltiëns, 1968: 165; Ruelens, 2013: s. p.). De Puydt regularly associated with biologists and probably with various artists (painters) from the 'Genk School' who resided in Genk. The findspot is less than

2 km from the Late Mesolithic sites of Genk-Opglabbeker Zavel (Dieltiëns, 1968: 157, 1972) and less than 4 km from the Late Mesolithic sites of Opglabbeek Ruiterskuilen and the Neolithic sites of Meeuwen-Donderslagheide and Houthalen-Hengelhoef (Vermeersch *et al.*, 1974; Creemers, 1985: 97-99, fig. 12 & pl. 4:2; Creemers & Vermeersch, 1987, 1989; Robinson *et al.*, 2008). All this suggests that the area was highly suitable for habitation during the Late Mesolithic and the transition to the Neolithic.

The specimen is a small, typical *durchlochte Breitkeil,* with a straight, perforated shaft hole located roughly one-third of the way down from the hammer end. The neck part of the artefact has considerable antique damage and percussion marks, which are probably traces of use. Several slivers also splintered from one face near the shaft hole at that time. One working face is flat, the other somewhat convex, thus creating a slightly D-shaped cross-section.

J. D. van der Waals classifies the artefact as a *durchlochte Breitkeil* (van der Waals, 1972: 178), while Hoof (1972: 304) calls it an *Arbeitsaxt*.

Rock type: dark-green metagabbro with foliations perpendicular to the longitudinal or symmetry axis of the hammer axe. The specimen has been bush-hammered ('*bouchardé*').

References
BAUWENS-LESENNE, 1968: 89
DE PUYDT, 1907: 157
SERVAIS & HAMAL-NANDRIN, 1929: 119
MARIËN, 1948: 38 M7
MARIËN, 1952: 135
REMANS, 1957-1958: 80 & 82-83 with illustration
DIELTIËNS, 1968: 165
HOOF, 1972: 304
VAN DER WAALS, 1972: 178, tab. 42
RUELENS, 2013 s. p., with colour photo

6. *Kinrooi, Geistingen (Limburg, Belgium) – Steenberg*

Coordinates: x = 251.2; y = 203.4
Collection: Municipality of Kinrooi, Heritage Depot (Jan Geerkens Fund). Inventory number: C37

L: 261 mm
W: 75 mm
T: 56 mm
Shaft hole: 2.65/2.90 mm, straight perforation but oblique in relation to the body

Period: Rössen

This specimen was found in March 1967 by Jan Geerkens on the Steenberg in Geistingen, on the present-day peninsula near De Spaanjerd, which at that time was the 'municipal gravel pit' (handwritten note on a photo of the findspot, courtesy of Hubert van Eygen). It was purchased by the municipality of Kinrooi and is part of the Jan Geerkens Fund. Some other items in the Geerkens collection are still held by the Geerkens family.

The artefact is a large *hohe durchlochte Schuhleistenkeil* with an asymmetrical, slightly adze-shaped cross-section. The hammer end is fairly straight, becoming more pointed in cross-section. The perforation runs obliquely in relation to the adze body. This *Keil,* together with the one from Bocholt (1) (see above) and for example from Wekeren-Gelderland (van der Waals, 1972: 174, tab. 41), must have been among the larger specimens.

Rock type: strongly weathered, greyish-blue volcano-sedimentary rock with oblique veinlets and a horizontal layering. Unknown origin.

7. *Kinrooi, Molenbeersel (Limburg, Belgium)*

Coordinates: x = 247.4; y = 205.7
Collection: Royal Museums of Art and History, Brussels, National Archaeology Collection. Label: Molenbeerse (I) B.483 (3128). Inventory number: B000483-001

L: 141 mm
W: 56 mm
T: 42 mm
Shaft hole: 25-27 mm, slightly conical

Period: Rössen

The exact findspot was not known for a long time, but Danny Keijers was able to locate it using original notes made by Guillon, who owned the artefact at the time (Keijers, 2000: 169; Roermond Municipal Archive, handwritten notes by Guillon: inv. no. 4, no. 635). The findspot is near Heyershof, less than 1.5 km north of the Hezerheide site. The *Keil* is held at the Royal Museums of Art and History. It was donated in 1869 by C. Guillon from Roermond (de Loë, 1928: 230; Mariën, 1948: 28). Before that, it was in the collection of Mgr. Franssen '*Camérier du Pape, curé d'Ittervoort*', who collected many artefacts in the Roermond area, in '*concurrence*' with Guillon (Schuermans, 1877: 27).

It is a *durchlochte Breitkeil* with a rounded butt, rectangular cross-section and rounded edges. The perforation is slightly conical, positioned somewhat obliquely to the adze body and polished completely smooth on the inside. The specimen is in almost entirely intact and is one of the few complete artefacts.

Rock type: dark-green to green-black amphibolite. Foliated due to a preferential orientation of stalk-like, black mafic minerals (hornblende?). Longitudinal axis of the adze runs parallel to the foliation.

References
SCHUERMANS, 1877: 27
DE LOË, 1928: 230
MARIËN, 1948: 38 M4
MARIËN, 1952: 135 & 137, fig. 132, no. 2
DE LAET, 1979: 191, 193, fig. 75
KEIJERS, 2000: 169

8. *Kinrooi, Ophoven (Limburg, Belgium) – Hezerheide 1*

Coordinates: x = 248.5; y = 204
Collection: Musea Maaseik, on loan since June 1986. Private loan from the Gerard Segers collection. Inventory number: MM 10/12 – 5/5/2 – MM/0010/0012

Fragmented
L: 64 mm
W: 46.7 mm
T: 44 mm
Shaft hole: 33–28.3–30 mm, biconical, unfinished perforation and fragmented

Period: Mesolithic/Early Neolithic

Fragment of a *Geröllkeule* that has been drilled from both sides. Due to the fracture, only part of the perforation has been preserved. The perforation has a distinctly biconical, or hourglass, shape. The raw material is identical to that of another find from Kinrooi, Hezerheide 2 (9), which is also from the Segers collection, also fragmented, and displaying a similar incomplete perforation. However, the two finds are not part of the same tool.

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The findspot, located at Hezerheide near the hamlet of Raam, was prospected by Gerard Segers. In his younger years, Segers associated a good deal with Jan Geerkens, who taught him about many sites, including this one. The site is located at the Kinrooi-Ophoven border.

Rock type: broken *Geröllkeule* of pale greyish-brown quartzitic sandstone with very rare micas, possibly originating from the Meuse terraces. The material is identical to that of the Kinrooi specimen (9), which is also fragmented, displaying a similar type of incomplete perforation but definitely originating from a different workpiece. Both artefacts come from the same site and are both from the Segers collection.

References
CLAASSEN, 1970: 160, nos. 49 & 162

9. *Kinrooi, Ophoven (Limburg, Belgium) – Hezerheide 2*

Coordinates: x = 248.5; y = 204
Collection: Musea Maaseik, on loan since June 1986. Private loan from the Gerard Segers collection.
Inventory number: MM 1g0/13 – 4/5/2 – MM/0010/0013

Fragmented
L: 58 mm
W: 49 mm
T: 38 mm
Shaft hole: 22 mm, not fully perforated, unfinished and fragmented

Period: Mesolithic/Early Neolithic

Fragment of a *Geröllkeule* that has been drilled from both sides. Due to the fracture, only part of the perforation has been preserved. The perforation is not finished. The raw material is identical to another find from Kinrooi, Hezerheide 1 (8), which is also from the Segers collection, also fragmented, and displaying a similar incomplete perforation. However, the two finds are not part of the same tool.

Both are fragments of *Geröllkeulen* from the Mesolithic or Neolithic. Similar artefacts of wide-ranging shape and weight have long been known (for the Kempen region see, for example, Verwers, 1988: 15-16, Loon op Zand, North Brabant; for elsewhere, Mirtschin, 1957). They appear to be more common above the Meuse and the Waal. *Geröllkeulen* with an hourglass-shaped perforation are Mesolithic, while specimens with a cylindrical or conical perforation, some with a polished surface, are more common in the Neolithic and Metal Ages (Hulst & Verlinde, 1976). A number of unfinished hammer axes, with an incomplete perforation, are also known (*e. g.* Harsema, 1976, a specimen from Borger & Odoorn; Achterop & Brongers, 1979: 294, a specimen from Drachten). A Mesolithic dating does not necessarily suggest a contradiction with respect to the unperforated adzes found nearby or the perforated phthanite adzes from Raam and Ophoven because the Mesolithic extended into the Rössen period. In other words, these *Geröllkeulen* may well have been manufactured by Mesolithic inhabitants of the region, and of course the site was not necessarily occupied simultaneously by a Mesolithic and a Neolithic population. There is no consensus regarding the function of these artefacts. They could be fishing net weights, digging stick weights, slingstones, hammerstones or other percussion stones, etc. (Hulst & Verlinde, 1976: 106-109). Neolithic specimens are more likely to be weapons and prestige objects (Claßen & Zimmerman, 2015).

Rock type: broken *Geröllkeule* of pale greyish-brown quartzitic sandstone with very rare micas, possibly originating from the Meuse terraces. The material is identical to that of another Kinrooi find (8), which is also fragmented, displaying a similar type of incomplete perforation but definitely originating from a different workpiece. Both artefacts come from the same site and are both from the Segers collection.

