A Tale of the Unexpected: Neolithic shaft mines at Valkenburg aan de Geul (Limburg, the Netherlands)

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In the first part of this paper we focus on the principal characteristics of a lithic raw material type known as Valkenburg flint and on chronological aspects of its use in prehistory. In the second part the results of a trial excavation at a recently discovered procurement site with shafts and galleries at Valkenburg aan de Geul are dealt with.

1. Introduction

During a survey in 1970 geologists came across a series of prehistoric flint procurement sites in the valley slopes near Valkenburg aan de Geul (Felder/Bosch 1971a, 1971b). The type of flint extracted was named Valkenburg flint after the municipality concerned. A preliminary inventory of archaeological finds from the region showed that some workshops and exploitation zones had been known to local amateur archaeologists for a long time (Brounen et al. 1993). In private collections, dating back to the thirties, rough-outs for axes and several (fragments of) antler "picks" were present (Eggen 1971; Felder 1975a). The antler tools had been found in a chalk-rubble deposit which formed the top layer of chalk pits that had destroyed parts of the procurement sites Hoorensberg/Geböschke and Schaelberg (fig. 1) (ibid. Brounen et al. 1993).

It was assumed that the flint nodules had been extracted in shallow open pits, dug into the weathered chalk (Felder 1975a, 1980; Felder/Bosch 1971a). Surface finds of flakes and rejects indicated that the raw material had been processed at the quarry sites as well as in workshops in the surroundings (Felder 1975a, 1980). The latter waste concentrations are situated at the edge of plateaus, up to 5 kms from the primary sources. At both types of sites predominantly rough-outs for axes seem to have been produced.

The exploitation zones known are located in the slopes of river-valleys (Geul and Maas) edging the so-called Margraten plateau and in the slopes of dry valleys eroded into that edge.¹

2. Valkenburg flint

2.1. Sources and characteristics

In a primary geological position Valkenburg flint occurs in the Maastricht lithofacies of the Upper Cretaceous Maastricht Formation in south-west Limburg and a neighbouring part of Belgium (Felder 1975b, 1989; Marichal 1983, 7). Within this formation the vertical distribution of flint layers is limited to a few stratigraphical units (fig. 2). Though in the Nekum Chalk sporadically a flint nodule may occur (Felder 1989, 26; Felder et al. 1979, 8), the raw material is found in exploitable quantities mainly in the Schiepersberg and in the Emael Chalk (Felder 1975a, 1980).² The horizontal distribution of flint nodules within these beds varies locally. In some places there is a concentration of these, whereas in others only a few scattered nodules can be found or none at all (Felder/Bosch 1971a, 10). In the Schiepersberg Chalk their shape is mostly irregular, but locally even tabular and nodular flints occur (Felder 1980, 568, 1989, 25). In the Emael Chalk the flints are more or less evenly shaped (ibid., 26). Especially the tabular nodules can be strikingly big (Felder et al. 1979, 7, 40), up to a few meters long and some decimetres thick.

Besides the natural outcrops of chalk where flint in a primary position was won, the raw material could be extracted from residual deposits.³ These nodules often show natural fractures and contain hidden cracks. They tend to be inferior in quality compared to the Bergfrisch (Louwe Kooijmans 1980, 165) raw material.

Since the Maastrichtian chalk was cut by the Pleistocene Maas some of the flints found in an archaeological context can have been gathered in gravel deposits (Heymans/Vermeersch 1983, 39).

The flint generally is described as coarser grained than the Rijkholt (Lanaye) type, predominantly light grey to bluish grey and brownish grey in colour, matt and granular looking at the fracture and completely opaque (Felder 1975a, 1989; De Grooth 1987; Marichal 1983; Zimmermann 1988). Different kinds of grey and textural differences usually occur within a nodule. The lighter the material, the more coarse-grained, matt and opaque it is.

This however is but one of the two characterised subtypes that at the gross can be distinguished within the range of textural and colour varieties (Pisters 1983). The other one is finer grained, greyish brown, semi-translucent and it has a slight lustre and a smoother looking fracture. It contains many light dots, often only the size of a pin's...
head. As for the granularity it falls well within the range of the Rijckholt type. It is supposed to usually be located under the cortex of nodules of the coarser subtype (ibid.), but “pure” nodules are certainly not the exceptions. Both subtypes have in common that they may be banded and have a granular, rough, but mostly even and rather well delineated cortex of a few millimetres to about a centimetre thick. They differ in their susceptibility to chemical alterations (Pisters 1983, 8). In general it can be put that, irrespective of the subtype, the flint looks coarser grained and more “porous” when it originates from the more or less weathered upper part of the limestone or from residual deposits (Felder 1975a, 1980). The colour then often has changed to a (very) pale brown. Yet it seems that the coarse-grained subtype is more sensitive. In a fresh condition it may easily be mistaken for a variety of Rijckholt flint. Fortunate for the archaeologist it tends to be easier to identify when it is found in an archaeological context. The surface of the artefacts changes in much the same way as the nodules from the weathered and residual deposits have done, that is it shifts to a pale brown on the löss (Zimmermann 1988, 605) or a smudged light grey on (poor) sandy and gravely soils and it has a coarser grained appearance (Pisters 1983). The deterioration of surface finds collected on the calcareous soil of the exploitation zone at the Biebosch (fig. 1) had advanced so far, that Neolithic flakes up to 5 millimetres in thickness were almost completely de-silicified and could easily be broken by hand. The finer grained subtype — as far as we know it from Neolithic surface scatters — patinates at a slower rate. It develops a shade of light blue and becomes slightly more lustrous.

2.2. CHRONOLOGY AND PRODUCTS
Valkenburg flint has been used for the production of artefacts since the Middle Palaeolithic (Janssens 1987, 1989; Kelderman/Wouters 1985; Pisters et al. 1984; Roebroeks 1983a, 1983b; De Warrimont, in press; Wouters 1980: 48, 51). The oldest pieces known so far form part of the Saalian Belvédère C and K assemblages (fig. 3) (De Loecker 1992, 1993; Roebroeks 1988). Site K has an absolute age of 250 ± 22 Ka, site C is somewhat older.
assemblages comprises artefacts of this type of flint. At the Late Magdalenian camp site of Eyserheide (Brounen 1987a) 2% of the artefacts were made of it (Rensink 1992). Notwithstanding the rather coarse-grained character of the raw material it was used to produce large blades. An allegedly Late Magdalenian assemblage collected in the slope of the procurement site Schaelsberg (fig. 1) (Arts 1988, 303; Arts/Deeben 1987, 52) comprises blades of Valkenburg flint as well.\(^5\) Apart from a few strayfinds of points (Rensink 1990), Federmesser artefacts from the southern part of Limburg are almost unknown (Arts 1988, 354). The Ahrensburgian site of Valkenburg-Heunsberg (Wouters 1983) has yielded only a few pieces of the flint type under consideration. It is unclear whether these indeed are of Late Palaeolithic age, since the assemblage may be mixed with Mesolithic material. This is indicated by the presence of several pieces of Wommersom quartzite and a surface-retouched triangular point.\(^6\)

Southern Limburg has long been considered to have only very sparsely been inhabited by Mesolithic hunter/gatherers (Arts 1985a, 306, 1985b, 149). A survey of private collections has shown that sites do occur in substantial numbers though (Van der Graaf 1988). A few flakes of Valkenburg flint occasionally occur in these. At Vaals-Vallis (Van Trierum 1980/1981) some pieces were identified, among which is a pick (Marichal 1983, 12). Others are part of a Late Mesolithic assemblage from Schinnen (Voormolen 1994). In the Valkenburg region (e.g. Vilt-Scoutshill) small blade cores are found in mixed surface scatters that comprise Mesolithic as well as Neolithic guide artefacts. As the coarser grained flint subtype is not very suitable for the production of bladelets, predominantly the greyish brown, relatively fine-grained facies was used.

