STUDIA PRAEHISTORICA BELGICA 3 - 1983 : 103-133

EARLY MIDDLE-PALAEOLITHIC FINDS FROM ICE-PUSHED DEPOSITS NEAR RHENEN (THE NETHERLANDS)

DICK STAPERT

1. INTRODUCTION

In recent years Palaeolithic finds have been reported from several sandpits in ice-pushed ridges of the Central Netherlands, by Mr. A.M. Wouters and Dr. C.J.H. Franssen. Especially 2 pits near Rhenen (Vogelenzang and Leccius de Ridder) were mentioned in the first instance, while later many finds were also reported from the large Kwintelooyen pit (between Rhenen and Venenaal : 1 in fig. 1). (Large parts of these collections are however hardly available for research).

On account of these reports, an intensive geological and archaeological investigation was begun in the Kwintelooyen pit in 1978. The two other pits (near Rhenen) no longer lend themselves for such investigation, as the exploitation there has practically stopped.

We are concerned here with important sites containing in any case extensive early Middle-Palaeolithic material. It is not impossible that Lower-Palaeolithic material is also present, but so far the author has not been able to establish this with certainty. Here below an attempt is made to summarize provisionally the most important results of the investigation of the Kwintelooyen pit (municipality of Rhenen). On October 16 and 17, 1980 the INQUA Commission for the Netherlands organized a meeting in Rhenen devoted to the geology and archaeology of Lower- and Middle-Pleistocene deposits in the ice-pushed ridge of Rhenen-Veenendaal (which is part of the *Utrechtse Heuvelrug*). The papers for this conference have been published in 1981 by the Geological Survey of the Netherlands (*Mededelingen R.G.D.*, vol. 35, edited by G.H.J. Ruegg & J.G. Zandstra : papers by G.H.K. Ruegg - stratigraphy, lithology, sedimentology; J.G. Zandstra - petrology, lithostratigraphy; J. de Jong - pollen-analysis; D. Stapert - archaeology; T. van Kolfschoten - fauna and F.M. van der Wateren - glacial tectonics).

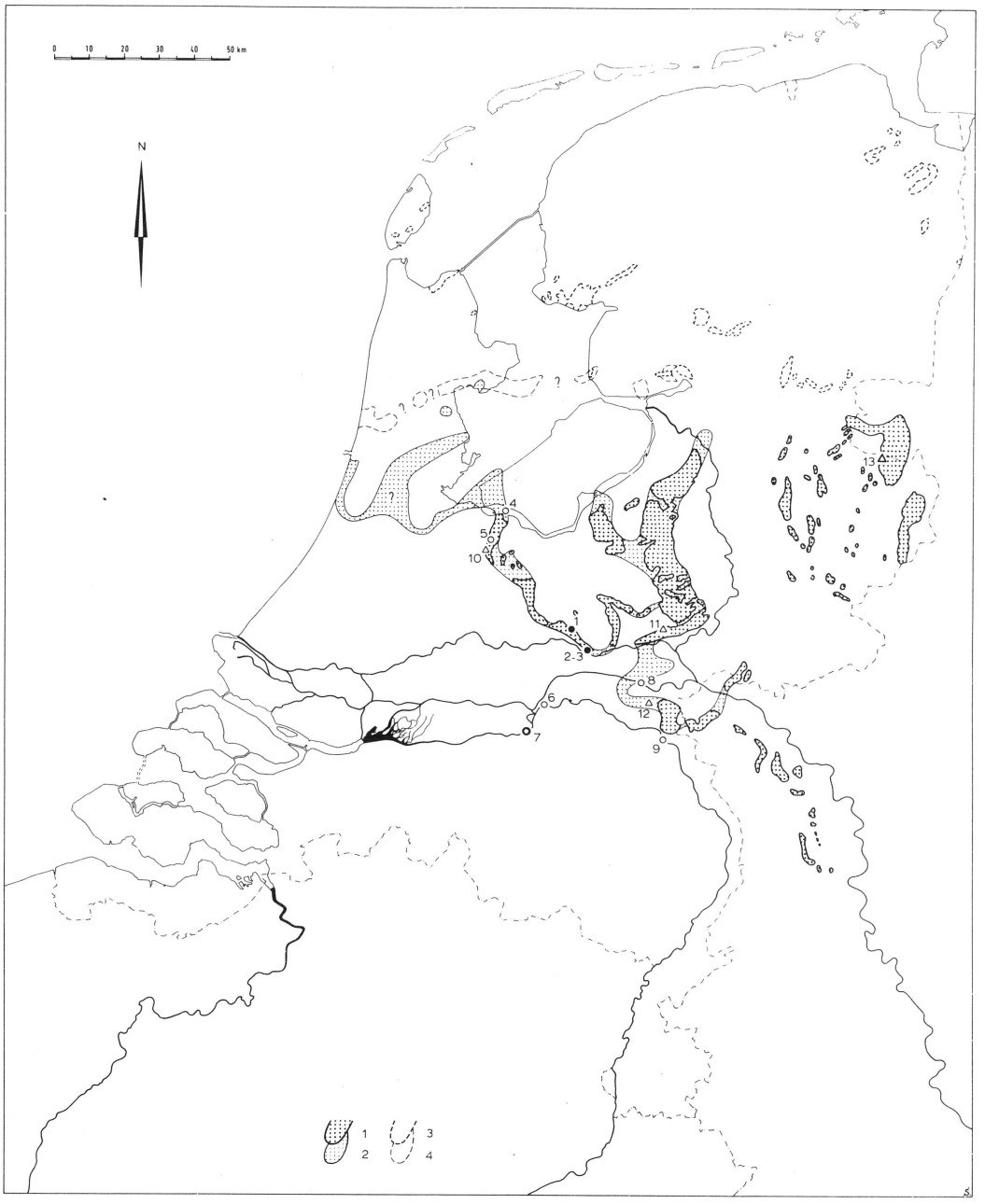

Fig. 1. Map of the Netherlands, showing the location of ice-pushed ridges (after Jelgersma and Breeuwer, 1975), and several Middle Paleolithic sites. Key : 1, 2 ice pushed ridges (2 covered by younger deposits), 3, 4 ice-pushed moraine hills (4 covered by younger deposits). Sites : 1 the Kwintelooyen quarry; 2, 3 the quarries of Vogelenzang and Leccius de Ridder near Rhenen; 4, 5, 6, 8, 9 sites of isolated finds that are comparable with those from Rhenen, some of which were obtained by suction-dredging; 7 site of several Middle-Paleolithic artefacts (obtained by suction-dredging), probably dating from the Weichselian; 10, 11, 12, 13 sites of Middle-Paleolithic artefacts dating from after the cover by the ice-sheet. Drawing by Mr. J.M. Smit, B.A.I.