References
CLAASSEN, 1970: 160, nos. 50 & 163

***10.** Kinrooi, Ophoven (Limburg, Belgium) – 'Geerkens'/Hezerheide*

Coordinates: x = 246.5; y = 203.5 (vicinity)
Collection: Gallo-Roman Museum, Begijnhof collection. Inventory number: BH 339. Hoof (1970) incorrectly names the Asselt museum as the repository, probably because of the great similarity between these two finds

L: 71.7 mm
W: 54 mm
T: 17 mm
Shaft hole: 21.3–11.7–15 mm, biconical

Period: late Linearbandkeramik

The artefact was ploughed up by Jan Schaekers in Ophoven in the late 1940s (Geerkens, 1950: 54, fig. 1 & 66-67). He ceded the find to Jan Geerkens, whose article gives no further information about the findspot. The find joined others (various flint and hardstone artefacts, including a high adze from Kinrooi and four bronze axes from the Heppeneert axe hoard) in the collection of the Begijnhof Hasselt (the Provincial Museum) and then in that of the Gallo-Roman Museum Tongeren. There has been considerable confusion about the findspots because several similar finds were made in Kinrooi, to which the municipality of Ophoven now belongs (see also the find from Kinrooi-Raam). However, the municipality of Kinrooi has an inventory that Geerkens compiled at the end of his life. The perforated adze from Ophoven is explicitly mentioned and leaves no doubt as to the findspot. The find is mentioned on page 3 (nr. 60), together with the following information: 'Jan Schaekers, found on his Nagelsweg land'. This is clarified once more on page 12 in relation to findspot 'C Ophoven': there he refers to the boundary between Kinrooi and Ophoven. His information shows that the find also comes from Hezerheide (Nagelsweg), not far from the Raam findspot (information courtesy of Hubert van Eygen). The top of this broad adze is badly damaged. One side has splintered off, from more than halfway along the top to halfway down the side, in line with the shaft hole. The 'cutting edge' is also slightly damaged in one corner. However, it can scarcely be called a cutting edge because it is blunt and is at least 4 mm thick. The cross-section is a flattened oval. The shaft hole is biconical, hourglass-shaped and drilled from both sides. Geerkens' description is as follows: '*Axe amulet: stone polished on all sides. The raw material consists of black stone ('mica schist'); it is 72 x 54 x 16 mm; a hole measuring 17 and 20 mm has been drilled straight through the middle. Although the sharp cutting edge is missing, this should be interpreted as a prehistoric axe, but it is unlikely to have been used as such since it is 4 mm thick where the cutting edge would be. Such an axe must certainly be interpreted as belonging to the axe amulets (hachettes amulettes), which have also been found in the Grand Duchy of Luxembourg and which are thought to have been worn by wizards.*' He adds a further interesting comment about the folkloric use of axes, taken from P. J. Maas: '*Some residents even sewed these 'thunderbolts', as they were called, into linen bags, worn on the chest, in the hope that they would help cure their stomach ailments*'.

It is a broad adze, a *Plättbolze* (van der Waals, 1972: 153) or *Rechteckkeil, Senkrecht durchbohrte Keil, breite Flachhacke* (Hoof, 1970: 73 & 306, no. 46g). It is notable that this adze and the one from Kinrooi-Raam (11), which were found no more than several kilometres apart, are almost identical in shape and raw material: they remain unique finds within a very large region.

In addition to the Kinrooi-Raam find, Hoof reports that another perforated flat adze (*Flachhacke*), with a straight perforation perpendicular to the width and with two cutting edges has been found in Kinrooi-Molenbeersel (Hoof, 1970: 307, no. 75; Buttler, 1931: 77). Like the known, often depicted *durchlochte Breitkeil,* that artefact is also held by the Royal Museums of Art and History.

Rock type: black phthanite, mica-rich, layered and rich in aluminium silicates.

References
GEERKENS, 1950: 54, fig. 1 & 66-67

11. *Kinrooi, Ophoven (Limburg, Belgium) – Raam*

Coordinates: x = 246.5; y = 203.5 (vicinity)
Collection: Cultuurhistorisch Museum Asselt (municipality of Roermond). Inventory number: CP60

L: 94 mm
W: 73 mm
T: 21 mm
Shaft hole: 17 mm

Period: late Linearbandkeramik

Kinrooi-Raam, 'on the left along the Maaseik – Kinrooi road', and placed by Dursin under the municipality of Ophoven (Dursin, 1931: 127). Before the merger in the 1970s, the municipality of Ophoven extended to just west of Raam. The findspot was close to that of Kinrooi Hezerheide and also Hagendoren, only a few hundred metres away in each instance. This would appear to be one large findspot, encompassing both Hezerheide and Raam. It may even include the Hagendoren site, since adzes have been found there too, as they have in Raam. The Gallo-Roman Museum has a high adze found in Raam from the Geerkens collection (Creemers & Carolus, 1992: 122, fig. 2, no. 2; Geerkens, 1950: 53-54, no. 2).

The artefact comes from the former Philips collection in Maaseik. Philips is said to have obtained the object from the owner of the Jettenhof.

It is a *Plättbolze:* a broad adze with a damaged top and a partly damaged cutting edge. The cross-section is a flattened oval with faceted sides. The shaft hole is hourglass-shaped and created using the pecking technique. Like the one from Kinrooi-Hezerheide (10), this specimen from Raam is of phthanite.

Rock type: phthanite, very fine-grained, silica-rich sedimentary rock, black (due to carbon), with visible stratification or cleavage. Probable provenance: Brabant Massif, Belgium.

References
DURSIN, 1931: 127
HOOF, 1970: 306, no. 49, tab. 18, no. 156

12. *Kinrooi, Ophoven (Limburg, Belgium)*

Coordinates: unknown
Collection: Musea Maaseik. Inventory number: 421

L: 122 mm
W: 42.8 mm
T: 30 mm
Shaft hole: 21 and 23 mm, straight perforation

Period: Rössen

Registered at the Musea Maaseik under 'Ophoven', Nijssens collection, which is poorly documented. The year of acquisition is unknown. The collection is said to date from 1910-1940. No further details are known. The artefact cannot be found in the Bauwens-Lesenne (1968) register: we believe that it has never been published.

Durchlochte Breitkeil. An irregular *Keil*, shaped through intensive use. The conical perforation is outside the longitudinal axis and parallel to the working faces and cutting edge. The butt is somewhat damaged. The entire surface is polished.

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Rock type: coarse-grained amphibolite with dark-green porphyroblasts. Analogous to Dilsen-Lanklaar-'Virveld' specimen (26). Late Neolithic.

13. *Lanaken, Rekem (Limburg, Belgium) – Hangveld*

Coordinates: x = 242.8; y = 179.1
Collection: Gallo-Roman Museum. Inventory number: 78.RE.sl xii-LV

L: 257 mm
W: 71 mm
T: 62.4 mm (near cutting edge) – 54 mm (near drill hole)
Shaft hole: 27.9-25.9 mm, conical

Period: Rössen

The findspot is located at an altitude of approx. 45 m, on the edge of the Meuse terrace of Maasmechelen, where gravel deposits lie beneath under a Late Glacial cover. Excavations were undertaken there as part of Luc Van Impe's investigation of a Metal Age grave field, but some parts of the site have also yielded possible settlement pottery from the LBK, the Late Neolithic and the Bronze Age (late Bell Beaker or Funnelbeaker pottery decorated with fingernail impressions, rim and wall sherds of 'barbed wire' pots and, more recently, thick-walled pottery). A suspected grave with an early ('*Epi-Maritime*') 'barbed wire' beaker from the 17th-16th century BC was also excavated in the immediate vicinity (the excavations extended across the submunicipality of Neerharen) (De Boe, 1986: 23-24; De Boe *et al.*, 1992: 482, fig. 273). The excavators also attributed some flint and sandstone axe fragments to this phase, as well as two hammer axes. One was unfinished, the other complete. It is the latter specimen, a find without a context, that we are describing here.

This remarkably large hammer axe, described at the time as an *Arbeitsaxt*, is preserved almost fully intact and is evenly polished over the entire surface. The conically perforated shaft hole is located about one-third of the way down from the top. The heel is rounded on the upper face and bevelled in profile. The upper and lower faces run almost parallel in profile, but one tapers slightly towards the hammer end. The conical shaft hole is situated slightly off-centre; in cross-section, the edges are rounded.

According to the excavators, the artefact could belong to the *Arbeitsäxte* group from the Metal Ages, also in view of the presence of a burial mound (?) with an Epi-Maritime 'barbed wire' beaker from about 1800-1600 BC in the immediate vicinity.

However, it is a stray find and we believe that, judging by its shape, rock type and tapering shaft hole, it should unequivocally be interpreted as a *hohe durchlochte Schuhleistenkeil*. We cannot rule out the possibility that it continued to play a role in a later cultural context, but it is primarily an Early Neolithic object.

Rock type: fine-grained, dark-green amphibolite, similar to Dilsen-Lanklaar-'Virveld' (26) (Late Neolithic) and Kinrooi-Ophoven (12) (Rössen). Cleavage is perpendicular to the axis. Visible green minerals: amphiboles and chlorite. Thijssen & Van Impe (1979, 59-60) report the raw material as garnet-chlorite-sericite schist (determined by Dirk Vogel, KU Leuven).

References
THYSSEN & VAN IMPE, 1979
DE BOE *et al.*, 1992: 481, fig. 272

14. *Maasmechelen (Limburg, Belgium) – Olenderheide*

Coordinates: x = 237.2; y = 189.2
Collection: Gallo-Roman Museum, private loan. Inventory number: 1994.6.1

L: 110 mm
W: 59 mm
T: 36.5 mm
Perforation: 36.4-28.8 mm, conical, and slightly elliptical at the widest part

Period: Rössen

This perforated hammer axe was found in a cultivated field near the 'Mechelen heath' in the early 1980s. The site was repeatedly prospected at the time by the 'Archaeological Association of Central Limburg' but there were no further finds in the immediate vicinity. However, a site some 100 metres east of the findspot of this *Breitkeil* has yielded Mesolithic and Neolithic finds, including a transverse arrowhead and fragments of polished axes (Creemers, 1985: 100-101, fig. 13).

Durchlochte Breitkeil. This is a complete specimen. The cutting edge is asymmetrical and blunt. Although fully polished, the artefact has a surprisingly rough appearance. The butt is round to flat, and both the upper and undersides are flat. The perforation is conical and unusually large. It may have been widened in a second phase, possibly by indigenous Mesolithic hunter-gatherers. The artefact is quite symmetrical in shape, which is rather exceptional for Rössen *Breitkeile*. We know of similar *Keile*, with smaller perforations, from Nörvenich-Düren (Weiner, 2002b) and Amersfoort (Tent, 1988: 48-50), for example.

To the best of our knowledge, the perforations in the known specimens are not as large as in the Maasmechelen specimen. The *Breitkeil* from As (43) (van der Waals, 1972: 178, tab. 41), which is much larger, was found at As-Station, less than a kilometre away as the crow flies.

Rock type: dark greenish grey, strongly weathered, coarse-grained greywacke-like sandstone (probably rich in quartz) with oblique stratification. No preferential orientation or cleavage visible. Origin: possibly Devonian.