It is to be expected that as a result of the non-sedentary mode of life of Palaeolithic and Mesolithic societies and perhaps through exchange occasionally Valkenburg flint artefacts may have been transported for some distance. To our knowledge none are mentioned in literature on the middle and northern part of Limburg and the neighbouring German and Belgian area (e.g. Arora 1979; Arts 1988; Lausberg et al. 1985; Lauwers 1986; Lauwers/Vermeersch 1982). In general raw material identification for the periods concerned is often frustrated by patination or by colouration that results from the artefacts having been embedded in humid soils. Moreover, since the flint type occurs in alluvial deposits, it may be hard to demonstrate a south Limburg origin for an occasional blade or flake. From the Early Neolithic A of the new Dutch chronology on the use of Valkenburg flint is no longer practically limited to the source area. In the Linearbandkeramik (LBK) the distribution of the raw material got underway, be it in

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\(^5\) ibid.). One of the few typologically datable strayfinds which was found at Wijlre is thought to have been produced in the Eemian or in the first half of the Weichselian (Roebroeks 1983b). Judging from the condition of the cortex, the nodules used were collected in Pleistocene terraces or the streambed of the Maas as well as in chalk cliffs or residual slope deposits.\(^4\) The latter assumption is supported by the fact that several pieces were found close to natural outcrops of Valkenburg flint. The artefact types comprise among other things Levallois flakes and hand axes. The number of indisputable and "uncontaminated" Late Palaeolithic sites in southern Limburg is rather limited. Consequently so are data on the use of Valkenburg flint in this period. As far as known but one of the few excavated
small quantities and over relatively short distances, that is mainly within the “home range” (Bakels 1978). Inhabitants of several villages within the Graetheide Siedlungskammer and from a site belonging to the Heeswater cluster transported nodules 10-15 kms to their settlements and produced mediolithic blades at the habitation site (Groenendijk 1980, 1980/1981; De Grooth 1986, 1987; Theunissen 1992). In the recently excavated settlement of Geleen-Jans Kamperveld (Louwe Kooijmans 1992; Kamermans et al. 1992) artefacts of Valkenburg flint occurred in pits of the Older LBK. Finds in the other settlements in general belong to the later phases of the Younger LBK (De Grooth 1987). The Valkenburg flints that were found in several settlements of the Merzbach cluster in the German Aldenhovener Platte area (Langenbrink 1992; Marichal 1983; Zimmerman 1988) reached the consumers in the form of blanks or tools (Zimmermann 1988, 605).

Some remarks should be made with regard to the origin of the flint that was used during the Early Neolithic. From excavations we know that in most Dutch Bandkeramik sites (residual) Rijckholt flint was used almost exclusively (De Grooth 1987). Valkenburg flint was used to a far lesser extent. With these raw material types that occur at several dispersed natural outcrops however it is hard to trace where they were won. De Grooth (1986, 24), presumably referring to the Savelsbosch, correctly argues that Rijckholt and Valkenburg flint could have been collected at one and the same location. Hypothetically the Rijckholt type could even have been transported from Spiennes (cf. Kars et al. 1990). In the last decade several Early Neolithic artefacts have been found in the Limburg flint region. The recovery rate in
the area, that for its richness in lithic finds has since long attracted the attention of many amateur archaeologists, is likely to be relatively high compared to the from a collectors’ point of view less “attractable” rather “empty” central parts of the löss plateaux to the north of it. Consequently the seemingly significant relation between the finds concerned and geological aspects of the region may represent nothing more than a small fraction of a veil of artefacts that came into being as a result of the same non-procurement-related activities taking place in different landscapes. After all Linearbandkeramik finds are also known from the middle Limburg coversand area (Brounen 1985; Van der Graaf 1987; Smeets 1991a, 1991b, 1991c; Wansleeben 1987). The proximity of most of the artefacts fore-mentioned to procurement sites leads us to suppose however that they probably were lost or discarded by “working parties” engaged in the acquisition of raw material and probably the production of blanks. A lydite adze and a flake of another one was found at Rijkholt (Weerts 1990), inbetween an exploited outcrop of Rijchkolt flint (Schoone Grub) and a Valkenburg flint exploitation zone 750 m to the north of it (pers. com. G. Fontein, Duizel). At Banholt-De Hei, at about 250 m from the residual Rijkholt flint procurement site (Nijst 1933), two amphibolite adzes, a number of mediolithic blade cores and some typologically Early Neolithic flint tools have been collected over the years by H. Nellsen (Banholt). A lydite adze was found at the same site by M. Vandewall (Eckelrade). At two locations quite near to the exploitation zone at Valkenburg-Schaelsberg a lydite adze, two concave-based asymmetrical projectile points and some mediolithic blade cores were found by H. Pisters (Valkenburg) and G. Weggemans (Strucht). Another adze forms part of the lithic inventory of a site at Valkenburg-Emmaberg (coll. H. Pisters). Furthermore adzes are known from the Simpelveld region and from two sites in the surroundings of Gulpen (Brounen 1987b).

The distribution of Valkenburg flint artefacts in small numbers and in the form of blanks seems to go for the Early Neolithic B as well (Marichal 1983; Zimmermann 1988, 605). 1.4% of the flints at the Rössen settlement site Inden 1 were produced from this raw material type (ibid.). In the Netherlands only one Rössen site has been discovered and investigated so far (Brounen/Dijkmans 1988; Louwe Kooijmans 1988). Though it is situated at less than 3 km from a procurement site, Valkenburg flint is almost absent in the assemblage (Oude Rengerink 1991, 28-29).

With the introduction of the flint axe, replacing crystalline rock adzes and related tool types, the specific properties of Valkenburg flint seem to have led to a gradual intensification of its use. Being coarse-grained and thus tough — that is relatively shock-resistant — it is well suited for tools that fulfill a heavy duty task. It should be noted that the assumption of an increased production for the moment rather is based on observations at and data from exploitation zones and workshops, than on the number of tools recovered in individual settlement sites. The use of Valkenburg flint for the production of axes starts in the Middle Neolithic A, at an early stage of the Michelsberg Culture (MK). At Koslar 10 a flake of a polished Valkenburg axe was found in a pit, in association with pottery from the older phases of the MK (Marichal 1983, 8). The assemblage from the site comprises a few artefacts more of the raw material type concerned, among which are two other fragments of axes (ibid.). In all Valkenburg flint forms less than half a per cent of the total flint inventory (Höhn 1984). At Maastricht-Klinkers (Theunissen 1990) likewise but a few pieces were found (ibid; Schreurs, this volume). The fill of a refuse pit at a recently discovered MK site at Maastricht-Vogelzang contained the edge of an axe (coll. B.Knippels, Maastricht). In an assemblage from a rather uncontaminated MK surface scatter at Valkenburg-Heunsberg, presumably representing a settlement site, the flint type is present among other things in the form of macrolithic scrapers and large blade cores (coll. H. Pisters). A similar site at Nuth-Grijzegrubben revealed some waste material, robust scrapers and a flake of a polished axe (coll. A. van Deijck, Honsbroek).

With the MK not only changed the way in which the raw material was used, but the distance across which it was transported also increased. MK-associated Valkenburg flint artefacts have been found in the coversand region of middle Limburg (pers. com. M. Wansleeben on HVR 22) and in the river area, at sites of the Dutch facies of the MK, that is Hazendonk 2 and 3 (Louwe Kooijmans/Verhart 1990; Verhart/Louwe Kooijmans 1989). It mostly concerns fragments of axes. In mixed assemblages from two sites in Westphalia a blade scraper and a fragment of a robust blade were identified, that typologically may belong to the MK (Arends 1990; Gaffrey 1990).

The maximum exploitation of Valkenburg flint seems to have happened in the period following that of the MK. Indications for this primarily come from the procurement sites themselves. Radio-carbon dating of antler fragments from three different quarry sites indicated that the exploitation had taken place in the Middle Neolithic B and the Late Neolithic A (fig. 24) (Felder 1981). Recent excavations have fortified this information (cf. below). In cultural terms the dates are contemporary with the Stein component of the Warthberg/Stein/Vlaardingen Complex (De Grooth 1991; Louwe Kooijmans 1983). In the archaeological record this is corroborated by the presence of Valkenburg flints in excavated assemblages of the culture group concerned. At Ewijk, a Vlaardingen site in the river
area, some flakes of polished Valkenburg axes were found (Asmussen/Moore 1987, 101). The fill of a refuse pit (HW 1/433) at Hasselsweiler 1 contained “Vlaardingen” pottery and among other things several artefacts of Valkenburg flint (Schwitalla 1984, 58). The raw material of a number of axes that antecedent to the excavation of the rather uncontaminated (Louwe Kooijmans 1983) Stein Group site Echt-Koningsbosch 27 were collected at the surface, at the time was described as “quartzitic flint” (Van Haaren/Modderman 1973, 11). Meanwhile these tools have appeared to be made of Valkenburg flint (pers. com. J. Schaap, Geleen). Furthermore there are several surface scatters with Stein and Jungneolitikum 2 pottery or guide artefacts, that have yielded Valkenburg flints (Aldenhovener Platte 1977, 496, 532, 1979b, 386-400; Schreurs 1991; Arora 1986a). The artefacts of this raw material type that have been excavated at the mixed Stein Group site of Geistingen (Heymans/Vermeersch 1983) are thought to have been produced on flint from gravel deposits (ibid.: 39).