2. GENERAL GEOLOGICAL ASPECTS

In the Central Netherlands a series of ice-pushed ridges is present (fig. 1), that were pushed up by the ice-sheet during the Saalian (see for a recent correction of the course of the ice-pushed ridge near Nijmegen : Verbraeck, 1975). They are maximally about 100 m high. These ridges surround five glacial basins that extend in some cases to a depth of more than 125 m under sea-level (Jelgerma & Breeuwer, 1975). Locally at the bottom of these basins there are still remains of ground moraine present, while they are in addition filled up with lacustroglacial clay layers, that are several tens of metres thick, and that for some part have a varve structure. Above these there are thick marine deposits dating from the Eemian. In the southern part of the *Gelderse Vallei* (the glacial basin to the east of the Rhenen-Veenendaal ridge) Saalian till is found between 30 and 15 m below sea level (Ruegg, 1981).

The ice-pushed ridges themselves consist of material that was pushed away laterally and frontally out of the basins. In the western part of the Central Netherlands it is mainly Lower and Middle Pleistocene fluviatile deposits that are concerned, of the Rhine and/or the Meuse (see Doppert *et al.*, 1975, for an overview of Quaternary deposits in the Netherlands). The occurrence of extensive thrust planes (such that the material is stacked in thrust sheets with an imbricate structure) indicates that the sediment was probably pushed up by the ice in a frozen state. There were several phases of ice-pushing (Maarleveld 1953; Jelgerma & Breeuwer, 1975; Maarleveld, 1981; Van der Wateren, 1981), while further north several stationary phases of the limit of the ice can still be discerned, that have locally given rise to ice-pushed moraine hills (Ter Wee 1962, 1966, 1981). Dutch geologists place the entire period of ice-cover in the Netherlands, with all the pushing and stationary phases, in the third (final) stadial of the Saalian. It appears from e.g. French data also, besides, that the third stadial of the Saalian (Riss) was distinctly colder than the first two (Bordes & Prat, 1965; Bordes, Laville & Paquereau, 1966; Laville, 1973). During the first two stadials of the Saalian the ice-sheet did not reach as far as the Netherlands. In this period in the Northern as well as the Southern Netherlands thick layers of mainly fine sands were deposited in a periglacial environment (Eindhoven Formation; see Ruegg, 1975; Ter Wee, 1979). Incorporated within these (eolian or fluvio-periglacial) deposits there are several (thinner) clay and gyttja layers, that were formed during interstadials. On the basis of pollen-analysis of these layers in the Northern Netherlands Zagwijn (1973) was able to discern two distinct interstadials, the Hoogeveen interstadial and the Bantega interstadial respectively. These must be interstadials within the Saalian, because stratigraphically lower layers dating from the Late Holsteinian have been distinguished. Although the upper interstadial (Bantega) is comparable with e.g. the early-Weichselian interstadials (Amersfoort, Brørup), the (older) Hoogeveen interstadial is more important, and could be described as a brief interglacial. The intermediate stadial (II) is relatively brief and of little importance, but the stadials I and III