References
CREEMERS, 1985: 100-101, 149, 187-188, pl. 14:2

15. *Tongeren (Limburg, Belgium)*

Coordinates: unknown
Collection: Grand Curtius, Liège. Label: 'environs de Tongres. Coll. Huygen' (?). Inventory number: MDP 6694

L: 147 mm
W: 71 mm
T: 29.2 mm
Shaft hole: 22.7-25.1 mm, conical perforation

Period: late Linearbandkeramik

The inventory of the Grand Curtius gives the provenance as '*environs de Tongres*'. The artefact came to the museum via Marcel De Puydt, who reported the findspot as being '*from the Tongeren area rather than Koninksem*'. It is not clear whether he meant the border area between Tongeren and Koninksem. The find was part of the Huygen-Devis collection (De Puydt *et al.*, 1911: 103-104). Two years later, Hamal-Nandrin & Servais gave '*Coninxheim*' as the provenance, although the exact location cannot be pinpointed.

The artefact corresponds more or less to the *Plättbolze* group (van der Waals, 1972: 153) or *Rechteckkeil*, *Senkrecht durchbohrte Keil, breite Flachhacke* (Hoof, 1970: 73). The edges are almost parallel, perhaps tapering slightly. Both ends are blunt; there is no cutting edge. The perforation is conical. The specimen is fairly evenly polished and has almost no damage.

The artefact displays similarities to the perforated adzes of Kinrooi-Raam and that of Ophoven, but there are clear differences in shape, thickness and raw material. It is similar to specimens from Germany, such as from Lingolsheim (Grossgartacher Kultur) (Goller, 1972: tab. 46), Kelz-Düren (Hoof, 1970: 224, tab. 18, no. 158) and Duisburg (Hoof, 1970: 185, tab. 19, no. 173), as well as from Barneveld (Gelderland) (Schut, 1991: 61, fig 41, 4). Brandt (1967: tab. 2, nos. 1-3) shows several similar *Plättbolzen*. The adze from Schessinghausen in particular bears a striking resemblance to this one from Tongeren. Prompted by Bakels, Schut suggests that the Gelderland finds that are related to the LBK adzes, but which have more rounded contours, are post-LBK.

A further interesting artefact was found in Koninksem: a *Gerölkeule* (quartzite) with an incomplete perforation, which De Puydt calls a '*casse-tête*'. It is an incompletely perforated *Gerölkeule* (De Puydt *et al.*, 1911: 108, pl. 6 no. 6; Servais & Hamal-Nandrin, 1929: 124, fig. 116; Lesenne, 1975: 53).

Rock type: fine-grained, olive-green amphibolite with foliation perpendicular to the longitudinal axis of the adze.

References
DE PUYDT *et al.*, 1911: 103-104, pl. VI, no. 1
HAMAL-NANDRIN & SERVAIS, 1913: 14
SERVAIS & HAMAL-NANDRIN, 1929: 124, fig. 116
LESENNE, 1975: 53

16. *Voeren – 's Gravenvoeren (Limburg, Belgium)*

Coordinates: unknown
Collection: Gallo-Roman Museum. Inventory number: Lo II, 12

L: 199 mm
W: 54.4 mm
T: 50.7 mm
Shaft hole: 21.5, straight perforation, positioned obliquely

Period: Rössen

The artefact was purchased in the 1960s from the Loncke brothers in Overpelt. Nothing is known about the findspot.

The artefact matches van der Waals' (1972) definition of a *hohe durchlochte Schühleistenkeile*.

Rock type: dark-grey/black, medium- to coarse-grained, weathered gabbro.

17. *Voeren, Sint-Pieters-Voeren (Limburg, Belgium)*

Coordinates: x = 254; y = 158 (vicinity)
Collection: Grand Curtius, Liège. Inventory number: MDP 4110/4110 Fourons. (MDP = Marcel De Puydt)

L: 214 mm
W: 56.6 mm
T: 55 mm
Shaft hole: 20.7-23.1 mm, conical

Period: Rössen

The index card at the Curtius Museum gives the findspot as: '*Station néolithique de Rullen. Com. de Fouron Saint-Pierre (9e de Liège) au lieu dit 'Bois des Dames.*' The label on the object itself reads

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'*Bois de Magis, Fourons 191.*' Knapen-Lescrenier's (1966: 271-277) register lists several Neolithic findspots with hearths and flint workshops under 'Sint-Pieters-Voeren'. There is no mention of a perforated axe.

Given that Vrouwenbos (*Bois des Dames*), Rullen (in a narrow sense) and Magis castle are set in a triangle about 1 km apart, the information seems contradictory at first. Alfred Magis owned the *Bois Communale*, north of Vrouwenbos, and was therefore probably also the owner of Vrouwenbos itself. The two named findspots – '*Bois de Magis*' and '*Bois des Dames*' – must therefore be the same location, namely Vrouwenbos (we would like to thank Jean-Pierre de Warrimont and Rik Palmans for their help in pinpointing the exact location). The Neolithic workshops at Rullen were also located on Alfred Magis' property, on the site where flint workshops were also discovered in 1998 when natural gas pipelines were laid (Creemers *et al.*, 1998; Vermeersch *et al.*, 2005).

The artefact in question is a fine, undamaged '*hohe durchlochte Schuhleistenkeil*' (van der Waals, 1972: 178). It has an asymmetrical cross-section and a conical perforation. The surface is smoothly polished. The height and width are roughly the same. The neck part is slightly pinched, giving it a slightly boat-shaped profile. The hammer end is flat.

Rock type: dark-green to olive green, fine-grained meta-doleritic rock (amphibolite?) displaying very fine foliation.

References
SERVAIS & HAMAL-NANDRIN, 1929: 119
KNAPEN-LESCRENIER, 1966: 273
VAN DER WAALS, 1972: 178, Li 7. J. D. van der Waals refers incorrectly to tab. 40: the artefact does not appear there, nor on the following pages.

Middle Neolithic

18. *Dilsen-Stokkem (Limburg, Belgium) – Hoefkamp*

Coordinates: x = 243.94; y = 193.84
Collection: H. Unger, Oud-Turnhout

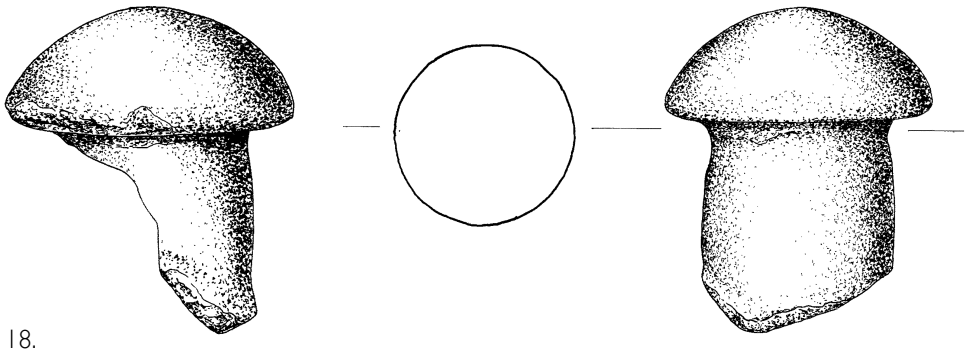
L: 68-71 mm
W/T: 57 mm/24 mm
Shaft hole missing

Period: Funnelbeaker culture

This fragment of a knob-butted axe was found by Heinz Unger in the early 1990s during prospections on the southern part of the site, whereas the other finds described elsewhere in this article [see (25) and the Appendix 1 (41, 42, 43)] were found on the northern side of the site. For a description of the findspot, we also refer the reader to Appendix 1. The following description and discussion were reviewed and supplemented by J. A. Bakker when the original notes were written up.

The mushroom-shaped fragment, measuring 6.8-7.1 cm in length, consists of the knob and stalk of a '*knob-butted axe of the Dutch type*'. The body containing the shaft hole and cutting edge are missing. The 2.4 cm-thick knob has a slightly pointed dome shape (diameter 5.7 cm). A flat face forms the transition to the stalk. The bar-shaped stalk is slightly narrower towards the knob, where it measures 3.8 cm. It measures about 4.1 cm at its largest diameter. The stalk is broken off near the axe body. The artefact displays little weathering.

This is the hammer end of a '*knob-butted axe of the Dutch type*'. Axes of this type are characteristic of the Funnelbeaker culture. The TRB does not generally occur south of the major rivers but is characteristic of the northern Netherlands, and northwest Germany west of the Hase and the Hunte. J. A. Bakker compiled an inventory of about 45 such axes from that area (Bakker, 1979a:



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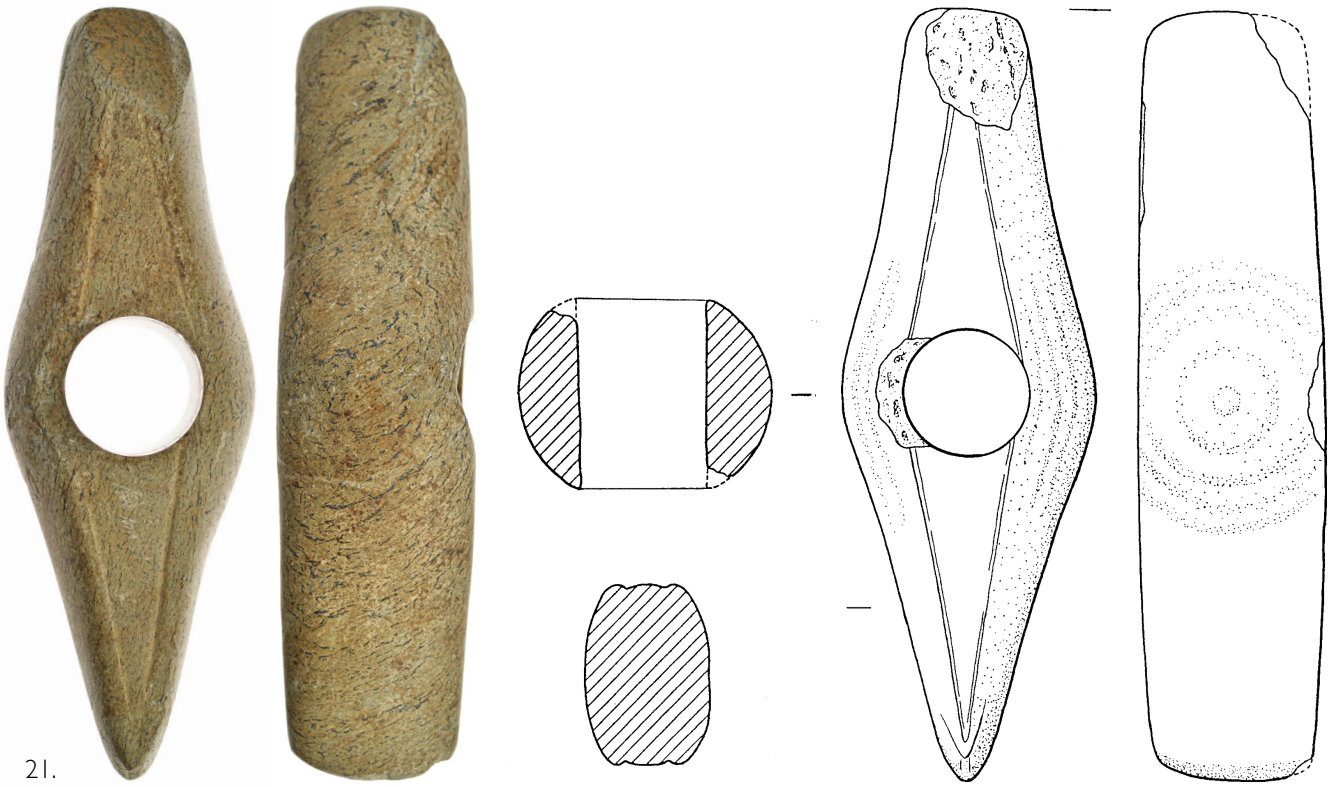

21.

96-108, 1979b: 140-145) which belong to horizons 4-5 of the TRB (c. 3200-2950 BC: calibrated C14 datings; Brindley, 1986. On the dating problems of the TRB West Group, see also Lanting & van der Plicht, 1999/2000: 32 & 67-69). Bakker interprets these fairly rare, often meticulously finished axe hammers, as probable ceremonial weapons. The rock type of 16 specimens from the TRB area were determined in 1979. Diabase was most prevalent (9 to 10 specimens) and two specimens were of porphyritic diabase. One specimen was made of amphibolite, one of granular granite with a high feldspar content, and one from an unspecified crystalline rock (based on studies by Bakker, 1979a & b). In what was then the TRB region, the raw materials could be gathered throughout the moraine plains and ice-pushed ridges, where they had been transported by land ice as erratic boulders, mainly from Scandinavia. Whereas the erratic boulders collected from the surface were usually too weathered to be made into axe hammers, those present in the till were fresh. Highly usable stones could also be found in streams and erosional gullies.

Rock type: diabase with black phenocrysts (hornblende?).

19. *Leudal, Neeritter (Limburg, Netherlands)*

Coordinates: x = 248; y = 207
Collection: Limburgs Museum, Venlo. From the Bouts collection. Inventory number: L27656. The Bouts collection inventory mentions two other hammer axes, but these were not among the artefacts transferred to the Limburgs Museum. They came from findspot 3A, half of an axe hammer (possibly a Breitkeil) from Ell-Op de Bus, and from findspot 3B, a rough axe hammer, green rock from Ell, terrain S9.

L: 131 mm
T: 48 mm, knob thickness 58 mm
Shaft hole: 27 mm

Period: Funnelbeaker culture

This artefact was found on land belonging to M. Corsten van de T[h]ulkenshof, in the vicinity of boundary post 143, 500 m south of the Aabeek. The find was made in 1956 or earlier, as reported by J. A. Bakker in 1979. He also mentions a letter from Bouts to the Biological Archaeological Institute, now the Groningen Institute of Archaeology (University of Groningen), dated 31 May 1956 (Bakker, 1979a: 102).

It is a knob-butted axe that has split lengthwise. The break occurred in antiquity, after which a secondary cutting edge was made. There is a ring around the shaft hole, top and bottom. A round face, level with the shaft hole, has been created on the preserved side of the axe. This will also have been present on the missing side. Pecking marks are visible on parts of the hammer axe, but the rings, the round face and the outside of the knob are almost entirely polished. The shaft hole has been made from both sides and is almost straight. There are no turning grooves visible in the shaft hole. The shaft hole is slightly wider at one of the rings.

Rock type: black, compact and homogenous basalt-like material, probably gabbro-like (with visible phenocrysts). No preferential orientation or cleavage, non-metamorphic.

References
BAKKER, 1979a: 102

Late Neolithic

20. *Bassenge/Wonck (Liège)*

Coordinates: unknown
Collection: Gallo-Roman Museum. Inventory number: GRM 4449. Oud Fonds collection – Museum – Huybrigts with mention of a ‘perforated mattock [kluitenhamer] – Wonk or Bitsingen’

L: 104.8 mm
W: 48.5 mm
T: 36.5 mm
Shaft hole: 22.6-21.1 mm

Period: Late Neolithic, c. 2600-2450 BC

The exact findspot is unknown. The specimen was originally in the François Huybrigts collection. The inventory of the Gallo-Roman Museum, in whose collection it is now held, states '*perforated mattock – Wonk or Bitsingen*'. Huybrigts is known to have carried out excavations from 1902 onward, together with De Puydt and Davin-Rigot, at an LBK site in Bassenge-Couvent, on the left bank of the Jeker. The specimen may have been unearthed during excavations conducted there by Huybrigts in the '*fonds de cabanes néolithiques*' (Bauwens, 1968: 415; Xa, 1909: 11). The Grand Curtius guidebook reports that these Neolithic structures were partly excavated by Marcel De Puydt and that the finds went to the Grand Curtius. The other part was excavated by François Huybrigts and, according to the guidebook, those finds were held at that time at the '*musée de Tongres*'. The Grand Curtius has another damaged perforated hammer axe excavated at that site by De Puydt (Hoof, 1972: 303. Hoof classifies the artefact as an *Arbeitsaxt*. It is also mentioned by Bauwens-Lesenne, 1968: 415). In 1914, Huybrigts also carried out excavations at an LBK site in Wonck-Dessus Hazette, a site where Hamal-Nandrin and Servais were also active (Bauwens-Lesenne, 1968: 430). Huybrigts' perforated hammer axe is not mentioned anywhere. We therefore do not know whether it was discovered during excavations. That seems doubtful. In our view, it would have been published if that were the case. Because Huybrigts knew the area well, he is likely to have acquired it from a private individual. Until 1962, both municipalities were part of the province of Limburg, which meant that Dutch versions of municipality names were also commonplace, hence the mention of '*Wonk or Bitsingen*'.

The artefact is complete. The entire surface is polished. The perforation is located roughly in the centre and is slightly conical. The specimen has a rounded rectangular cross-section. The neck tapers to a rounded point and is only slightly flattened. The cutting edge is blunt.

There is no doubt that this is a Late Neolithic type of perforated hammer axe. A similar specimen was found in Achim (Lower Saxony), together with All-Over-Ornamented beakers, and a somewhat similar hammer axe was also found in Uddelemeer (Veluwe), along with a Veluwe bell beaker (Lanting & van der Waals, 1976: 26, 36). Hoof classifies such specimens as *Streitäxte*; they are similar in shape to those, for example, from Theux, Echt-Patersbroek (Cultuurhistorisch Museum Asselt) and Maastricht (Hoof, 1970: 276, no. 77, 283, no. 200, 337, no. 160, tab. XXII, no. 206, 207 & 208).

Rock type: medium grey to black, medium-grained, weathered gabbro.

21*. Bekkevoort, Assent (Flemish Brabant)*

Coordinates: x = 196.5; y = 182
Collection: Richard Jamar, on loan to Gallo-Roman Museum. Inventory number: 1994.2.1

L: 153.6 mm
W: 51 mm
T: 38 mm
Shaft hole: 25.4-25.9 mm, straight perforation

Period: end of Late Neolithic (2600-2000 BC) – Early Bronze Age (2000-1800 BC)

This find was made by Richard Jamar, together with his companion Paul Fabré, during prospections in the late 1980s near the boundary between Diest-Webbekom and Bekkevoort-Assent, on a country road just north of the current motorway. It is an isolated find.

It is a virtually intact hammer axe, with a perforation roughly in the centre and with a rhombic decoration carved above and below the perforation. The specimen is fully polished and the semi-

straight perforation is also smoothly carved out. The hammer end is slightly rounded. The sides of the body are slightly wider at the perforation. In plan view, the cutting edge is quite pointed. The axe end has an almost parallel profile, narrowing slightly towards the cutting edge and the hammer end. There are several minor points of damage to the cutting edge, near the perforation and the hammer end.

Although the specimen itself is made of stone, the rhombic decoration – a groove following the exterior contours close to the edge – imitates a decoration found on cast metal specimens in Central Europe. In terms of shape, the specimen resembles the Late Neolithic hammer axes that circulated in the Low Countries, with a broadening at the shaft hole but, given the profile, it also resembles the Zuidvelde type from the Early Bronze Age (2000-1800 BC). And yet, it does not have all the characteristics of Zuidvelde hammer axes (Lanting, 1973: 233, fig. 7, 234, fig. 8 & 297-321). Only a few hammer axes of the Zuidvelde type are known. A fairly similar fragmented artefact, probably of the Zuidvelde type – with a similar decoration, a lower middle section and with no broadening at the shaft hole – is that of Rhoden, Kreis Halberstadt (Lanting, 1973: 298 & 303, fig. 39a). The profile is reminiscent of *Arbeitsäxte* from the early Bronze Age. The raw material from which it is made suggests that it was probably an imported item, perhaps a *flache Knaufhammeraxt vom südwestdeutsch-schweizerisches Typ* (Lanting, 1973: 298). However, Lanting gives no bibliographic references for this type of hammer axe.

Rock type: pale green (originally bluish green), weathered serpentinite (amphibolite variant), foliated along the axis, analogous to the perforated hammer axe from Dilsen-Lanklaar-'Virveld' (26).