Flint artefacts that typologically can be attributed to the Late Neolithic Beaker period are not scarce in private collections in Limburg. Some of the tanged-and-barbed points observed are made of Valkenburg flint, that admittedly may have been collected in gravel beds. The number of pottery fragments (Beckers/Beckers 1940; Bursch 1933, 92) and assemblages from indisputably “pure” sites in the southern part of the province on the other hand certainly is very small. As the Beaker cultures in general preferably used local raw materials, excluding the artefacts of exotic flint acquired through exchange, it can be assumed that this will have been the case in the area concerned too. Nevertheless not a single “unimpeachable” piece of Valkenburg flint from this period can be traced in literature or in collections. As far as mention is made of sites, there is always the problem that the assemblages seem to be mixed. At Vilt (Pisters/Schrooders 1987) for example among other things tanged and tanged-and-barbed points occur, which as a rule are thought to be part of the lithic inventory of respectively the Stein Group and the AOO/BB phases of the Beaker period. Though the latter type of point is considered to occur in the Belgium S.O.M. (Cauwe 1988, 54), the data-base for the Late Neolithic of the southern Netherlands for the time being does not allow for a similar conclusion regarding the Stein Group. In other words a mixture of artefacts belonging to different cultures in the assemblage fore-mentioned is likely. This problem goes for an interesting settlement site at Heerlen (Van Dejick 1987), where at a rough estimate about 70% of the artefacts is made of Valkenburg flint, as well.

On the eventual post-Neolithic use of the raw material little can be said. The Bronze Age in southern Limburg is a major Forschungsstücke. Apart from burial mounds (Beckers/Beckers 1940; Hooijer 1961) and a number of strayfinds of bronze axes (e.g. Brounen 1988; Willems 1983) the area still is devoid of cultural remains. In the neighbouring Rhineland and at Maastricht-Aubeldomm in fragments of Valkenburg flint axes have been found in Early Iron Age refuse pits (Arora 1986a, 33; pers. com. B. Knippsels, Maastricht). Leaving out of consideration the possibility of contamination with older artefacts, the occasional use of “pick-ups” can not be ruled out. A regular production of Valkenburg flint tools after at the latest the Early Bronze Age for the moment seems rather unlikely (cf. Gronenborn 1992, 186; De Grooth 1991).

In the Roman period the use of the raw material finally changed to that of building stones for the foundations of villas.

In conclusion it can be put that Valkenburg flint, like most other suitable lithic raw materials, was used throughout a large part of the stone age. It has in common with other flint types as well, that a long period of equable low level use is followed by an intensification of the procurement, in a period when its specific lithological properties best met the requirements of a new artefact type, that is axe blades. Judging from the data available so far, the exploitation seems to have been “stepped up” at a lower rate than that of Rijckholt flint. It may have culminated at the time when the procurement of the latter flint type was gradually levelling off compared to the preceding Middle Neolithic A (cf. De Grooth 1991). With the intensification of the production the geographical distance across which the products were distributed augmented as well, which once again is not different from to the “behaviour” of other flint types.

2.3. ASSOCIATED RAW MATERIALS

A supplementary indication for the cultural identity of the miners in the Valkenburg region might be several finds of Lousberg flint axes in the above-mentioned workshops (Pisters 1986; database Valkenburg project). Lousberg axes from the southern part of the Netherlands are preferably assigned to the Stein Group (Gronenborn 1992; Louwe Kooijmans 1983; Modderman 1980a). Apart from a single blade of this raw material type that has been found in a secured Vlaardingen context in the western Netherlands (Louwe Kooijmans 1983, 62; Verhart 1990, 577) and from a flake of an axe at Hasselsweiler 1/433 (Schwitalla 1984), the finds from most (assumed) settlement sites form part of assemblages that were collected on the surface or in the ploughzone. This goes for Dutch sites (Van Haaren/Modderman 1973; Schreurs 1991, 90) as well as for several Jungneolitikum 2 sites in the Rhineland (Aldenhovener Platte 1979a, 327, 1979b, 393; Arora 1986a). In Drente fragments of a Lousberg axe have been found at a surface
site of the contemporary TRB-culture (Beuker 1986). Some of the southern Lousberg axes collected may have belonged to members of the Michelsberg Culture population (Gronenborn 1992; Van Haaren/Modderman 1973, 17; Louwe Kooijmans/Verhart 1990; Weiner 1986). Besides by C14 dates from the procurement site itself, the assumption is fortified by finds at for example Koslar 10 (Aldenhovener Platte 1981, 256), Hambach 11 (Gronenborn 1992), Theusies (Vermeersch/Vynckier/Walter 1990, 7, 63) and in the above-mentioned surface scatter at Nuth-Grijzegrubben. An assemblage from the southernmost part of Limburg (Einrade-Holset; Arora/Franzen 1987, 27) comprises besides Lousberg and Simpelveld flint artefacts some tanged-and-barbed points (observation by one of the authors), which may extend the span of quarrying at the Lousberg into the Beaker period. Affirmation for this is given by Gronenborn (1992, 186), mentioning some tanged-and-barbed points made of the raw material type under consideration. So it appears that the time span in which Lousberg flint was used for the production of axes is too long to make these tools a satisfactory chronological marker for workshops and thus flint exploitation in the Valkenburg region.

Another raw material type that stands out for its “exotic” quality should be mentioned, namely Romigny-Lhery flint (Arts 1986; cf. De Grooth 1983). A handful of artefacts, comprising unpolished robust blades, blade-tools and a large triangular projectile point, is part of a typologically well datable Michelsberg Culture assemblage collected at a surface site at Valkenburg-Heunsberg (cf. above). The association of this flint type from northern France with MK guide artefacts goes for several sites in middle and northern Limburg and the Rhineland too (Höhn 1984; Mooren 1993; Smeets 1993). For the south Limburg löss region a number of artefacts from the MK surface scatter at Nuth-Grijzegrubben and from a MK refuse pit at Maastricht-Vogelzang (coll. B. Knippels, Maastricht) can be added.

3. The Biebosch excavation

Until recently information about the nature of the extraction of Valkenburg flint was limited to a hypothesis that mainly was derived from geological characteristics of the procurement sites (Felder 1975a). In order to verify it, the Institute of Prehistory of Leiden University (IPL) carried out a trial excavation in 1990 and 1991 at a site called Biebosch (Brounen 1992). The place-name refers to a wooded promontory along the Geul valley to the south-east of Valkenburg (fig. 1). About half-way the slope of the headland a zone where nodules had been extracted could be traced for more than 1500 m through the mapping of flint debris on the surface.

In testpits the assumed practice of open exploitation was confirmed by the uncovering of shallow diggings with a maximum depth of about 1.9 m. Higher up the slope a trench of 5.5 m long, 1 m wide and 3 m deep, sunk into the solid Emael chalk, was discovered. At both extremities it appeared to be extended with small subterranean workings, which made this extraction point a true flint mine. The largest of these measures 2.5 m long by 1.5 m wide. A narrow passage in its side-wall connected it with the gallery of an adjacent mine.

Among the excavated artefacts antler objects were conspicuously absent. The miners’ implements consisted almost exclusively of notched flint picks, so-called Kerbschlägel (Aldenhovener Platte 1980, 281; Weiner/Weisgerber 1980).

In the chalk-rubble deposit of the trench the remains of a hearth were found that contained charcoal particles of Alnus spec. By means of radio-carbon dating the age of the mine was established at 4330 ± 60 BP (GrN-19832), that is between 3280 and 2780 cal B.C. (fig. 24; Brounen et al. 1993). This result, that is quite in accordance with the date known for another exploitation site in the Valkenburg region (Felder 1981), indicates that the flint from the Biebosch mine has been extracted by miners of the Stein Group.

4. Flint mines at the Plenkertstraat

4.1. Introduction

In consequence of the Biebosch research a survey for other features connected with an underground extraction of flint was instigated. At several locations to the south of Valkenburg such prehistoric cavities were discovered in man-made chalk-bluffs (fig. 1). Some of these can be seen in a rock-face at the edge of the Sprookjesbos (cf. Felder 1975a). In an abandoned chalk quarry lying in the west slope of the Sibbergrubbe a partly sectioned shaft was observed. It cuts through several meters of löss before reaching the chalk deposits. Its precise depth is unknown at the moment but it certainly surpasses 4 meters. In the following another site — situated opposite of hotel Brouwers and the Leeuw brewery in the Plenkertstraat (fig. 8) — will be dealt with.