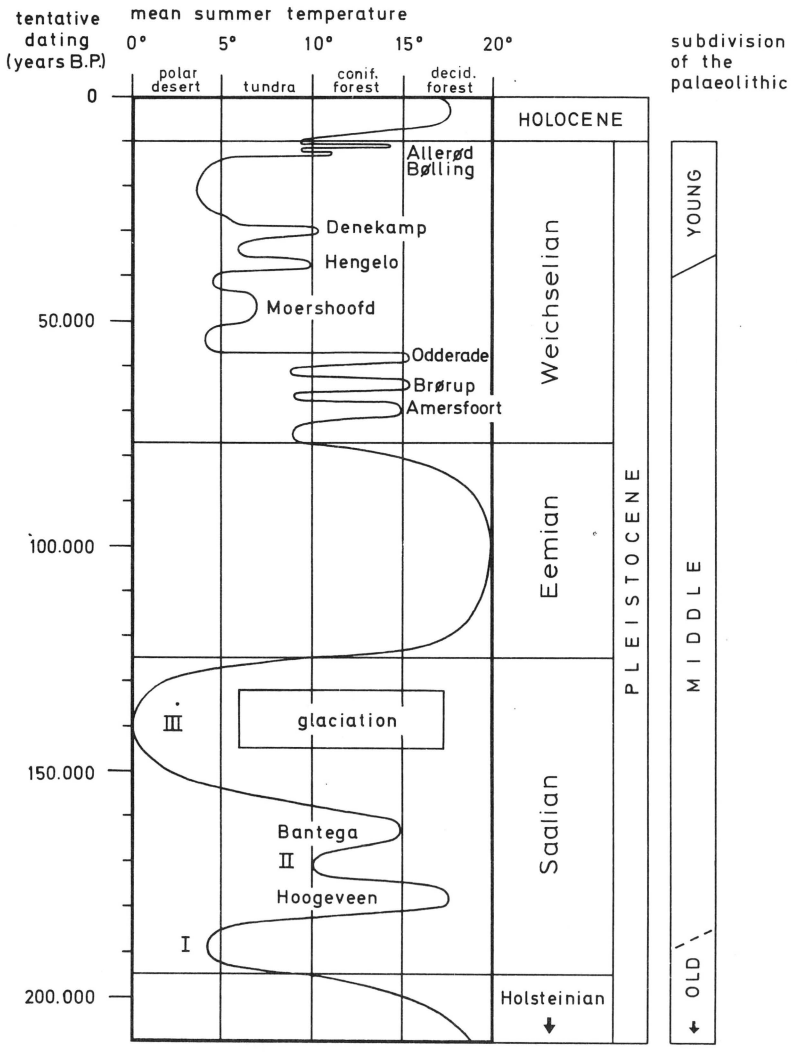

Fig. 2. Climatic curve for the last part of the Pleistocene in the Netherlands (after Zagwijn, 1975). Drawing by Mr. J.M. Smit, B.A.I.

are characterized by such phenomena as cryoturbation and frost-wedges. Finally, pollen-analysis of deposits in the glacial basin near Amsterdam has shown that between the time when the ice-sheet withdrew and the beginning of the Eemian there were no significant climatic fluctuations, so in this way too it is clear that the covering by the ice-sheet took place in the Netherlands at the end of the Saalian (Jelgersma & Breeuwer 1975). The climatic development during the Saalian as determined in the Netherlands is shown concisely in figure 2 (after Zagwijn 1975).

3. STRATIGRAPHY IN THE KWINTELOOYEN PIT

The quarry is situated on the north-eastern slope of an ice-pushed ridge running more or less NW-SE, that in the immediate vicinity reaches a height of ca. 60 m above sea-level. In the quarry a number of thrust masses are visible, that are the result of glacial pushing. Locally the thrust sheets have E-W strikes, and dip usually 30-40° northwards. Within the different thrust masses can be seen in principle the same succession of lithological units.

Intensive research has been carried out in the Kwintelooyen quarry by a team from the *Rijks Geologische Dienst* (State Geological Survey), so we now have a clear insight into the local stratigraphy (De Jong, 1981; Ruegg, 1981; Zandstra, 1981). Their results are summarized here by means of a table (fig. 3), that illustrates the succession in the best-known thrust mass (B).

Ruegg distinguished a total of 10 lithological units, that are briefly described here from bottom to top :

unit 1. Green to grey fine sands, sometimes with thin loamy layers; thickness 1.3 m. For this unit a periglacial eolian genesis is assumed.

unit 2. Grey clay, with towards the top a transition locally into a thin peaty layer; thickness 1.1 m. This clay may have been deposited in the backswamps of a river.

unit 3. Brown loam; thickness 0.3 m. Fluviatile deposit, probably in backswamps.

unit 4. Brown to greenish-brown, usually moderately fine sands, with coarse sand intermittently and locally at the base some gravel; thickness 1.5 m. Within this unit there are also (in other thrust sheets) clay layers (up to 0.5 m thick). For the genesis of this unit a slowly flowing river seems likely. The unit is referred to in the field as "Green Layer" (as an analogy of deposits elsewhere on the basis of its heavy mineral content; see Zandstra, 1971, 1975, 1981). In the layers of this unit there are many calcareous concretions. Locally cobbly gravel lenses are found at the base of unit 4, up to 0.3 m thick (Ruegg, 1981; Zandstra, 1981). Of the gravel, pebbles and cobbles on the average ca. 66 % is fragmentated, probably by frost action. These isolated gravel lenses must be considered as erosion-remnants in slight depressions of the surface of the underlying clay (of unit 3). Inspection