References
JAMAR, 1990
CREEMERS, 2015: 66-67 & 246

22. *Bilzen, 'Munsterbilzen' (?) (Limburg, Belgium)*

Coordinates: unknown
Collection: Royal Museums of Art and History, Brussels, National Archaeology Collection. Contemporary label: - (...)bourg B13 (later overwritten) Col. Hagein(.). Inventory number: B000389-001

L: 168 mm
W: 57 mm
T: 35 mm
Shaft hole: 24-23 mm

Period: Late Neolithic, 2600-2450 BC

The artefact appears in the inventory of the Royal Museums of Art and History, Brussels. It was registered in about 1862 and was found '*dans les environs de Munster-Bilzen*'. However, Bauwens-Lesenne reports that, according to Schuermans, the artefact came from Münster, Westphalia (Germany) (Schuermans, 1877: 27 fn1; Bauwens-Lesenne, 1968: 239). Here, Schuermans refers to the new catalogue of the *Musée royal d'antiquités de Bruxelles*. He queries why this axe, which is noted as being found at '*Munster*', has been linked to Munsterbilzen rather than to Munster in Westphalia.

It is a perfectly intact H-hammer. It is wider at the shaft hole and has a rounded hammer end. In cross-section, the axe body is curved at both the cutting edge and the hammer end. It is evenly polished. The shaft hole widens slightly towards the surface. It is Late Neolithic, c. 2600-2450 BC.

Rock type: a dark-brown patina covers the entire specimen. No preferential orientation. Black-and-white speckled, fine-grained diorite or gabbro.

References
X, 1864: 105 no. 270
SCHUERMANS, 1877: 27 vn 1
BAUWENS-LESENNE, 1968: 239

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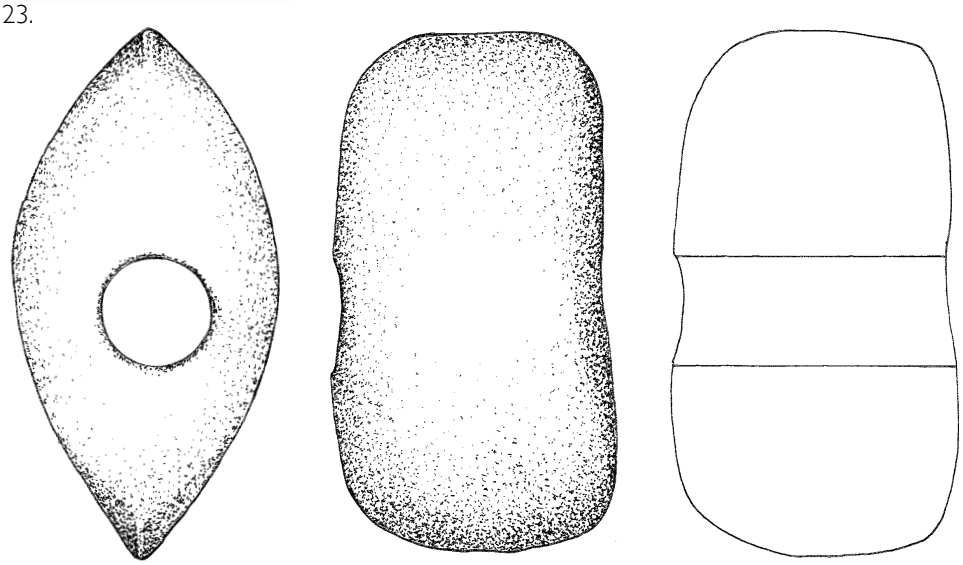

23. *'Diepenbeek' (Limburg, Belgium)*

Coordinates: unknown
Collection: François Schrijvers, Kukkelbosstraat 86, 3590 Diepenbeek

L: 104.3 mm
W: 53.5 mm
T: 56.2 mm
Shaft hole: 24.1-24.9 mm, conical, slightly oblique angle

Period: Late Neolithic (2600-2450 BC), possibly slightly later

This perforated hammer axe was found among gravel on the driveway to a house. The original provenance of the gravel can no longer be traced. In a broad sense, we can suggest 'Limburg Meuse Valley' – probably Zutendaal according to the owner.

This perforated hammer axe has two, rather blunt, cutting edges. Like the sides, the top and underside are curved, giving it a fairly oval cross-section. There is a slight depression in the surface near the shaft hole, at top and bottom. It is a perfectly intact specimen, with the entire surface polished.

The specimen could be an axe hammer, although two-bladed axes are generally much thinner (Hoof, 1970: 93-94). Hoof places them in the Late Neolithic. In view of the divergent shape of the Diepenbeek artefact, however, it is uncertain whether we can give a similar date to this specimen. We know of a somewhat analogous, but thinner, specimen from Horst (North Limburg, Netherlands), with a double-conical perforation and a lower surface near the shaft hole (Hoof, 1970: 279, no. 137, tab. XV, no. 130).

Rock type: very porous, brownish-grey, weathered volcanic rock without preferential orientation. Millimetric crystals present (light-green phenocrysts of biotite, amphibole (?), feldspars or feldspathoids). Origin: possibly Eifel.

24. *Dilsen–Stokkem (Limburg, Belgium) – Driepaalhoeve/Driebeukenbos*

Coordinates: x = 241.63; y = 193.08
Collection: Jacques Carolus

L: 70 mm
W: 53 mm
T: 44.3 mm

Period: Late Neolithic (2600-2450 BC), possibly a little later

The find was made in the 1990s by Jacques Carolus during prospections at the Driepaalhoeve. The site has yielded finds from different periods, mainly Middle and Late Neolithic artefacts.

This is a fragment – the hammer end – of a perforated hammer axe. The diameter of the shaft hole, which had a straight perforation, could no longer be determined because of the artefact's fragmented condition. The exact type could not be determined for the same reason. One side of the surface is flat, while the other is convex. Both edges are also convex.

Given its somewhat tapering shape, this hammer axe should be classified as a Late Neolithic or possibly Early Metal Age axe.

Rock type: fine-grained, weathered micro-gabbro.

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25. *Dilsen-Stokkem (Limburg, Belgium) – Hoefkamp*

Coordinates: x = 243.94; y = 193.84
Collection: Jacques Carolus

L: 80.5 mm
W: 30 mm
T: 45 mm
Shaft hole: 22-26 mm, somewhat conical perforation, slightly oblique

Period: Late Neolithic, c. 2900-2450 BC

Fragment of a perforated hammer axe. The perforation is about 10 mm from the side on one face, and only about 5 mm on the other. The preserved surface is fairly evenly polished, but it is a rough, rather coarse-grained specimen. The damaged sides appear to have been subsequently used: they have light rubbing or polishing marks, especially near the shaft hole. The exact type of hammer axe can no longer be determined, but it probably belongs to the group of Late Neolithic perforated hammer axes.

Rock type: brown-grey, highly porous, weathered, medium-grained volcano-sedimentary rock.

26. *Dilsen-Stokkem, Lanklaar (Limburg, Belgium) – 'Virveld'*

Coordinates: x = 244; y = 190 (vicinity)
Collection: Cultuurhistorisch Museum Asselt (municipality of Roermond). From the Philips collection. According to Philips' barely legible notes, the artefact was found by Math. K [....], head of the [.....] in Dilsen (1935). Inventory number: CP250

L: 102 mm
W: 44 mm
T: 37 mm
Shaft hole: 19-25 mm

Period: Late Neolithic, c. 2600-2450 BC

According to the original report, the artefact was found at Lanklaar 'Virveld'. The farm where the coalmine horses were temporarily housed – named 'Virveld'/'Vierveld' (topographic map NGI, 1:25.000 1973: 'Vierveld') – had to make way for the current Lanklaar industrial estate. The location is just west of Noteborn and the Zuid-Willemsvaart, between Eisden-Tuinwijk and the current N75 expressway, two kilometres east of the foot of the Kempen Plateau.

It is an irregular hammer axe (type R/S/*Arbeitsaxt*) with no broadening at the shaft hole (Butler & Fokkens, 2005: 394); the end section is irregular. The hammer axe has an irregular cross-section. The shaft hole is asymmetrical and has been made from both sides: on one side with a straight drill hole and on the other side from a hollow, creating a strongly rounded upper edge. The shaft hole has a slight hourglass shape. No turning grooves are visible in the interior. However, the shaft hole still contains some earth. The hammer axe is almost entirely polished but some pecking marks are still visible at the top.

Rock type: greyish green, fine-grained metamorphic rock with preferential orientation of the constituent minerals. Quartz and feldspar may be present but cannot be properly identified. Further analysis is required to determine this precisely, but this specimen closely resembles the two other that are identified as amphibolite and 'possibly amphibolite', namely Kinrooi-Ophoven (12) (Rössen) and Kinrooi-Geistingen-Ooe (28) (late Neolithic).

27. *Kinrooi (Limburg, Belgium) – Hagendoren/Batven*

Coordinates: x = 245.3; y = 203.1

Collection: Musea Maaseik. On loan since June 1986. Private loan from the Gerard Segers collection. Inventory number: MM 10/11 – 5/5/1 – MM/0010/0011

L: 83 mm
W: 63 mm
T: 37 mm
Shaft hole: 21.8 mm and 22.2 mm, straight perforation, fragmented

Period: Late Neolithic, c. 2900-2450 BC

Gerard Segers discovered the find just north of the Itterbeek, near Batven and Hagendoren, in about 1960. He also found many other lithic artefacts at that site, and from different periods, including quartzite from Wommersom (Dursin,1931; Geerkens, 1950).

It is a fragment of a hammer axe with tapering, concave sides and a rounded hammer end. In profile, the body becomes somewhat lower towards the hammer end.

The exact type cannot be determined. The artefact probably belongs to the group of hammer axes of types B–P, c. 2900-2450 BC (Butler & Fokkens, 2005: 394).

Rock type: medium-grained metagabbro.

References
CLAASSEN, 1970: 160, nos. 160 & 163

28. *Kinrooi, Geistingen (Limburg, Belgium) – 'In de Ooe'*

Coordinates: x = 252.5; y = 204.5 (vicinity)
Collection: Musea Maaseik. Inventory number: MM/5/133 – 75.GE.11 – 494 – MM/0005/0133. The Museum inventory incorrectly reports that the object was found during an excavation in 1979 (location designation: Huizerhof).