In januari 1992 workshops on the plateau bordering the south slope of the Geul valley were surveyed. The artefacts collected represented a facies of Valkenburg flint that was thought to originate from a hypothetical procurement site somewhere along the Plenkertstraat (Pisters/Schroorders 1987). The subsequent visit of a bluff with nodules of this specific type of raw material in the Plenkertstraat led to the recognition of three cavities (fig. 4) that clearly showed characteristics of prehistoric galleries (Brounen 1993; Brounen et al. 1993). They had been cut as a result of chalk
quarrying. When an adjacent part of the rock-face opposite of the Leeuw brewery was examined two partially sectioned shafts were discovered (fig. 5). From their dimensions and shape and from the geological aspects of the site it could be inferred that these features represented an unexpected phenomenon for the Valkenburg region, that is deep shaft mining.

Consultation with the provincial archaeologist of the State Service for Archaeological Investigations resulted in the task of valuating the relics, so an opportunity for research presented itself. In the summer of 1992 the IPL executed a trial excavation at the site. The investigations comprised the documentation of visible remains and a search for hidden features in a plot of about 40 x 10 m. Most of the shafts and galleries discovered were investigated by means of test pits and trenches. The aim of the excavation was to assess the extent and the nature of the exploitation, to collect a sample of flint waste and tools and to gain datable material from the fill of the mines.

The investigations formed part of a research project that was subsidized by the Foundation for Archaeological Research (ARCHON), which is subsidized by the Netherlands Organization for Scientific Research (N.W.O.).

4.2. LOCATION AND GEOLOGY

In contrast to the Biebosch mines, that are situated halfway the slope of a dry valley, these Plenkertstraat mines lie in the foot of a slope that joins the Geul valley bottom. The lower part of the slope has been dug off, most probably because of road construction and the building of a gunpowder mill in the early 19th century or previously (fig. 6). On that occasion a zone with hypothetical traces of open extraction and flint production may have got lost. What is left is a narrow remnant of an exploitation zone, only a few meters wide and displaying the remains of several mines that strangely enough have never been identified as such since their exposure.

The average altitude of the resulting rock-face is about + 73 N.A.P. (Dutch Ordinance Level). Its height does not surpass 5 m.

In the investigated part of the bluff three units of the Maastricht Formation can be distinguished (fig. 7): Nekum, Emael and Schiepersberg Chalk (cf. Felder 1975b). These relatively soft but solid beds are separated by horizons of shell debris: the Laumont and the Romontbos Horizon. At the site and in its vicinity the rock has cracked into large vertical slabs and smaller blocks.

The maximum dimensions of tabular flint nodules observed in the Emael Chalk at the Plenkertstraat site are about 55x12 cm. As only the upper part of the Schiepersberg Chalk was exposed, no observations on flint in that bed have been done. From literature and observations at other geological exposures it is known that these nodules can reach considerable dimensions.

4.3. THE MINES

Within a strip of 40 m seven mines have been discovered, each some 5 m apart from the other (fig. 8). None is intact nor is any of them fully excavated. As a
Figure 5. Valkenburg-Plenkertstraat. Upper part of a shaft (mine IV) sectioned by chalk quarrying.
Figure 6. Valkenburg-Plenkertstraat. Cross-section of the lower part of the valley slope and the Geul valley bottom.

Figure 7. Valkenburg-Plenkertstraat. Lithological section of the Maastricht Formation with the position of the mines I, II, III, IV, VII.

Figure 8. Valkenburg-Plenkertstraat. Site location and excavation plan.
result the database and the conclusions to be drawn from it are subjected to limitations. The interpretation of the nature of two features is but a (strong) supposition. In the testpit of mine number VII no artefacts have been found because the chalk-rubble deposit at the base, which contrary to the backfill usually contains flint waste, was not layed bare. The same goes for number V, though a few flakes were found in the backfill, about 2 m below the present-day surface. The contour of both shafts is unknown, as is the possible existence of subterranean workings. The reason to interpret them nevertheless as a mine is because it concerns deep pits adjacent to and with characteristics similar to those of the investigated mines. In the same way the distinctive appearance of their fill corresponds with the other ones.

Of four mines in the eastern half of the site only (parts of) galleries are left and occasionally a small part of the shaft’s wall (figs 9, 13). The other three are less damaged: sections of the shafts and about half of the fill are left. Their subterranean workings presumably are untouched. Apart from the measure of chalk quarrying and the position of the mines in the slope, this difference in affection is caused by the respective depth of the two groups, which in turn is determined by geological factors (cf. below). The lower part of deeper pits was well below the level of the recent chalk digging.

Another aspect of differential preservation should be mentioned. In spite of the fact that the features have been exposed to wind and weather for probably more than one and a half century, the walls of three mines are still covered with very well preserved pick marks (fig. 10). The Nekum and especially the Emael Chalk are known for their resistance to atmospheric action (Diederen 1989; Felder 1979). The walls of other mines, sunken into the same beds, however are weathered. Differences in preservation at so short a distance must be imputed to changing lithological properties of the rock, that can occur within a few meters on the same level (Felder 1979, 21).

The diameter of the shafts known shows that the miners did not keep to a more or less standardized dimension such as seems to have been the case in Rijkholt for example (Bosch/Felder 1990; Felder/Rademakers 1973). The flint was extracted by means of wide shafts that, with the mines investigated, vary in diameter between some 3 and at least 6 m (fig. 11). Their depth is conditioned by the location in the slope, the relief of the surface, the level of the flint layers exploited and geological factors. The Maastricht Formation and thus the flint layers embedded in it inclines to the west (Felder 1979, 42) thereby affecting the depth of the shafts in that direction. At less than 100 m to the west of mine VII the flint bearing beds are situated at an inexploitable depth, that is below the present-day water level of the Geul.
Figure 10. Valkenburg-Plenkertstraat. Pick marks in the wall of a shaft (mine IV).

river (ibid.). Between mine III and IV a minor fault seems to be present in the rock. The result of this is a difference in levels of the Romontbos Horizon in the respective mines of 2 m (fig. 7). In all but one mine flint from the lower part of the Emael Chalk was exploited. On several occasions it was observed that a shaft was sunk until the Romontbos Horizon was reached, no further. Only one shaft (VII) cuts through it for several meters (fig. 7). This exception to the rule might be the result of a local absence of nodules in the Emael Chalk (Felder 1980; Felder/Bosch 1971a).

Consequently the raw material had to be extracted from the lower Schiepersberg Chalk. The shafts vary in depth between 4 m in the east to more than 8½ m in the west. Their original depth may have been larger as part of the slope deposits are likely to have eroded.

With the shallow mines the shafts gave access to galleries of modest proportions. As far as could be ascertained their length hardly surpasses 3 m. Large vertical fissures in the rock that presumably represent lines of fracture along which slabs of chalk moved vertically, in part determined the shape and dimensions of the galleries. They provided a natural fall-away surface on the one hand (Mortimore 1979) and formed the joint where the level of a flint layer exploited abruptly could change, on the other. These shallow mines are representatives of an underground exploitation system that is called Duckelbau (Fober/Weisgerber 1980).

The roughly circular shape of the deep shaft IV was interrupted in the East. At that location part of a plateau situated beside the shaft was uncovered at an estimated 1 m above the shafts floor. It may represent a niche that was partly destroyed by the chalk quarrying. Taking into account the gradient of the slope and thus the lesser height of the wall at that side it may also have provided an entrance to the mine and a transportation platform. At the base of the shaft a for the greater part filled artificial cavity was observed in a trial pit (fig. 12). It clearly represented a working. Since there was no compelling reason for further investigation, dimensions on this phenomenon are lacking.

Information on the lay-out of the subterranean area of the mines could only (in part) be retrieved in one case. From the (not preserved) shaft of mine III short workings spread out in three, originally probably four directions (fig. 13). Some of the galleries of abreasting mines did communicate with one another. The underground connection between II and III was marked by a threshold in the floor (figs 8, 13).

The fill in the lower part of shafts and galleries consists of chalk-rubble. It contains fragments of flint nodules, flakes and mining tools. In two mines bits of charcoal were found. The dimensions of the waste chalk diverge from meal to chunks of 5 to 6 decimetres in length. Part of the prehistoric excavation is likely to have been done by block chalk digging. In the gallery of mine III it was observed
that a large chunk was wedged between the floor and the ceiling, presumably to support a part of the latter (fig. 14). The deposit on top of the rubble comprises a series of layers consisting of a mixture of loam, gravel and chalk. The stratigraphy and the laminated structure of some layers indicates that the filling of the shaft at least in part was a gradual natural process. Part of the sediment has entered the galleries and in some instances filled them up. In the shallow mines silt may as well have penetrated the galleries through fissures in the rock.