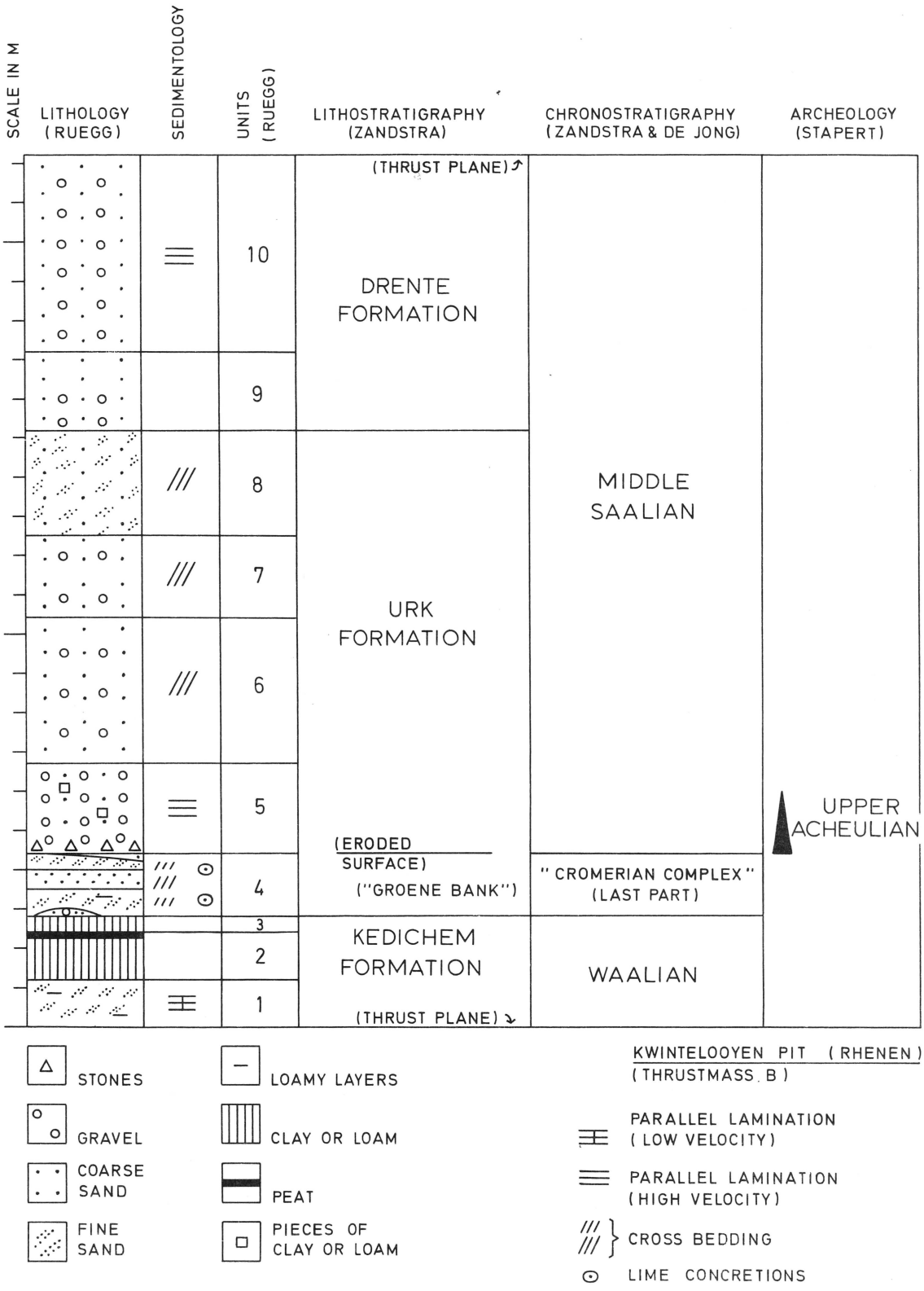

Fig. 3. Table of stratigraphy (of thrust mass B) in the Kwintelooyen quarry (after Ruegg, 1981; Zandstra, 1981; De Jong, 1981). Drawing by Mr. J.M. Smit, B.A.I.

showed that there is no reason to suppose the presence of artefacts among these broken pebbles. (Possibly these are the pebble tools described by Franssen & Wouters, 1981-b?).

unit 5. Coarse gravels and gravel-bearing coarse sands, mostly brown in colour; thickness 2.3 m. At the base there occur large hardly rolled cobbles and boulders (probably transported by floating ice), while in addition many stones have been split *in situ* by frost action, so it is clear that this deposit came into being under glacial conditions. The base of this unit is an erosion level; within this unit there occur e.g. also lumps of clay, that have been washed out of older deposits (including out of Early Pleistocene layers : De Jong, 1981). Genesis : deposit of the main current of a fast-flowing meandering river (basal lag deposit). The lowermost 1-2 metres of this deposit contain Palaeolithic artefacts, as has been shown by several excavations (Stapert, 1981-a, -b). In 3 section in other thrust masses Ruegg (1981) found a clay layer intercalated in the layers of unit 5; this layer is variable in thickness (0.5-2.2 m) and situated resp. 2-3 m, 3.3 m, and 5 m above the base of unit 5. A pollen-analysis of a sample from one of these clay layers is given by De Jong (1981). A temperature climate is suggested, which points to deposition during an interglacial or an interstadial, than cannot, however, be indicated more precisely. In view of the fact that unit 5 must be dated in the Saalian (Zandstra, 1981), it concerns most probably an interstadial of the Saalian (perhaps the Bantega interstadial?). In these clay layers no flints were found (pers. comm. G.H.J. Ruegg).

unit 6. Gravel-bearing to gravel-poor coarse brown sands; thickness 3.7 m. Genesis : as 7.

unit 7. Gravel-poor brown coarse sands; thickness 2 m. Genesis : lower pointbar deposits.

unit 8. Moderately fine to moderately coarse sands with scattered gravel, and with locally reworked plant remains; thickness 2.7 m. Genesis : possibly deposits of a meandering river, and fillings of channels in the upper pointbar area.

unit 9. Moderately coarse to moderately fine brown sands, at the base and also elsewhere locally containing gravel; thickness 2.0 m. Here we are concerned with mass flow deposits under the influence of little water, in direct connection with the ice-sheet.

unit 10. Coarse gravel-rich sands to gravels; thickness 5 m. This unit is regarded as a *sandur* deposit (glacio-fluvial deposits).

Finally, at the surface there are locally unpushed glacial deposits such as boulder clay.

Units 1-3 can be lithostratigraphically attributed to the Kedichem Formation (Early Pleistocene). This is mainly based on a pollen-analysis of the peaty top-layer of unit 2 (De Jong, 1981), that dates this layer to the Waalian interglacial. Units

4-8 can be placed on the basis of sediment petrology in the Middle Pleistocene Urk Formation. Unit 4 has been correlated by Zandstra (1981), on the basis of the heavy mineral content, with deposits which occur in the Northern Netherlands under those of the Peelo Formation (Elsterian); a dating in the last interglacial (IV) of the "Cromerian Complex" therefore seems to Zandstra to be the most likely provisionally.

It has already been pointed out above that units 5-8 were formed during a glacial. Both the stratigraphical position (deposits 9, 10 above formed in contact with ice) as well as the petrological composition of the gravel- and stone-fractions (including some elements of northern origin) date these units to the (Middle) Saalian (Zandstra, 1981).

If these provisional interpretations of the State Geological Survey are correct, then the Elsterian and the Holsteinian would not be represented by deposits in the Kwintelooyen quarry. The base of unit 5 is however an erosion level, and elements from earlier deposits have certainly been included within the layers of this unit.