L: 121 mm
W: 55 mm
T: 35 mm
Perforation: 19-18 mm, straight perforation

Period: Late Neolithic, c. 2600-2450 BC

The artefact was found at 'In de Ooe', near the Geistingen-Kessenich border. It was discovered by chance in a gravel pit in 1975.

It is a fine, intact hammer axe. It is slightly faceted, with a slightly damaged cutting edge. The artefact is evenly polished over almost the entire body, giving it a surface sheen. Pecking or bush-hammer marks show through the polished surface in places, especially on the flat sides. The cutting edge is quite blunt. In profile, the hammer part drops down slightly on one face. The hammer end is slightly oblique and there are also bush-hammer marks in this zone. The axe fans out more widely near the shaft hole.

This axe belongs to the group of faceted hammer axes (Butler & Fokkens, 2005: 395) and can be placed in the late group from the Late Neolithic, c. 2600-2450 BC.

Rock type: medium-grained metamorphic rock with dark-green porphyroblasts, analogous to the specimens from Dilsen-Lanklaar-'Virveld' (26) and Kinrooi-Ophoven (12). Possibly amphibolite. Good preferential cleavage or orientation of the constituent minerals. The original publication erroneously gives stratified black phthanite as the raw material.

References
HEYMANS, 1976

29. *Kinrooi, Ophoven (Limburg, Belgium)*

Coordinates: unknown
Collection: Musea Maaseik. Inventory number: 406

Fragmented
L: 114 mm
W: 68.5 mm
T: 51 mm
Shaft hole: 25 and 24 mm, straight perforation, fragmented and incomplete

Period: Late Neolithic, 2900-2450 BC

'*Ophoven*'. The artefact comes from a collection registered at the Musea Maaseik as 'Municipal Museum'. The original collection is said to date from 1910-1940. The artefact was found in 1932; no further details are known. No fragment of a perforated hammer axe can be found anywhere in Bauwens-Lesenne's register under 'Ophoven' (Bauwens-Lesenne, 1968: 275).

It is the cutting edge of a hammer axe, preserved up to the shaft hole, which is broken across the middle. The cutting edge is somewhat fan-shaped in profile. The axe is wider at the shaft hole. The artefact is fairly evenly polished.

The broadening at the shaft hole suggests that the axe probably belongs to groups A–P (Late Neolithic, 2900-2450 BC) (Butler & Fokkens, 2005: 395).

Rock type: pale, greenish grey, medium- to coarse-grained, highly weathered, unknown magmatic rock. No preferential orientation or cleavage. Possibly diorite/rhyodacite? Silica-rich with weathered feldspar.

30. *Leudal, Hunsel (Limburg, Netherlands)*

Coordinates: x = 251.9; y = 209.8
Collection: Limburgs Museum. Inventory number: L27655

L: 183 mm
W: 56 mm
T: 34 mm, thickness of cutting edge 44 mm
Shaft hole: 23 mm

Period: Late Neolithic, c. 2900-2800 BC

This artefact was found at Hunsel, Kamp (Schillersheide), by Th. Bouts in the period between the end of the Second World War and c. 1960, findspot 17B. The find reportedly comes from a Beaker grave. However, it is not clear whether this conclusion is based on the traditional association of such artefacts with Beaker graves or whether the find has actually been established as coming from such a grave.

This is a boat-shaped hammer axe (type A) with no broadening at the shaft hole and with an imitation casting seam running the entire length of the upper side. The upper side is fairly flat and the top tapers more or less to a point, with a flattened butt that is slightly damaged. The underside is concave with a fanned cutting edge and butt.

The hammer axe has an oval cross-section. The shaft hole is straight and was drilled from both sides. Turning grooves are visible inside the shaft hole. The hammer axe is almost entirely polished. A pronounced secondary dark-brown discolouration is visible at the cutting edge.

Rock type: dark-green metagabbro with ophitic texture (feldspar and amphibolite phenocrysts). No cleavage or preferential orientation.

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31. *Leudal, Neeritter (Limburg, Netherlands)*

Coordinates: x = 249; y = 207.3 (vicinity)
Collection: private collection, René van de Vin

L: 177 mm
W: 59 mm
T: 44 mm
Shaft hole: 22-20 mm

Period: Late Neolithic, c. 2600-2450 BC

This artefact was found in Neeritter, Heioord, while digging potatoes. The find date is 25 August 1996.

It is a notched hammer axe (type P) (Butler & Fokkens, 2005: 395) with a broadening at the shaft hole and a round butt. The hammer axe has been fully ground, leaving no facets, and with percussion marks here in various places that appear to have been made after grinding. The shaft hole has been drilled from both sides; turning grooves are visible on the inside.

The artefact belongs to the late group of Late Neolithic hammer axes, c. 2600-2450 BC.

Rock type: dark-green, fine-grained metagabbro.

32. *Lommel (Limburg, Belgium)*

Coordinates: unknown
Collection: Gallo-Roman Museum, purchased from the Loncke brothers. Inventory number: Lo 676

L: 126.5 mm
W: 59 mm
T: 3.6 mm
Shaft hole: 19.1-18.5 mm, straight

Period: Late Neolithic, c. 2600-2450 BC

The exact findspot is not known. This is a fragment of a perforated hammer axe: the front section is missing. The surface is fairly evenly polished. The hammer axe is wider at the shaft hole. The hammer part is flat, with a slight convex curve. In profile, the hammer axe is bent. There is a groove in the perforation. The axe has a lengthwise seam that is 0.2-0.3 mm wide on the convex side, imitating the mould joint on a cast copper axe. It is a hammer axe of type G (Butler & Fokkens, 2005: 394-395). In the Low Countries, axes of this type are placed in the late phase of the Late Neolithic, c. 2600-2450 BC.

Rock type: dark-green, fine-grained metagabbro or amphibolite schist, foliated along the longitudinal axis.

References
CLAASSEN, 1955: 157-159
ENGELS, 1985: 4, fig. 1

33. *Maaseik, Opoeteren, Dorne, 'Dornerheide' (Limburg, Belgium)*

Coordinates: x = 239.7; y = 192.6
Collection: Jacques Carolus

L: 142.6 mm
W: 54.4 mm
T: 54.5 mm (near cutting edge)
Shaft hole: 22.7 mm, straight perforation, drilled from both sides

Period: Late Neolithic, c. 2600-2450 BC

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This fragmented perforated axe hammer was found by Jacques Carolus during prospections in the 1990s. The artefact is not preserved in its entirety. It is a faceted axe hammer with cylindrical butt and a broadening at the shaft hole. In profile, the cutting edge fans out wider than the rest of the axe body. The shaft hole, which is preserved on only one side, still has turning grooves in the middle section. The upper part of the shaft hole is slightly narrower and is evenly polished to about 1 cm from the edge. The shaft hole was probably drilled from both sides. A large flake is missing from one surface at the hammer end, causing serious damage to that surface, including the shaft hole. A much smaller flake is missing from the other surface, again from the hammer end, but it does not extend as far as the shaft hole. The hammer end, which is made narrower because of these reductions, shows intensive percussion marks, some of which must have appeared after the flaking. This hammer axe appears to have functioned as a mallet after its 'first' life. The cutting edge shows some minor damage. One of the sides has several deep, antique scratches.

This is a faceted axe hammer, belonging to the later group of Late Neolithic axes, c. 2600-2450 BC (Butler & Fokkens, 2005: 394; Hoof, 1970: 94-95).

Rock type: weathered brown-grey, medium-grained, microdioritic magmatic rock.

34. *Maasmechelen, Vucht (Limburg, Belgium)*

Coordinates: x = 245.5; y = 185.8
Collection: Jacques Carolus

L: 66.5 mm
W: 58.5 mm
T: 34.5 mm
Shaft hole: 25 mm, broken and therefore difficult to establish with certainty

Period: Late Neolithic, 2900-2450 BC

The artefact was found between Maaswinkel and 'Grindgroeve', southwest of boundary post 113, very close to a country lane and only about 500 metres from the current course of the Meuse. The specimen is not complete. The shaft hole is also incomplete, making it impossible to determine the diameter and exact shape. The perforation is smoothly polished. This is the hammer end of a hammer axe. The butt is quite flat and more roughly finished, possibly partly as a result of use. The original thickness of the artefact is also unknown since one flat face is damaged by antique reductions. The same applies to the width, which can no longer be determined because of an antique flake removal. The oblique fractures are also ancient. The remaining surface is evenly polished. In view of the shape, we suspect that this hammer axe belongs to the Late Neolithic group, from the R/S hammer axes onwards (Butler & Fokkens, 2005: 394-395).

Rock type: diabase (ophitic texture?) with green phenocrysts, unfoliated.

35. *Oudsbergen, Gruitrode (Limburg, Belgium) – Campstraat*

Coordinates: x = 235.1; y = 195.5
Collection: Private collection

L: 112 mm
W: 47 mm
T: 25/21 mm, conical

Period: Late Neolithic, c. 2800-2700 BC

This is an isolated find. No other archaeological finds have been made in the immediate vicinity, although an unpolished flint axe and a polished axe made of green hardstone were found some

600 metres to the north, and fragments of a Late Neolithic beaker with herringbone decoration were found further afield, 1500 metres to the west, on the Ophovenerheide (Creemers, 1987: 28). Because the find is no longer accessible, we are utilising the data published at the time.

It is a perforated hammer axe. The upper side and underside are flat. The butt is rounded and somewhat rough, probably because of bush-hammer marks. The cutting edge is quite blunt.

This is a B-hammer axe (Butler & Fokkens, 2005: 394-395).

Rock type: 'brownish-grey hard rock with white speckles'. Because the specimen is no longer accessible, the rock type could not be further identified.

References
CREEMERS, 1985: 148, pl. 13:3
CREEMERS, 1987: 28
CREEMERS, 1988

Metal Ages

36. *Maaseik, Opoeteren, Dorne, 'Zandgroeve' (Limburg, Belgium)*

Coordinates: x = 239.1; y = 192.5
Collection: Jacques Carolus

L: 82 mm
W: 27 mm
T: 33.5 mm
Shaft hole: diameter could not be determined, biconical

Period: Early/Middle Bronze Age, c. 2000-1500 BC

Findspot: near 'Zandgroeve', Dorne. The find was made by Jacques Carolus during prospections in the 1990s.