Information on the processing of extracted flint on the site was presumably lost with the above-mentioned 19th century chalk quarrying. In the vicinity of the mines not a trace of knapping debris on the surface was left. flakes and rejected rough-outs (cf. below) that were found in and on top of the chalk-rubble deposit in a shaft and in galleries show that at least part of the reduction did take place at the procurement site.

4.4. **THE MINERS’ IMPLEMENTS**

A total of 39 (recognizable fragments of) tools has been collected, excluding flakes that display macroscopically visible use-wear traces, sharpening flakes and a hammerstone (fig. 15). All but three were found in or on top of the chalk-rubble deposit. Judging from the adhering chalk residue and the secondary position it was found in, one of these originally has been embedded in the chalk detritus. An exception to the rule is the finding of a positively used Kerbschlögel (cf. below) in a layer of lumps of chalk and loam and gravel situated at about 2 m above the chalk-rubble deposit. It may have been used in an adjacent mine and discarded in the partly filled shaft it was found in or it may simply have slid in from a rubbish heap next to the shaft. None of the tools is an antler object. Except for a quartzite hammerstone the implements are made of Valkenburg flint. As far as could be inferred from cortex remains, it mostly concerns mined raw material. In some instances the flint used was of residual origin or extracted close to the ground level, as is reflected by deviations in colour and texture and to a lesser extent the cortex. The tools are mainly produced on large primary flakes and lumps of “less suitable” raw material, such as flint rich in fossils, chalk-filled cavities or cracks. Besides debris and “second-rate” material good quality flint was used, but scarcely. Judging from the context they were found in, it is to be expected that most of the implements in one way or another have been used in the process of raw material procurement. Not all of them can be classified as mining tools though. Some are likely to have been employed after the actual extraction.

The miners used a diverse tool-kit. Functionally a subdivision can be made in heavy-duty and light-duty instruments: the ones primarily intended to work the solid chalk and others that were possibly meant to carve out nodules or prepare them for flaking. Typologically several categories can be distinguished. The bounds between these are not as clearcut as one might wish, especially when it comes to differentiating “flake-axes” (cf. below) from other instruments. With some tools difficulties arise as to whether metrical, morphological or functional aspects should be determinant in the denomination (Bostyn/Launchon 1992, 174, 209; Hubert 1974, 31). Considerable dimensional differences occur between specimens that morphologically are representatives of the same type of tool (fig. 15). Most implements display almost identical macroscopically visible traces of use and were found in the same archaeological context, which makes it hard to differentiate on these aspects. Morphological criteria have been decisive in categorizing.

**Kerbschlögel**

These are often crudely produced picks of varying shape and cross-section, with characteristic notches on the sides meant to facilitate the hafting of a handle (Weiner 1986, 109). The notches are situated at the middle part of the tool or slightly to the back of it with respect to the funtional
Figure 12. Valkenburg-Plenkertstraat. Cross-section of mine IV.
Figure 13. Valkenburg-Plenkertstraat. Plan of the preserved part of mine III with reconstructed position of the shaft.

Figure 14. Valkenburg-Plenkertstraat. Cross-section of the south-gallery of mine III.
end. They were created by flaking and often additionally blunted by pecking. The same goes for ribs and edges in height of the notches. Large primary flakes and chunks of flint were used as blanks. In side-view the majority of these implements is roughly boat- to sickle-shaped (fig. 16). The location of macroscopically visible use-wear traces enables us to reconstruct the position in which they were hafted. Traces are present not only on the working-end(s) but on the convex side as well, indicating that this was the upper side of the tooi.

Schlagel with one and with two working ends occur, as do heavy and relatively light specimens. A conspicuously big example, weighing 4.15 kilograms, is an exception to the rest of the group, that for the greater part weigh less than one kilogram (fig. 15). This piece may have been intended to become a rough-out for an axe but was discarded at an early stage of the reduction sequence, presumably because of inferior raw material quality (residual flint). It can hardly have been a manageable tooi. Nevertheless it displays slight traces of use. A slightly curved tubular nodule that was sharpened to a point lacks notches but displays use-wear traces similar to those of the other instruments in this category. It too is likely to have been used as a Schlägel.

That Kerbschlägel were used to hew is clearly shown by their splintered edges and powdery chalk still embedded in flake-scars at the ends. Striking piek marks particularly in the walls of shafts bear testimony to their use (fig. 10). The finding of this type of implement in the Plenkertstraat is anew an affirmation that Kerbschlägel are characteristic flint mining tools for the Valkenburg region. Apart from the pieces the Biebosch and the Plenkertstraat mines have produced, specimens have been collected as

<table>
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<th>type of tool</th>
<th>weight</th>
<th>length</th>
<th>width</th>
<th>thickness</th>
<th>blank</th>
<th>working-ends</th>
<th>mine</th>
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<td>146</td>
<td>73</td>
<td>47</td>
<td>?</td>
<td>2</td>
<td>IV</td>
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<td>162</td>
<td>89</td>
<td>48</td>
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<td>156</td>
<td>93</td>
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<td>101</td>
<td>69</td>
<td>65</td>
<td>?</td>
<td>1</td>
<td>IV</td>
</tr>
</tbody>
</table>

| Pick             | 539    | 230    | 67    | 54        | ?      | 1            | II   |
| Flake-axe        | 63     | 119    | 44    | 16        | ?      | 1            | II   |
| 63               | 123    | 45     | 19    | 22        | ?      | 1            | II   |
| 107              | 140    | 54     | 25    | 1         | ?      | 1            | II   |
| 133              | 161    | 52     | 27    | 1         | ?      | 1            | II   |
| 134              | 137    | 49     | 34    | 1         | ?      | 1            | II   |
| 161              | 145    | 58     | 34    | 1         | ?      | 1            | II   |
| 224              | 145    | 68     | 28    | 1         | ?      | 1            | II   |
| 258              | 141    | 61     | 39    | 1         | ?      | 1            | II   |
| 309              | 129    | 68     | 36    | 1         | ?      | 1            | II   |
| 316              | 150    | 68     | 41    | 1         | ?      | 1            | II   |

| Rough-out        | 190    | 138    | 52    | 34        | ?      | 1            | II   |
| Retouched        | 356    | 140    | 96    | 38        | ?      | -            | II   |
| 354              | 135    | 88     | 33    | -         | -      | -            | II   |
surface finds at other (disturbed) procurement sites (fig. 1) in the surroundings (coll. H. Pisters). Some of these artefacts were found at the Schaelsberg (Marichal 1983; Pisters 1986). Others were picked up just outside the edge of the Biebosch, in the south slope of the Geul river valley. They form part of an assemblage gathered in a patch of chalk-rubble in a ploughed field, that indicates the presence of a small isolated extraction unit in the subsoil. Another findspot of Kerbschlägel is the Wiegersdel, which is the place-name for a part of the west slope of the Sibbergrubbe.

Pick

One specimen only that resembles the familiar type of pick as it is known from dozens of European exploitation sites has been found (fig. 17). It should be noted that this piece can have been hafted in the same way as the implements in the previous category. Picks have also sporadically been found at the Schaelsberg (pers. com. H. Pisters).

Rough-outs for axes

Three artefacts have been collected that may be called rough-outs or fragments of these, not including the large piece mentioned above. None of these could have been finished to a satisfying axe because of a flaw in the raw material or technological problems the knapper encountered. Two (almost) complete specimens, one of which is rather small (fig. 18), clearly have been used to hew chalk (cf. Bostyn/Launcho 1992, 174). A secondary use of unfit pieces seems likely. The fragment may have entered the mine as a reject, without having been put into use (cf. Felder/Rademakers 1973).

Flake-axe-like instruments

The category of “flake-axes” comprises a morphologically rather heterogeneous group of tools. They share the presence of one or two steeply retouched sides and/or a working-end with uniform traces of use.