4. STRATIGRAPHY IN THE LECCIUS DE RIDDER PIT (RHENEN)

The Leccius de Ridder pit is the eastern one of the two sandpits near Rhenen (fig. 1 : 3). The sediments in this pit have much less been studied in detail than in the case with the Kwintelloyen pit. It is certain that the stratigraphy here is in some aspects different from that in the Kwintelooyen pit. For instance, a clay layer (thickness ca. 2 m), that was found by us in 1979 (possibly a remnant of the clay layer, visible for a great distance in a photo in : Bosscha Erdbrink *et al.* 1979), is not present in Kwintelooyen. The pollen-analysis dates this layer in the first interglacial of the "Cromerian Complex" (De Jong, 1981). Another (thin) clay layer probably dates from the Early Pleistocene (De Jong, 1981). Both clay layers are intercalated in sand of unknown lithostratigraphical position. The eastern face of the Leccius de Ridder pit is known in somewhat greater detail (De Jong, 1981). Four clay lenses have been sampled here in 1966. They are intercalated in extremely coarse sands with gravel and stones (up to 30 cm), the litho-stratigraphical position of which is not known precisely. These sands are however comparable provisionally with units 5-7 (which are augite-bearing) in the Kwintelooyen pit : for instance, from these coarse layers probably many mammal bones are derived, as is the case with units 5-7 in the Kwintelloyen pit. The larger mammal fauna of Leccius de Ridder is very well comparable with that of Kwintelooyen (Van Kolfschoten, 1981).

According to Zandstra (1966) at least part of these coarse layers (which are augite-bearing) belong to the Middle Pleistocene Urk Formation, but they cannot be dated with certainty to a specific glacial or interglacial for the meantime. One clay lens (in the southern part of this quarry face) can be dated pollen-analytically to the Early Pleistocene, however (De Jong, 1981). Three lenses in the Northern part of the quarry face are similar; they consist of calcareous clay and contain small fragments

of molluscs and rodents. The rodents from one of these lenses have been studied by Van Kolfschoten (1981); this fauna can be dated probably to an interstadial of the Saalian.

De Jong (1981) studied the pollen from another of these 3 lenses. The two spectra obtained can according to De Jong very well be compared to pollen-diagrams of the Hoogeveen interstadial of the Saalian. It is known, that this part of the Leccius de Ridder pit has yielded many artefacts and large mammal bones (see Franssen & Wouters, 1978-a).

5. THE FAUNA (LARGER MAMMALS)

Both of the quarries near Rhenen as well as the Kwintelooyen pit have yielded bones of mammalia that have been studied by Van Kolfschoten (1981). They most probably come from the layers of units 5-7 (a small number have been found *in situ* within the layers of units 5-7). Van Kolfschoten found the following species to be present : *Mammuthus primigenius, Elephas namadicus (= antiquus), Equus* species, *Dicerorhinus kirchbergensis, Dicerorhinus hemitoechus, Coelodonta antiquitatis, Sus scrofa, Hippopotamus* cf. *amphibius, Cervus (Megaceros) giganteus, Cervus elaphus, Ovibos aff. moschatus, Bison priscus*. Half of the material studied by Van Kolfschoten comes from the mammoth. The occurrence of hippopotamus is striking.

The fauna includes both cold and warm elements, thus suggesting that we are here concerned with a mixture of (at least) two different faunas. The cold elements must date from the Saalian, and may therefore well be more or less con temporaneous with the deposit in which they are now to be found. This applies less to the warm fauna, which according to Van Kolfschoten dates from the (late) Holsteinian, or (perhaps more likely) from an interstadial (e.g. Hoogeveen) of the Saalian. This would mean that, either, part of the bones originate from a layer that has now disappeared as a result of erosion, which is very well possible (see under 3), or, that the fauna as a whole dates from the transition from an interstadial (e.g. Hoogeveen) to a stadial. The latter possibility is more probable, in view of the circumstance that the bones are not conspiciously rolled.

Bosscha Erdbrink *et al.* (1979) describe the proximal part of a *femur* that they attribute to what is probably a neanderthaloid. The bone fragment was found in 1967 in one of the two quarries near Rhenen (Vogelenzang, Leccius de Ridder). They suggest that the bone may have been broken intentionally (to extract the marrow).(1)

6. THE ARCHAEOLOGICAL INVESTIGATION IN THE KWINTELOOYEN PIT

6. 1. General remarks

From the quarries near Rhenen so far several thousands of artefacts have been collected by amateur archaeologists. The collections have practically all originated