It is a fragment of a smaller, rather slender, perforated hammer axe. In profile, one side is completely preserved up to the shaft hole. The shaft hole has been drilled from both sides and is biconical. The shaft hole must have been situated about one-third of the way down from the hammer end. The hammer body, in profile, still clearly narrows towards the cutting edge. Originally, the hammer axe is unlikely to have exceeded 12 cm. Because the body is fairly parallel in profile, narrowing towards the cutting edge, we are inclined to place this hammer axe in the later group, namely the Early and Middle Bronze Age (2000-1800/1500 BC) (Butler & Fokkens, 2005: 394). The fact that there is no broadening at the shaft hole could also be used as an argument for this.

Rock type: weathered, brown-grey, medium-grained, microdioritic magmatic rock.

37. *Cranendonck, Soerendonk (North Brabant)*

Coordinates: x = 233.89; y = 222.78
Collection: private. The find was reported to us by Henk Vandekerkhof (Pelt - Neerpelt)

L: 128 mm
W: 41 mm
T: 36 mm (max. near shaft hole)/36 mm (max. near cutting edge)
Shaft hole diameter: 18 mm

Period: Late Bronze Age to Middle Iron Age, c. 1000-400 BC

This hammer axe has a curious history of discovery. It was found in the 1950s by Jan van Lievenoogen (husband of Anna van Mierlo), the then owner of a historic, characteristic Brabant farmhouse, during renovations to the roof. Unsure what to do with it, he put the artefact in his cellar among the jars of preserves. It was his son-in-law, Henk Vandekerkhof, who noticed that it was a prehistoric find. He then reported it to Inspector Claassen from Achel, who made the first find report and a sketch of the artefact. The artefact was found at Beekstraat 4 Soerendonk. The farmhouse appears on the first land registry map of Soerendonk from 1832, and was then owned by Joanna Clemens, widow of Joannes Dirk Kuipers. The property remained in the possession of the Kuijpers family until 1885, when it was sold to Jan Meurkens, who 'rebuilt and renovated' it. In 1942 it was sold to Adrianus van Lievenoogen, who sold it to his son Jan in 1954. Jan worked on the roof shortly afterwards and discovered the perforated hammer axe among the roof battens. The property was later sold. There is now a new building containing four dwellings on the site, in the same style as the historic farmhouse. Because the building was sold, 'rebuilt and renovated' in 1885, it is impossible to ascertain whether the roof where the artefact was found dates from before 1832, or from shortly after 1885. The latter is probably the case.

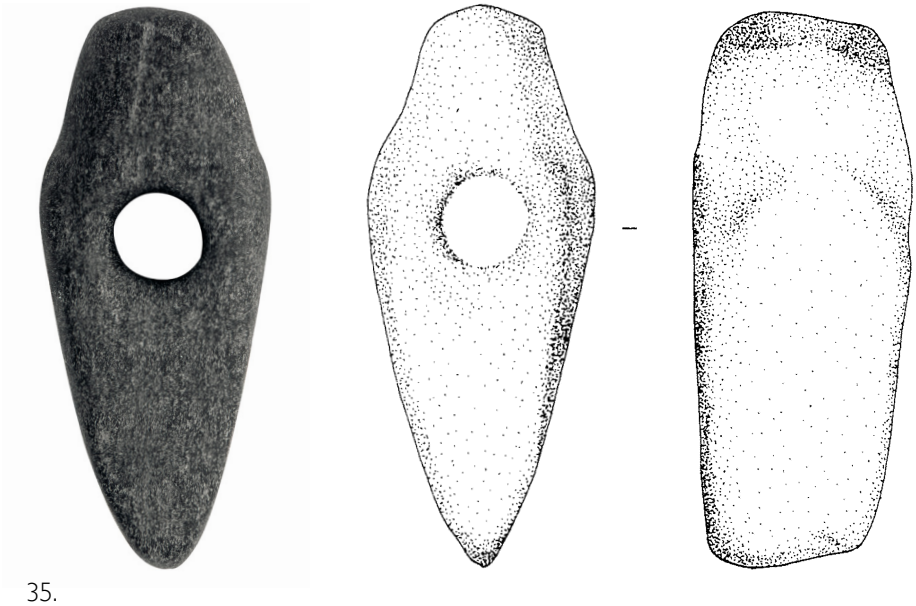
This hammer axe is complete. It has a curved profile and a narrower hammer end. The cutting edge is blunt. The shaft hole is fairly small. The body has a rather rectangular cross-section. There is no broadening at the shaft hole.

It is a late hammer axe of the Muntendam I type, c. 1000-400 BC, Late Bronze Age to Middle Iron Age (Achterop & Brongers, 1979). It is one of the slimmer hammer axes within the Muntendam I group. For the Muntendam type south of the Dutch river area, we know of only one other comparable find, a Muntendam II type hammer axe from Vlodrop-Herkenbosch (Achterop & Brongers, 1979: 347). Muntendam hammer axes are most densely distributed in the northern Netherlands and the neighbouring part of Germany.

The interesting thing about this find – apart from the fact that it is one of the few documented late perforated hammer axes south of the Meuse and the Waal – is that it is an almost unique find that can be directly linked to popular beliefs. Until now, we have never been able to document finds of this kind within our research area, although it is known that both polished axes and perforated hammer axes played an important role (Verhart, 2016a). In 1886, for example, Constant Bamps (1886: 101) reported that polished axes or wedges were previously regarded as fossils, namely '*pierres de tonnerre*' ('thunderbolts') or the remains of fallen stars, adding: '*de nos jours encore, les paysans leur assignent cette origine*'. During the Middle Ages it was believed that these '*thunderbolts*', which Pliny the Elder had called '*ceraunea cuneata*', were brought to Earth by lightning. People believed that the falling stones caused lightning. This tradition was also known in the Middle Ages. The *Liber lapidum/Liber de gemmis*, for example, describes the magical powers of thunderbolts. This belief has also been documented in various Scandinavian written sources (Carelli, 1997). In some places, such as Lund (Sweden), a significant number of polished axes have been found in medieval contexts. The fact that magical powers were still attributed to stones throughout Europe during the Middle Ages is also demonstrated by the Neolithic polished axes that were sometimes bricked into the entrance to farmhouses. They were also frequently placed beneath the threshold or bricked into walls. Some twenty years ago, a *Breitkeil* was discovered hanging from a nail beneath a thatched roof in Staphorst (Verhart, 2016a: 8). And in 19th-century Limburg: '*Some residents even sewed these 'thunderbolts', as they were called, into linen bags, worn on the chest, in the hope that they would help cure their stomach ailments*' (Geerkens, 1950: 69, referring to Maas, 1905, I: 9).

Thunderbolts also had a range of applications in our regions, from curing udder infections in cows to toothache in horses (Verhart, 2016a). It was not until the 18th, and especially the 19th, century that people began to realise that these were prehistoric objects. It is also no coincidence that polished axes and hammers were attached beneath the roof, which marked the symbolic boundary between family life and the outside world (Trefois, 1980: 173-179). In Scandinavian mythology, the gods Donar (Thor) and Wodan (Odin) were the guardians of the domestic hearth. At the same time, Wodan is a horseman riding the storm above the shaking roofs. For a fuller discussion of the folklore associated with this artefact, we refer the reader to Verhart, Creemers, Dreesen & Goemaere 2021.

Rock type: amphibolite, rich in plagioclase (?) and amphibole.



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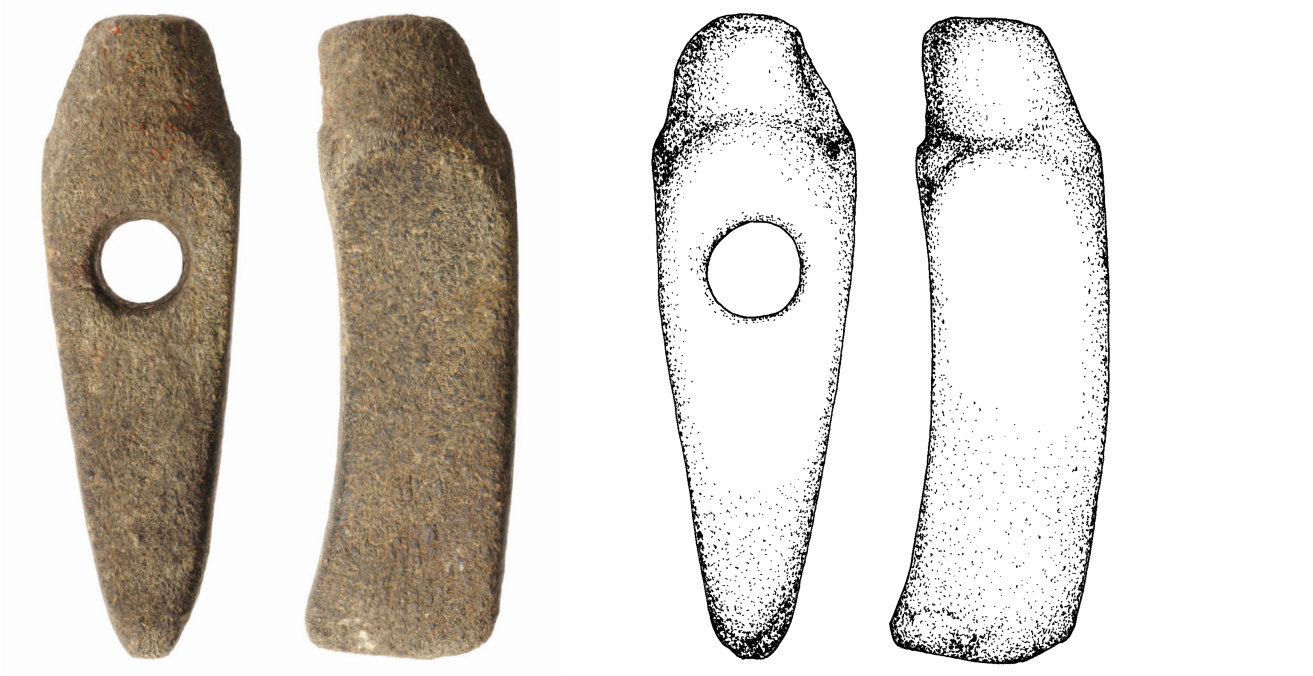

37.