As has been noticed for specimens from other European mine sites (Fober/Weisgerber 1980, 47; Hamal-Nandrin/Servais 1923, 388), the Valkenburg “flake-axes” deviate from the standard Mesolithic tool type in several aspects. They are rather oblong, with parallel to converging or slightly convex sides. Some of the parallel-sided examples in fact are robust blades (fig. 19). Of those that display converging sides the broader end is a striking platform and thus unfit for use (fig. 20), or it is unused (fig. 21). The narrow end usually is the functional part of the tool (cf. Weiner/Weisgerber 1980, 117). A few have been used on both ends (fig. 22). Apart from the lateral retouch some
have been flaked on the ventral and dorsal side as well. With most tools there is insufficient evidence for thinning and shaping of the proximal part in order to make it fit a socket or another hafting-device. The presence of broken pieces displaying an end shock fracture and others with a lateral straight edge however rules out the possibility that they were held by hand. Since no organic remains were found and indicative aspects like notches (cf. Weiner/Weisgerber 1980, 116) are lacking it is yet unclear in what way they were hafted.
Figure 19. Valkenburg-Plenkertstraat. Retouched robust blade displaying use-wear traces at the distal part (mine I). Scale 1:2.

Figure 20. Valkenburg-Plenkertstraat. Flake-axe-like implement (mine II). Scale 1:2.

Though authors agree on the fact that “flake-axes” have been used at mine sites (Fober/Weisgerber 1980; Olausson et al. 1980, 195; Rudebeck 1987, 153) the function of the pieces concerned is not quite clear. It has been suggested that they have served to remove adhering limestone from extracted nodules (Fober/Weisgerber 1980, 47; Weiner/Weisgerber 1980, 117). This being an activity that preceeds the primary reduction, the assumption is supported by the fact that this type of implement is mainly found at locations were rough-outs and blanks were produced.

Most “flake-axes” from the Plenkertstraat have been used to hew chalk. They show splinterings on and rounding of the edge or point and the distal part of their sides. Powdery chalk is embedded in flake-scars at the working end. Some broken pieces display an end shock fracture. As the implements have been found in the chalk-rubble deposit of the galleries, they supposedly were used in the mines.

In view of the fact that in most subterranean workings the space is rather cramped, the cleaning of the cortex would have to be done at the base of the shaft. Considering the relative softness of the chalk, the removal of the remaining sediment could easily be undertaken with any simple flake or scraper. Since the latter artefact type and flakes displaying edge-damage were found in the deposit as well (cf. below), this may suggest that nodules largely were prepared for flaking underground.

Some comments should be be made on the supposed cortex cleaning by means of “flake-axes”. From the debris it is clear that part of the chalk came off still adhered to large flakes, that is it was not removed before the reduction proces started. From the average weight and maximum thickness of the two categories of tools (fig. 15) it can be inferred that “flake-axes” were intended to fulfill a less “heavy” task than Kerbschlägel. Yet there is no obvious reason why the chalk removal could not have been done with the same Schlägel by means of which the nodule was won or simply with a flake (cf. Weiner 1986, 111). The lithological properties of the Maastrichtian chalk are such that a special purpose tool for the activity mentioned is not required. Moreover flake-axes do appear at sites where cleaning seems superfluous because the nodules are embedded in sandy, residual deposits, like in the Belgian Voer region (Hamal-Nandrin/Servais 1921, 1922; Straet/Buntgens 1980). The “flake-axe” seems to have been a multi-functional tool employed in various ways in different situations and at different types of sites.

Weiner (1986, 111) suggests that some heavy flakes from the Lousberg could have been used during the actual mining-process. Elaborating this option for the Valkenburg mines, a “flake-axe” may have been a specific type of light-duty tool that was used for a more “delicate” task like carving out flint nodules (cf. Schmid 1980, 164; Weiner 1984). As part of the nodules observed in the Plenkertstraat mines are situated half-way or in the upper part of the gallery walls (especially mine I), they presumably were extracted by removing the chalk underneath and dislodging them then (cf. Bosch 1975; Bosch/Felder 1990, 260; Felder/Rademakers 1973). With a narrow, low-pitched front at the end of a gallery the comparatively light “flake-axes” may have been the instruments to do the job. The rounding of the distal part of the sides may indicate that the implement has been used in such a way that the working-end was orientated at a right angle to the floor. In that position its side(s) will have been in contact with the chalk and be worn
in hewing. Curvilinear marks that have been observed in especially the extremities of gallery floors seem to correspond with the assumption. As the narrow end is the functional part of most pieces, an alternative application might be the carving of narrow grooves that would have facilitated the cleaving of blocks of chalk (Weiner/Weisgerber 1980, 118). Several options will have to be tested experimentally.

Retouched flakes
A number of flakes shows intentional retouch, in a continuous or denticulate, unifacial or bifacial way. Judging from use-wear traces they have been used to work an abrasive material like chalk. A removal of sediment adhering to the cortex seems likely (fig. 23). Two specimen are massive scrapers, similar to those from e.g. Rijckholt-St. Geertruid and several Polish procurement sites (Hamal-Nandrin/Servais 1923, 362, 395; Lech 1981, 44; Schild et al. 1985, 199).

Some unretouched flakes show use-wear traces like edge-removals and edge-rounding. Their function may correspond with the intentionally retouched pieces.

A last group of artefacts showing intentional and unintentional removals are for the greater part small pieces that are characterized by powdery chalk embedded in flake-scars and edge rounding, indicating that they once formed part of a working edge or end. This is corroborated by the refitting of such a chip to a tool (fig. 23). Some may have come off as a result of an impact-fracture, when the implement hit a flint nodule during mining. Others display
Figure 23. Valkenburg-Plenkertstraat. Flake-axe-like implement displaying parallel scratches in the cortex, presumably due to chalk removal (mine I). Note the refitted chip at the working end. Scale 1:2.

characteristics that match those of Middle Paleolithic long and transverse sharpening flakes (Cornford 1986). They will have been produced in the curation of implements.

The only hammerstone found may have served several purposes: to detach sharpening flakes, to remove protuberances from nodules or to do some primary flaking at the base of or next to the shaft. It is a nearly 6 cm thick and roughly triangular quartzite pebble of 1.14 kilograms.

In general the lithic tool-kit used at Valkenburg-Plenkertstraat shows some remarkable resemblances to that of the Lousberg (cf. Pisters 1986). Kerbschlägel occur at both locations. In contrast to the Plenkertstraat site, at the Lousberg not only flint was used to produce them but boulders as well. The partial differences in raw materials used at the two sites are likely to be caused by different lithological properties of the sediments to be worked: soft homogeneous chalk at Valkenburg versus heterogeneous, partly hard limestone at the Lousberg (Aldenhovener Platte 1979b, 375; Weiner 1986). In Limburg a cutting end was needed to work the matrix-sediment, at the German site primarily a pounding end.14 Flint Schlägel are thought to have been used at the Lousberg on softer sections of the limestone (Weiner 1984). The two sites share the occurrence of “flake-axes” as well (Weiner 1986; Weiner/Weisgerber 1980), be it that they occur in different numbers. The major disparity lies with the antler tools, which are prominent at the Lousberg (Weiner/Weisgerber 1980, 114) and at some sites in the Valkenburg region (Brounen et al. 1993) but have neither been found in the Plenkertstraat nor in the Biebosch. This too may be imputed to a different geological setting and to differences in the way of exploitation (Fober/Weisgerber 1980, 45).

Limiting a survey for a comparable lithic tool-kit to other Limburg procurement and production sites and those from the neighbouring Belgian area, it appears that researchers occasionally have come across Kerbschlägel. This type of implement is for example known from a few relatively shallow mines with short galleries at the fringe of the Rijckholt Grand Atelier; pers. comm. W.M. Felder; (cf. Bosch/Felder 1990; Felder et al. 1979: 62). “Flake-axes” are reported from another part of the Rijckholt exploitation site, that is from a mine and from workshops at the Schoone Grub (Hamal-Nandrtn/Servais 1923, 362, 382). In the Belgian Voer region, in which flint of the Rullen type was exploited, Kerbschlägel have been found at the production sites of Vrouwenbos and Rullen (De Warrimont/Groenendijk 1993, 38). Their occurrence surprises in much the same way as the “flake-axes” from these locations do (cf. above), since Rullen flint is supposed not to have been extracted from solid chalk beds, but from residual deposits (Albers/Felder 1980). Two alleged Kerbschlägel are reported from workshops in southeast Limburg in which Simpelveld flint was processed (Arora/Franzen 1987, 27; Franzen 1986, 65). None of the sites mentioned, including the Lousberg, is situated at more than 20 kilometers distance from the Plenkertstraat.

Outside the south Limburg and bordering Belgian/German area procurement sites in Europe where Kerbschlägel have been found are rare. To our knowledge this type of implement is only reported from Saint-Mihiel and Champignolles in France (Guillaume 1975, 22; 1980) and
from Peppard in England (Aldenhovener Platte 1980, 281 referring to Peake 1914, 408).