(1)See note 1 p.133

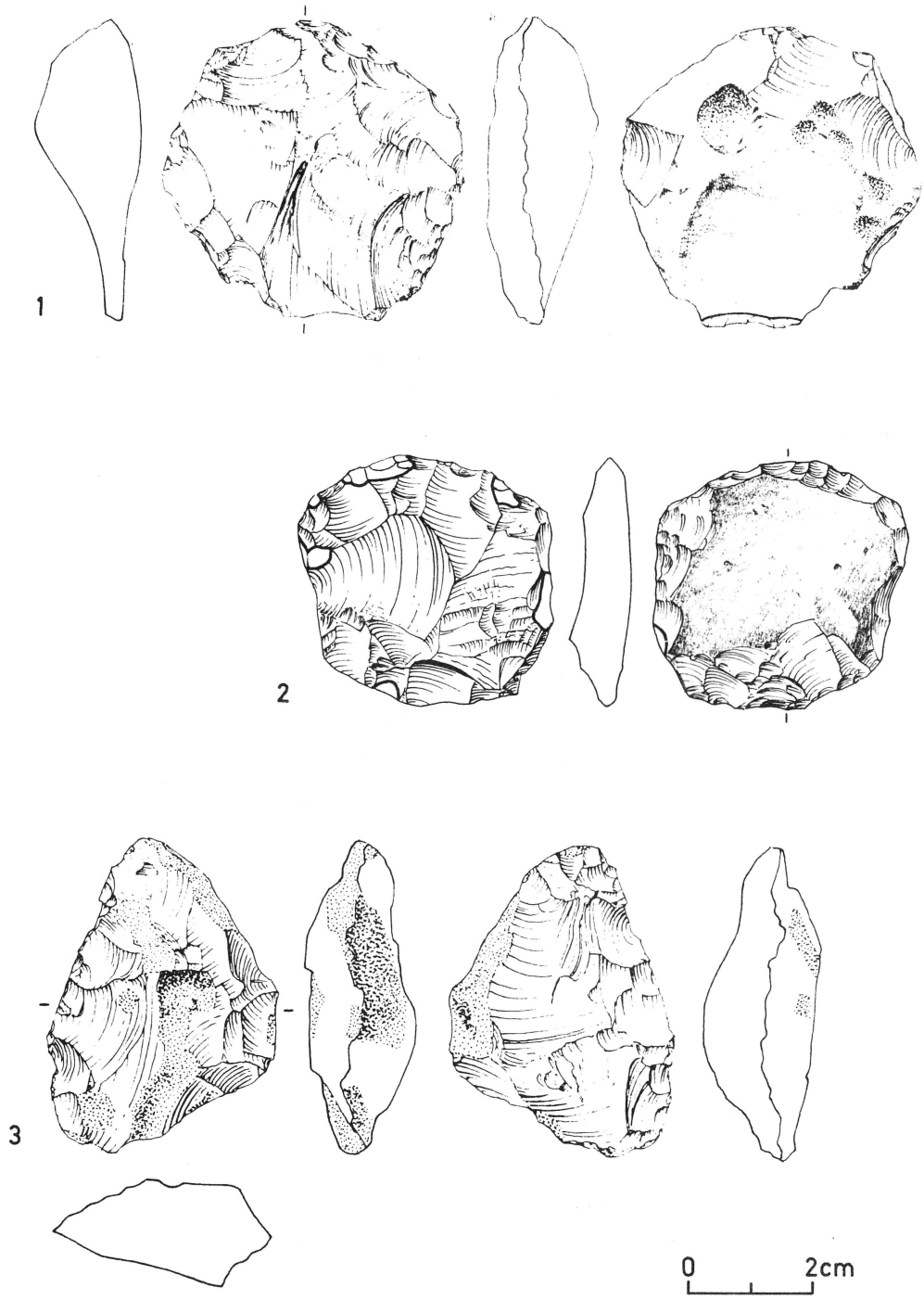

Fig. 4. 1, 2 *Disques* made out of natural pieces of flint; 3 *blattförmiger Schaber*. 1 Knöps collection, 2 Drost collection, 3 Lagerwerf collection. Collected on the gravel dumps at Vogelenzang/Leccius de Ridder, but originating from Kwintelooyen. Key to drawings of artefacts : white - (sub) recent damage, grey - old frost-split faces, stippled - remains of cortex, closed circle - position of point of percussion, open circle - direction of point of percussion (not present). Drawings by Mr. H.R. Roelink, B.A.I.