References
CLAASSEN, 1987
VERHART L. *et al.*, 2021

Others finds

38. *'Jekervallei' (Limburg, Belgium/Liège)*

Coordinates: unknown
Collection: Gallo-Roman Museum. Oud Fonds Collection – Museum – Huybrigts with a mention of a 'perforated mattock [kluitenhamer]'. Inventory number: 3730

L: 94 mm
W: 45.2 mm
T: 35.4 mm
Shaft hole: 12.8-14 mm, narrowing somewhat at the centre, slightly biconical

Period: probably recent, almost certainly an imitation

The exact findspot is unknown. Since Tongeren is not mentioned as the findspot, we suspect that it could be the area between Mal-Sluizen and Bassenge-Eben-Emael. The item was probably purchased by François Huybrigts in the late 19th or early 20th century, in any case before World War One.

The top and underside are flat. In profile, both sides are only slightly curved, creating a fairly rectangular cross-section. There are many sanding and cut marks at the top and underside of the shaft hole that were created when enlarging the narrow shaft hole near both surfaces. One cutting edge is damaged and has later been partially repolished. Part of the body has a whitish discolouration, as well as small cracks. We believe these to be traces of heating, whether modern or antique cannot be determined. Part of the Huybrigts collection went up in flames during World War One: the burn marks may relate to that event. A number of other archaeological artefacts from the collection also show burn marks.

In typological terms, the item can be placed among the axe hammers (two-bladed axes), but it is not as slender (Hoof, 1970: 93-94, tab. XXIII, 216-217). Compared with the hammer axe from Diepenbeek (23), this one has a rectangular cross-section. We do not know of any perfectly analogous artefacts. In principle, it could be a Late Neolithic two-bladed hammer axe. However, in view of the rock type used, which to our knowledge does not occur with perforated hammer axes, and in view of its bizarre shape and the percussion marks near the shaft hole, we suspect that this is not an authentic object.

Rock type: medium-grained, burned bioclastic limestone with brownish-grey flecks. Recognisable allochems: ostracodes, brachiopods, crinoids, tabulate corals, sponge spiculae and dark intraclasts. Palaeozoic limestone, possibly Meuse limestone (Visean).

39. *'Verwilghen'*

Coordinates: unknown
Collection: Gallo-Roman Museum. Inventory number: JV 96

L: 155 mm
W: 70 mm
T: 49.8 mm
Shaft hole: 39.5-19.4-37.2 mm, biconical

Period: Rössen

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The artefact was part of the collection belonging to Jo Verwilghen, a son of Hubert Verwilghen, who was provincial governor of Belgian Limburg from 1928 to 1950 (with an interruption during the war years). The Gallo-Roman Museum acquired this collection, which was largely built up in the 1950s and 1960s, through donation. Most of the 'Jo Verwilghen' collection comes from Belgian Limburg, but it also contains finds that were found and purchased elsewhere in Belgium and in the Netherlands. Jo Verwilghen did his own prospecting, carried out clandestine 'excavations' and also purchased archaeological finds. He maintained good relations with the Loncke brothers in Overpelt. This artefact appears to be a purchased find.

The artefact has much in common with Rössen *Keile*, but it has a biconical perforation and is made from a different raw material. It matches the description of *Spitzhauen* (Hulst & Verlinde, 1976, 1979; Verhart, 2009: 574, 2012: 25-29). The object is roughly consistent with the average length of such artefacts (130-150 mm), and appears to show no traces of hammering. It is either unused or barely used.

This is a *Spitzhaue* (pick). *Spitzhauen* are mainly found in the northwestern part of the Lower Rhine region (northwest Germany and the Netherlands, north of the Meuse and the Waal). They are difficult to date. The biconical perforation makes hafting difficult or at least not very functional, and the usually blunt cutting edge does not suggest an obvious use in woodworking. Apart from some hammer marks, they rarely display tool marks. They could be northern, local imitations of Rössen *Keile* (Verhart, 2009, 2012), hence the biconical perforation '*in Mesolithic fashion*' that we find in '*Gerölkeulen*'. In view of their distribution area – they rarely occur south of the Dutch river area – we can assume that this artefact comes from the north, that Jo Verwilghen acquired it through purchase, and that it is not an archaeological find from 'Limburg'.

Rock type: coarse-grained, dark-grey to brown granodiorite, containing biotite and muscovite.

Appendices

Appendix 1

Dilsen-Hoefkamp: several other relevant Neolithic finds (Dilsen-Stokkem, Limburg, Belgium)

Coordinates: centre of findspot: x = 243.9; y = 193.8

We have included two fragments of hammer axes from this site in our catalogue. One is the knob of knob-butted axe from the Middle Neolithic and the other is a fragment of a Late Neolithic specimen. We have also included several other finds that can shed more light on the nature and importance of the site.

The Hoefkamp site is located about 3.5 km west of the current course of the Meuse, a little over 2 km east of the steep edge of the Kempen Plateau, and just east of the Zuid-Willemsvaart. The findspot, at that time a field that yielded numerous finds from the Neolithic, is located on a not very prominent sand ridge. It has a slight north-south orientation and a diameter of approx. 700 x 300 m. Part of the findspot, especially the northern side, is now occupied by industrial estates. Jacques Carolus carried out prospections in the vicinity in the 1980s and 1990s, and specifically also the plot in question and adjacent plots, where he discovered countless artefacts. Heinz Unger also conducted prospections in the same area and at the same sites at around the same time. In addition to the knob-butted axe discussed here (18), there are more possible TRB artefacts and a hammer axe (25) and pottery dating from the Late Neolithic.

Other finds from this site include polished axes and fragments of such axes from hardstone and flint, including a further axe of Lousberg flint, other than the one discussed below, three leaf-shaped arrowheads, two stemmed arrowheads and two winged arrowheads.

Below we give a brief overview of the most characteristic artefacts, all of which come from the Jacques Carolus collection.

40. *Northern-type flint axe of northern origin*

L: 86.7 mm
W: 35 mm
T: 21.5 mm

Period: Funnelbeaker culture

This is the fragment of an axe made of fine-grained whitish flint. It has a fine surface sheen on the polished faces and original reduction surfaces. The cross-section is rectangular. The cutting edge has not been preserved but, as is generally the case with this type of axe, it must have been located on the widest side. The tail end is also not preserved. The artefact must originally have had a more or less trapezoid shape. The axe is of the northern type, and should be classified under 'flint axes of rectangular cross-section' (Bakker, 1979: 78-86), '*dünnblattige Flint-Rechteckbeile*' (Brandt, 1967: 118-122, tab. 21), or '*nordische Silexbeile*' (Hoof, 1970: 42-43). The flint is very likely of Scandinavian/northern Germanic origin, probably from the coastal areas of Schleswig-Holstein (Beuker, 2005).

41. *Lousberg flint axe with rectangular cross-section*

L: 85 mm
W: 48 mm
T: 17 mm

Period: Funnelbeaker culture?

This is a fragment of an axe made of slightly less fine-grained flint. It is greyish with brown and light-brown flecks. Hollows containing cortex are preserved on both faces. It has a rectangular cross-section. The cutting edge has not been preserved but, as is generally the case with this type of axe, it must have been located on the widest side. The tail end is also not preserved. Like the previous artefact, it must originally have had a more or less trapezoid shape. It is made of Lousberg flint. The axe itself is of the northern type and, like the previous one, it belongs to the flint axes with rectangular cross-section. Interestingly, this axe, with a rectangular cross-section and by definition an exotic northern axe type, was manufactured locally or regionally in flint. From that point of view, it is, as far as we know, a unique find.

42. *Decorated sherd*

Period: Late Neolithic

This rim sherd with a slightly everted rim carries a stamped decoration of oblique lines (slanting to the right) between horizontal bands, separated by undecorated zones. The horizontal lines are at 6 to 8 mm intervals. The shape and decoration fit within the spectrum of Late Neolithic beakers (probably All-Over-Ornamented or Bell Beaker) rather than the TRB group (see e. g. Lanting & van der Waals, 1976).

Appendix 2

Finds not included in this inventory

For various reasons, several perforated hammer axes known to us have not been included in the above list because they could not be traced in collections or inventories. For the sake of completeness, however, we decided to include them on the maps in this article (when it was possible to ascribe them to a specific Neolithic period), and we have therefore assigned them a serial number. These artefacts are as follows.

43. *As*

Period: Early Neolithic, Rössen
Findspot: x 236.0; y 189.1. Gravel quarry between As station and village centre, October 1924

References
DURSIN, 1931: 123
HOOF, 1970: 303
VAN DER WAALS, 1972: 178 (Li 2), tab. 41

44. *Maaseik-Heppeneert*

Period: Early Neolithic, Rössen
Findspot: x 250.3; y 197.7. Found during dredging work in the Meuse in 1926, 1 km from the Maaseik bridge at a bend of the Meuse opposite the hamlets of Heppeneert and Koekeleert

References
DURSIN, 1931: 125
HOOF, 1970: 307 no. 65
VAN DER WAALS, 1972: 178 (Li 3), tab. 43
BAKELS, 1992: 65, fig. 36

45. *Maaseik-Heppeneert*

Period: Neolithic

References
HOOF, 1970: 307 no. 68

46. *Kinrooi-Molenbeersel*

Period: Early Neolithic (LBK)
Perforation perpendicular to the two cutting edges: *Flachhacke* (LBK)

References
HOOF, 1970: 307, no. 75

47. *Lanaken-Opgrimbie*

Period: Early Neolithic (Rössen)
'Lateral perforation.' Given the dimensions (L: 24.5, W. 4.9, T. 7.2, diameter of shaft hole 2.5-3 cm), this is most likely a Rössen *Keil*. There is no illustration in the publications.

References
BANNENBERG, 1957: 103
HOOF, 1970: 309, no. 103

48. *Kinrooi-Geistingen*

Period: Neolithic

References
HOOF, 1970: 309, no. 108

49. *Leudal-Ittervoort (?)*

Period: Early Neolithic, Rössen

References
VAN DER WAALS, 1972: 177, tab. 43

50. *Leudal-Hunsel*

Period: Neolithic

References
HOOF, 1970: 280, no. 148

51. *Leudal-Ittervoort*

Period: Middle Neolithic, TRB
Knob of knob-butted axe

References
HOOF, 1972: 280, no. 150, tab. 21, no. 183