4.5. Charcoal

In the limestone-rubble deposit at the base of gallery II and shaft IV scattered pieces of charcoal have been found. Occasionally burnt bits of chalk were observed in gallery II. Both categories of finds have been embedded in the deposit during the transport of detritus, so while the exploitation was still going on.\(^{15}\) It is unlikely that under those conditions the remains of a hearth in the vicinity of the mine should have entered it as a deliberate backfill. The amount of charcoal in the gallery was too large to originate from an accidental fall into the shaft (cf. Bosch/Felder 1990, 252). This implicates that for whatever reason a fire may have been made at the base of the shaft and the ashes cleared away afterwards (cf. Schild et al. 1977, 36, 129). With the broad shafts and short galleries observed a need for additional light in the subterranean workings can hardly be the reason sought.

4.6. Chronology

The excavation has not revealed any typologically datable flint artefacts or pottery sherds. Two moments within the total time span of extraction were assessed by radio-carbon dating of charcoal samples from the mines II and IV. The resulting dates match up rather well, as is to be expected with extraction units that are situated at short range of one another (cf. De Grooth 1991, 159). The dates are 4670 ± 60 B.P. (GrN-19831) and 4610 ± 80 B.P. (GrN-19830), that is 3620-3090 cal B.C. and 3630-3340 cal B.C.\(^{16}\) Compared to the dates of the Biebosch mine and those of other extraction zones in the Valkenburg region (Brounen et al. 1993; Felder 1981) the flint exploitation in the Plenkertstraat seems to have taken place at an earlier stage (fig. 24). The Plenkertstraat dates equal the end of the Middle Neolithic A and the Middle Neolithic B. In cultural terms this means that not only the Stein Group may have been responsible for the exploitation but that the flint could as well have been extracted by the (late) Michelsberg Culture (MK). Though on account of other C14-dates on Valkenburg flint procurement sites an exploitation by Stein Group miners seems preferable, the data on settlement assemblages prevent us from rejecting the alternative option. In the Valkenburg region at least one site (Heunsberg) with a characteristic MK flint inventory is situated in the vicinity of an exploitation zone. Valkenburg flint is present in the assemblage, but not prominent. To clarify the chronological picture additional dates from other Valkenburg flint procurement sites and more data on especially Stein/ \textit{Jungneolithikum 2} settlement sites are needed. It is tempting to presume for example that the raw material for MK Valkenburg flint artefacts exclusively was won quite close to the well-known procurement site at Rijckholt-St. Geertruid, that is in the Savelsbosch (Felder 1980, 560).

5. Final remarks

From the excavations at Biebosch and Plenkertstraat and from observations of sectioned extraction units at other sites in the area in between, it has become clear that flint mining was a regular way of raw material extraction in the Valkenburg region, along with open diggings. All sites concerned are situated in the south slope of the Geul Valley, the Plenkertstraat being a geographical extension of a series of sites mentioned by Felder (1975a). They once may have formed part of a continuous exploitation zone of about 2½ kilometer in length, starting at the Biebosch and for reasons of inaccessibility of the flint layers coming to an end at the Plenkertstraat. Unfortunately the greater part of the valley slope is severely damaged by chalk digging and occupied by buildings, so it is difficult to prove this supposition. Strayfnds of flakes in the few plots spared seem to support the assumption however. Assuming that the option is valid, this would mean that, averaging a mine every 5 m, a considerable amount of raw material was won. Taking into account that this is only one of the procurement sites known, it is surprising to find that, apart from German literature on research in the Aldenhovener Platte region and Dutch publications on Linearbandkeramik flint (Groenendijk 1980, 1980/1981; De Grooth 1986, 1987), Valkenburg flint artefacts are rarely mentioned. Several factors may be responsible for this “lack”. Compared to Rijckholt the Valkenburg raw material and the procurement sites have only recently been discovered and described by (semi-) professional archaeologists (cf. Brounen et al. 1993). The appearance of the flint type consequently has been unknown to researchers for a long time and maybe still is to quite a lot of them. As for the texture and colour it can be mistaken for a variety of Rijckholt (Lanaye) flint. Most of the finds of Valkenburg flint artefacts at somewhat more remote German sites are mentioned by authors that participated in the excavation of or have worked out sites in the Aldenhovener Platte region, where they presumably have become acquainted with the raw material. It is to be expected that within the vague category of \textit{Maasfeuerstein} or \textit{westlicher Feuerstein} a number of Valkenburg flints may be “hidden”. Supposing that the peak in the exploitation indeed occurred in the period that the area was inhabited by people of the Stein Group, it is a fact that we know but few well documented sites (Louwe Kooijmans/Verhart 1990), in fact even little about their material culture in general (Louwe Kooijmans 1983). Alternatively there is the possibility that the Valkenburg industry has been nothing but an “insignificant” regional industry after all (Marichal 1983, 20).
Two considerations, admittedly speculative for the time being, may suggest that this is not the case. Assuming that the practice of underground raw material extraction goes for other Valkenburg flint procurement sites known as well, this would almost double the area where flint could have been won (pers. com. W.M. Felder). Adding up the individual sites, the total procurement area would be about equivalent to that of the Rijckholt shaft mining area (ibid.). Furthermore the supposition seems to be contradicted by identified finds of Valkenburg flint axes as far as Drente (Beuker 1988, pers. comm.), Overijssel (observation by one of the authors), Westphalia (Arends 1990; Bakdash 1990, 1991, 114; Eckert 1987; Gaffrey 1990; Marichal 1983, 8; Rüschhoff-Thale 1992, 234), Luxemburg (Binsfeld et al. 1987, 373; Marichal 1983, 8) and the neighbouring part of the Rhineland (Marichal 1983). In this respect it would be interesting to verify whether “southern” axes from Gelderland that are described as having been produced from “quartzitic flint” (Hulst 1970, 27; Schut 1987, 7, 11) in fact are made of the Valkenburg raw material. Lousberg flint axes, being easier to identify, have been found north of the Rhine (Beuker 1986; Louwe Kooijmans 1985; Hulst 1988, 185; Scholte Lubberink 1991; Schut 1987, 1991; Van der Walle-van der Woude 1983). In view of the (partly) contemporaneous exploitation and associated finds of the two flint types, as well as the short distance between the respective procurement sites, Valkenburg axes may have been distributed along the same lines of exchange as their Lousberg counterparts. Both raw materials predominantly were used for the production of axe blades. Though the distribution map of Valkenburg flint products for reasons above-mentioned seems to be far from complete, the products of the two procurement areas partly are recovered in the same regions, even at a distance of about 200 km from the source area that is in south-east Drente.

On the subject of distribution of Lousberg flint some preliminary comments should be made in order to fill in an apparent Forschungslücke. It has been suggested that finds of Lousberg flint artefacts are lacking in southern Limburg because of the “competition” of local raw material supplies (Modderman 1980a). The “blind spot” on the distribution map apparently was caused by a lack of data at that time for the area concerned. Nowadays a fair number of Lousberg axes is known in the Limburg chalk (and flint) region, be it that specimens are rarely mentioned in literature (e.g. Pisters 1986; Stoepker 1991, 275). Quite a lot of them were found in the surroundings of Valkenburg. Apart from sites referred to by Pisters (1986) an older find is mentioned by Modderman (1980b, 119; Geulhem) and others have been collected by one of the authors in the course of a survey. In private collections additional pieces from the same area are present, but cannot at the moment be pin-pointed to a precise location. Several of the sites have produced more than one artefact of Lousberg flint. Not
all of them are axes. Occasionally small flakes are found amidst of debris of other flint types. As mentioned above Lousberg axes remarkably often were found in Valkenburg flint workshops. This might be the result of the specific attention these waste concentrations are given in search of rough-outs and so be the product of a recovery bias. Yet we do not know any Lousberg axe from the area concerned that has been found in an off-site situation, whereas strayfinds of other axes do occur. Assuming that the association of the Lousberg pieces with the artefact scatters is valid, a possible explanation may be the retooling and reworking of damaged axe blades, embedded in the production of Valkenburg flint rough-outs. Of course this presupposes the presence of spare blades in the working-kit, since a rough-out needs to be polished before hafting; the finishing off — being a laborious job — is usually presumed to have taken place at the settlement (Vermoesch 1987-1988, 7) or, judging from ethnographic information, at polishing “factories” (Vial 1940, 160).