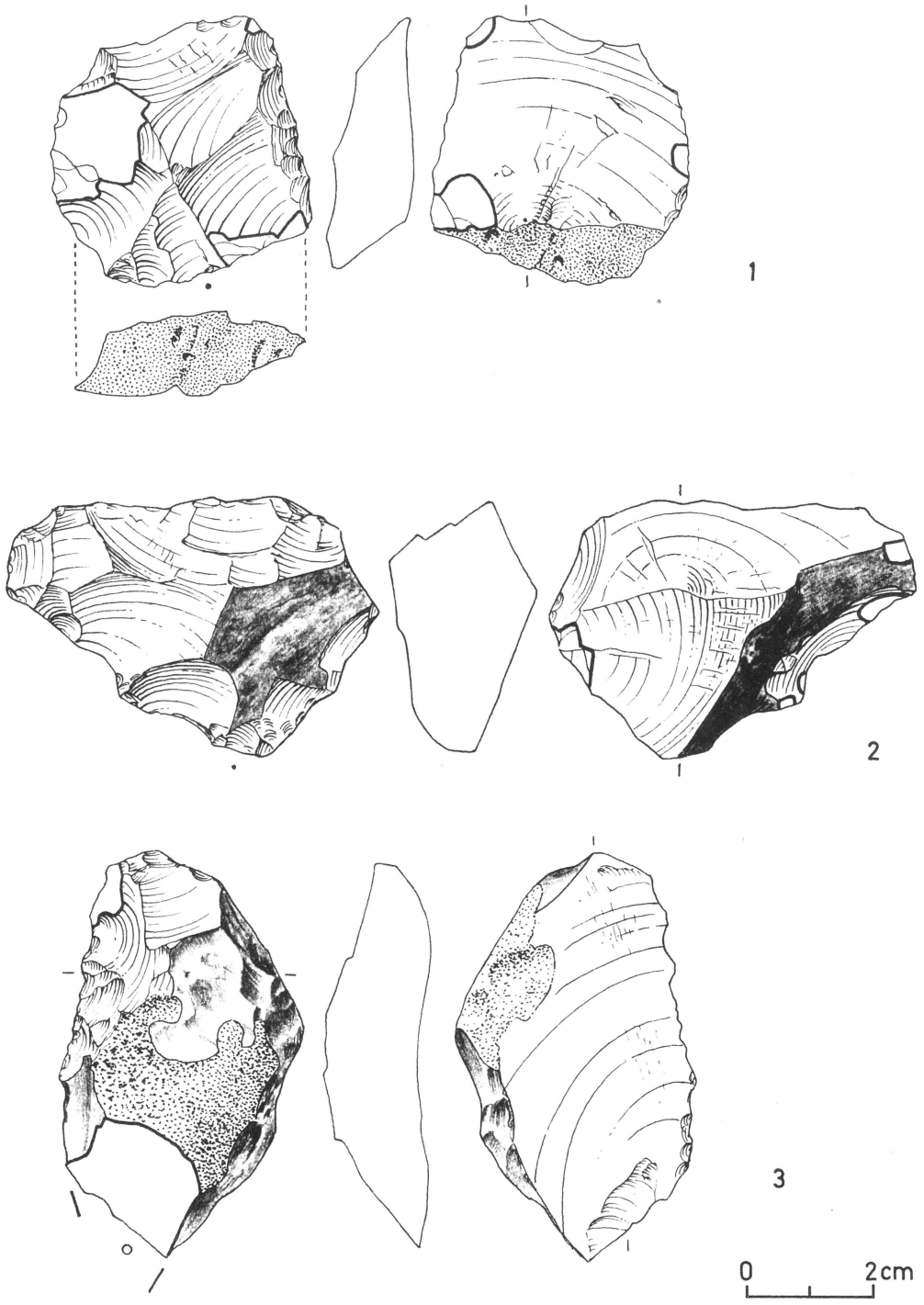

Fig. 5. 1 Straight side-scraper made out of levallois flake; 2 core-like scraper; 3 straight side-scraper. 1 Drost collection, 2 Lagerwerf collection, 3 B.A.I. collection. Collected on the gravel dumps at Vogelenzang/Leccius de Ridder, but originating from Kwintelooyen. Drawings by Mr. H.R. Roelink, B.A.I.

from searching through the gravel dumps at the brick factories of Vogelenzang and Leccius de Ridder (Rhenen). Here gravel is separated from the sand by sifting; also a part of the sand from the Kwintelooyen quarry is sieved here. It is clear that the stratigraphical origin of finds made in this way can no longer be ascertained. As will later become evident it is however rather difficult to collect *large* complexes *in situ*, so these collections are of great importance to gain an impression of the archaeological tradition(s) represented. A relatively small amount of this material could be studied by us (Stapert, 1980, 1981-b), of which a total of 152 items come from the Kwintelooyen quarry. Several other small collections of amateur archaeologists could be observed superficially. These finds are briefly discussed under 6.2. In addition stray finds were collected in the Kwintelooyen quarry. These amount to a total of 32 items, of which the stratigraphical origin is mostly equally unknown (6.3). Finally in four different spots in the Kwintelooyen quarry excavations were carried out, as a result of which several dozen finds could be collected from the lowermost 1 to 2 metres of unit 5 (6.4).

6.2. Finds from the gravel dumps

It was possible to study smaller collections (total 88) of three amateur archaeologists (Mr. C. Lagerwerf, Mr. A. Knöps and Mr. H. Drost) that had been collected on the dumps of the factories in Rhenen. The majority certainly originate from Kwintelooyen, but is possible that some of these finds come from the two pits near Rhenen. In addition a total of 64 artefacts, originating from Kwintelooyen, were collected by the B.A.I. on the dumps at Vogelenzang.

Of the 152 items studied 16 can be described as "tools" :

1 partially bifacially worked tool (a rough-out?),
2 *disques* (both made out of natural pieces of flint) (fig. 4 - 1,2),
3 *blattförmiger Schaber* (bifacial) (fig. 4 - 3),
4 scrapers (including one dentated) made out of flakes (including one levallois flake) (fig. 5 - 1,3),
1 scraper made out of a levallois core,
1 core-like scraper (fig. 5 - 2),
2 scrapers made out of natural pieces of flint,
2 Clacton notches (one made out of a natural piece of flint, one out of a flake),
1 blade with two retouched edges (fig. 6 - 2),
1 partially retouched flake.

Also present are the following :

3 levallois cores (one of which can be described as a micro-core) (fig. 8 - 1),
11 other cores,
6 levallois flakes (one fairly big : l. : 13 cm) (fig. 8 - 2,3; fig. 9),
15 blades or blade-like flakes (one with core preparation retouch) (fig. 6 - 1,