The Valkenburg region is not unique in its presence of axes “exotic” to the raw material procurement area. On the plateau (“Kaap/de Hej”) bordering on the exploitation site at Rijckholt-St. Geertruid (cf. De Grooth 1991, 157) a great number of axes and fragments of these are found that are made of a raw material other than the Rijckholt flint type (ibid. 1990, 176; pers. com. W. Roebroeks). Unlike the Valkenburg area Lousberg specimen are rare among these.

It has been argued that the Lousberg and Valkenburg flint procurement sites have been in operation at the same time. De Grooth (1991) suggests that at Rijckholt-St. Geertruid flint was still being extracted at that time (cf. Schwitalla 1984, 58). Leaving out of consideration the possibility that part of the artefacts may have originated from the “scavenging” of older flint debris accumulations (cf. Borkowski et al. 1989, 201; Pisters 1983, 6; Pisters/Schrooders 1987) or simply are “pick-ups”, this would mean that three mine sites were simultaneously being exploited within half a day’s march distance. The presence of a limited number of Lousberg and Valkenburg flint artefacts at the Simpelveld flint workshops (Franzen 1986, 64) may even indicate that a fourth quarry, of which the location and the extent is yet unknown, can be added to this series. With that arises the question as to whether the respective exploitation was done by a single or by a number of separate communities, in other words: does the appearance of flint types “exotic” to the micro-region reflect open access or restricted access followed by exchange (within-group or between-group transport; De Grooth 1991, 167). The resemblance of the tool-kits from the Lousberg and Valkenburg, both being somewhat at variance with the standard equipment of most other procurement sites, has hypothetically been interpreted as an indication for a “close relationship” between the miners concerned (Pisters 1986). As recently emphasized by De Grooth (1991), to enable one to decide on the matter of control over resources however, a complex of data on different types of sites within the lithic production system is required. At present for none of the raw material types concerned these conditions are fulfilled.

Acknowledgements

The Plenkertstraat site would perhaps still not have been recognized as a prehistoric monument without the inspiring enthousiasm of our fellow-discoverers Karen van der Graaf and Hub Pisters to whom we are greatly indebted. Special thanks are owed to Prof. Dr. L.P. Louwe Kooijmans for bearing with us in times when progress was only vaguely discernable. We are much obliged to the Stichting Valkenburg Omhoog, for allowing us to excavate on their property. We thank the municipality of Valkenburg aan de Geul, the foundation In onsen Lande van Valckenborgh and the Historische Kring Valkenburg en Heuvelland for financially supporting the excavations. A great number of colleagues, students and amateur archaeologists kindly made available yet unpublished data from which this publication benefitted. Students and amateur archaeologists spent — admittedly pleasant — weeks in the field and contributed in making the excavation successful. J.-A. Schenk spent part of his leisure doing those puzzling things that transform computer data into comprehensible plots. A.E. de Hingh changed seemingly identical charcoal particles into different species of trees. The drawings and computer plots were made by H.A. de Lorm and P. Heavens, photographs by J. Pauptit. Their craftsmanship should be obvious for every reader.

Anthracological aspects of Valkenburg-Plenkertstraat
by A.E. de Hingh

About 25 fragments of charcoal from the mines II and IV at Valkenburg-Plenkertstraat were available for determination. The analysis of the material produced the following results:

<table>
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<th>Charcoal Species</th>
<th>Mine II</th>
<th>Mine IV</th>
</tr>
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<tbody>
<tr>
<td>Fraxinus excelsior</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Corylus avellana</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Buxus sempervirens</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Alnus glutinosa</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>

The charcoal particles obviously are remains of burned wood, but this does not necessarily imply that the wood concerned was intended as fuel primarily. Part of the charcoal may originate from discarded (components of) implements or from the production of those.
Though hard to demonstrate, the assumption may fit the case with *Buxus sempervirens*. The boxtree is likely to have been comparatively rare at the time. *Buxus* supposedly could only be acquired at specific locations and in limited amounts. Nowadays this species is quite rare in the Moselle valley and in the Belgian Meuse valley, where a relatively warm microclimate in the deeply incised valleys with steep chalk cliffs creates an ideal environment for this shrub. During the Atlanticum and the Subboreal the average temperatures were higher and the extreme northern limit of the species of *Buxus* is supposed to have been situated more northerly.

The wood of boxtree is not likely to have been collected as fuel, as other species that are more attractive as firewood, were more available. Moreover, in comparison to other woods available during the Neolithic in south Limburg it is characterized by certain properties that should have made it a valued organic raw material. It is rather heavy, hard and flexible. For these reasons it may have been used in the process of quarrying, as a digging stick, lever, bar or a wedge (cf. Crabtree 1972, 25). Alternatively it should be noted that contemporary European flintknappers used it to produce a billet, that is a club-like rod to detach flakes by direct and indirect percussion (Beuker 1983, 36; Tixier 1982, 15; Tixier et al. 1980, 98).

Another interesting species with respect to the archaeological context in which it was found is *Corylus avellana*. Split twigs of hazel are supposed to have been used as a wrap-around handle for *Kerbschlägel* (Weiner 1984). *Fraxinus* (Ash) and occasionally *Alnus* (Alder) are known to have been used as handles for lithic tools as well (cf. Baudais 1987, 199).

### notes

1 Since the survey by Felder et al. in 1970, additional exploitation zones have been discovered at Visé-St. Pietersberg (Marichal 1983, 6) and near Groot-Welsden (municipality Margraten; pers. com. J.H.G. Franzen/W.M.Felder).

2 The Gronsveld Chalk contains many — rather sprawling — flint nodules as well (Caspar 1984, 112; Felder et al. 1979, 6). To date there is no evidence for a prehistoric exploitation of these.

3 The amassment of flint nodules found in residual deposits is considered to lie in a secondary position. Sometimes flint from gravel deposits, however, is incorrectly defined with the same term (e.g. Bakels 1978, 101; Newell 1970, 145). Admittedly the differences between the two categories of raw material are not always clearcut when found in an archaeological context, as is demonstrated by intermediary categories as *Rijckholt-Schotter* and *Schotter-Rijckholt* in German literature. Yet in using the term for both residual and fluviatile transported flint the economic implications that are behind it are lost sight of. Residual flint can be won in considerable quantities by means of extraction pits and with a rather predictable degree of result, whereas alluvial flint in general must be gathered from bare lying gravel beds (cp. Vermeersch *et al.* 1984, 1991). Moreover, as for its procurement residual flint usually can be pin-pointed to a location or a region, whereas rolled flint cannot. For these reasons in regard to flint from gravel deposits the term tertiary position should be used.

4 A Middle Palaeolithic exploitation of flint in a primary geological position is also suggested for the Rijckholt area (Roebroeks 1980, 21, 32).

5 Since the 1987 publication by Arts & Deeben several dozens of artefacts more have been collected. Though Magdalenian guide artefacts still are lacking, the assemblage displays technological characteristics that reinforce the interpretation given by the authors fore-mentioned.

6 Wommersom quartzite has been mentioned to be present in other Late Palaeolithic assemblages (e.g. Machiels 1993, 61, 63; Vermeersch 1984, 185). In general however it is assumed to have been used only since the Mesolithic.

7 J.P. de Warrimont (1994) mentions additional finds of adzes from Banholt-De Hei and from Rijckholt.

8 We are grateful to J. Schreurs for offering us the opportunity to study part of the lithic inventory of the site for raw material types. It was kindly made available for study at the Leiden Institute of Prehistory by Prof. Dr. J. Lüning and Dr. B. Höhn.

9 We are greatly indebted to Prof. Dr. J. Lüning and Dr. G. Schwitalla for allowing us to use data from the unpublished graduate thesis (Schwitalla 1984; Köln).

10 Calibration was done by means of Cal10 of the Groningen Centrum voor Isotopen Onderzoek, based on Pearson *et al.* 1986, using a double s.d.

11 The measure of inclination can best be illustrated by comparing the Biebosch mines with their Plenkertstraat counterparts. The sites are situated at about 1600 m from one another. At both locations a flint layer in the Emael chalk was exploited. The difference in altitude between the sites is more than 50 m.


13 At the Biebosch mine, where a layer of flint was exploited at floor level, no “flake-axes” have been found.

14 Recently a quartzite boulder with two picked grooves, a so-called *Rillenschlägel*, was found at the Schaelsberg procurement site (Pisters, in press). It may have been used to shatter a hardground in the chalk (cf. Felder 1975b).

15 The occurrence of large primary flakes in the chalk-rubble deposit of galleries can be explained in the same way.

16 Cf. note 10.

17 As far as “factories” are concerned: a comparable situation occurs with for example the location of the grindstone at Sluaken (Modderman 1980c).
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