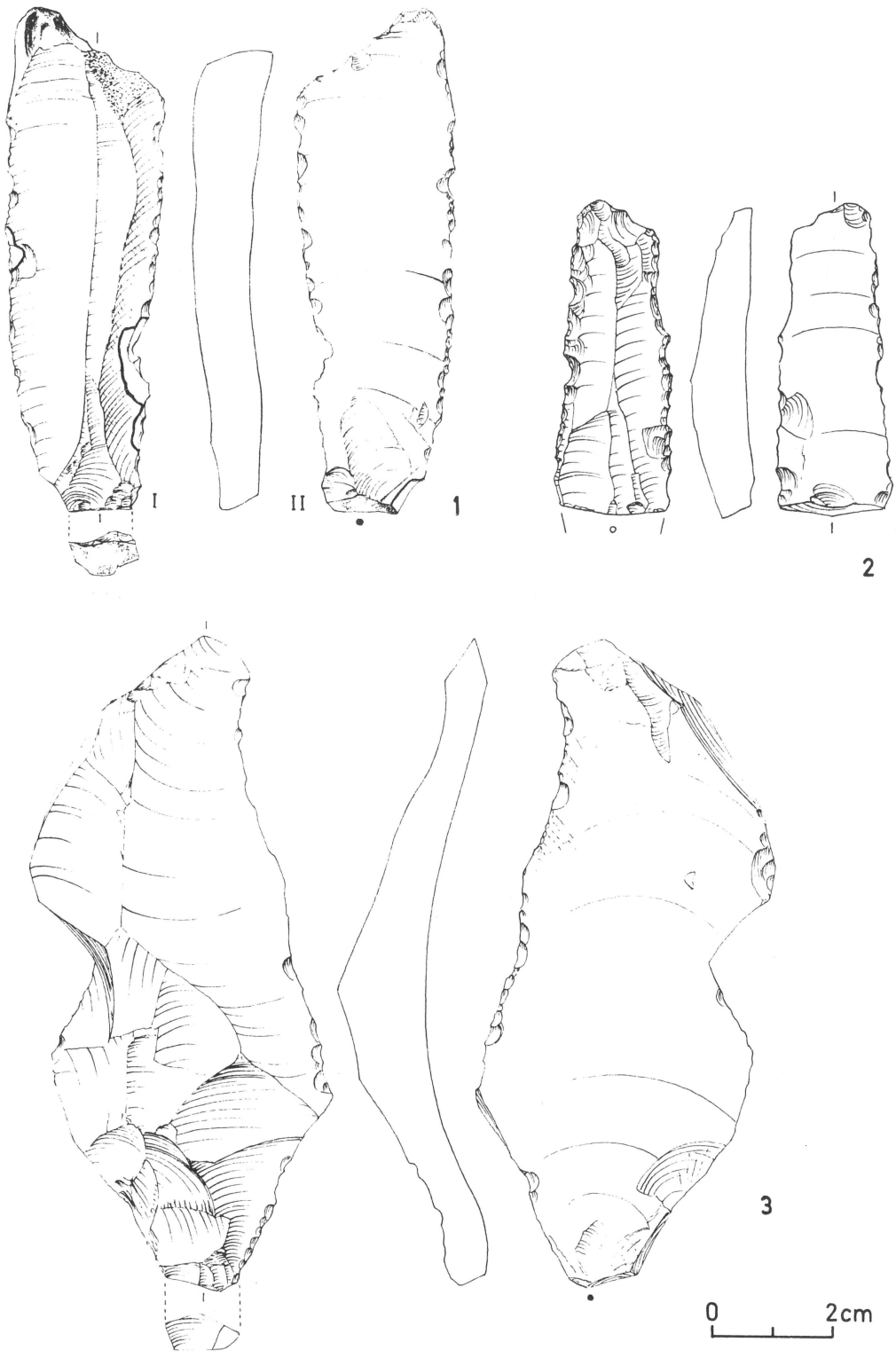

Fig. 6. 1, 2, 3 Levallois blades (2 retouched). 1 Knöps collection; 2, 3 Lagerwerf collection. Collected on the gravel dumps at Vogelenzang/Leccius de Ridder, but originating from Kwintelooyen. Drawings by Mr. H.R. Roelink, B.A.I.

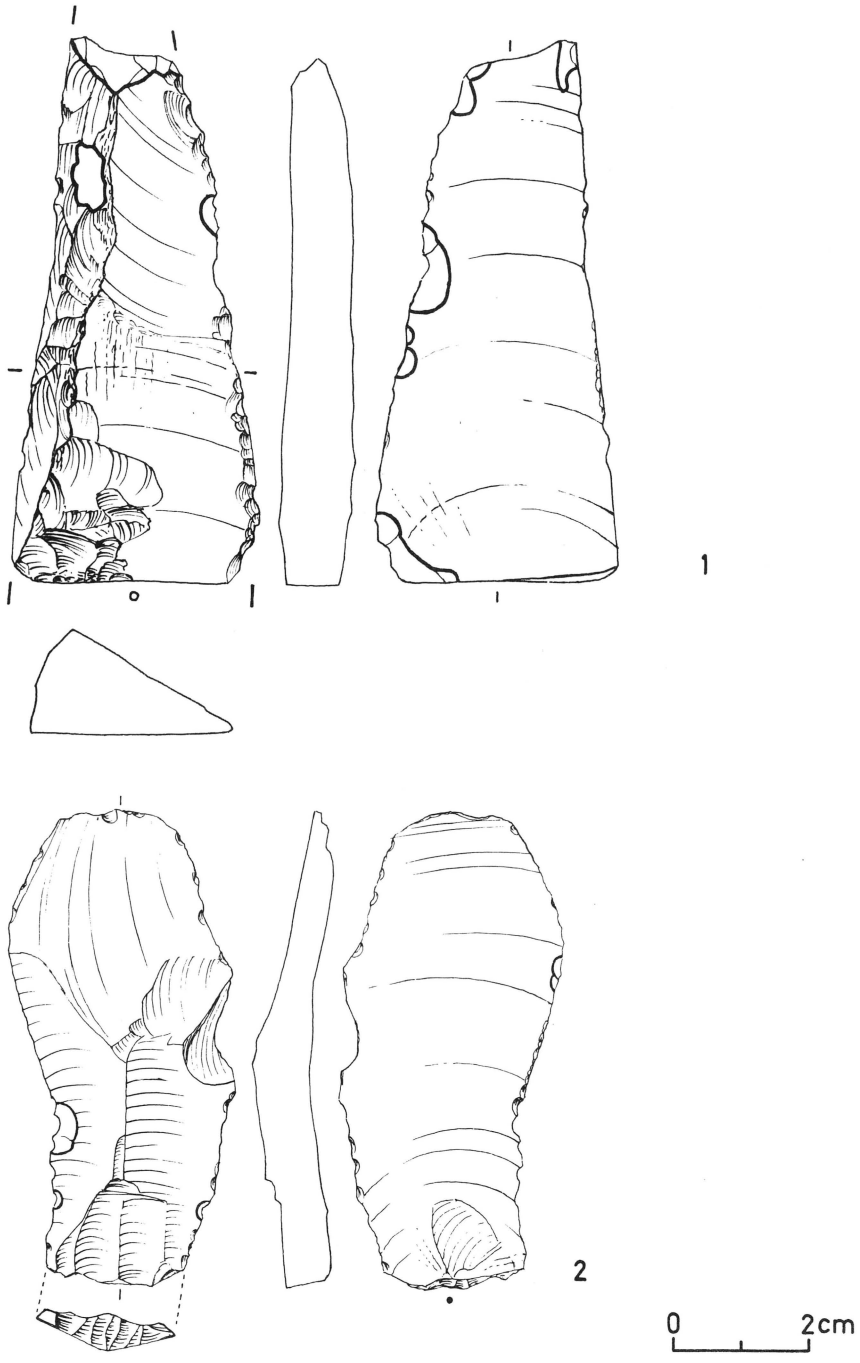

Fig. 7. 1, 2 Levallois blades (1 with core preparation dorsally). 1 B.A.I. collection, 2 Lagerwerf collection. Collected on the gravel dumps at Vogelenzang/Leccius de Ridder, but originating from Kwintelooyen. Drawings by Mr. H.R. Roelink, B.A.I.

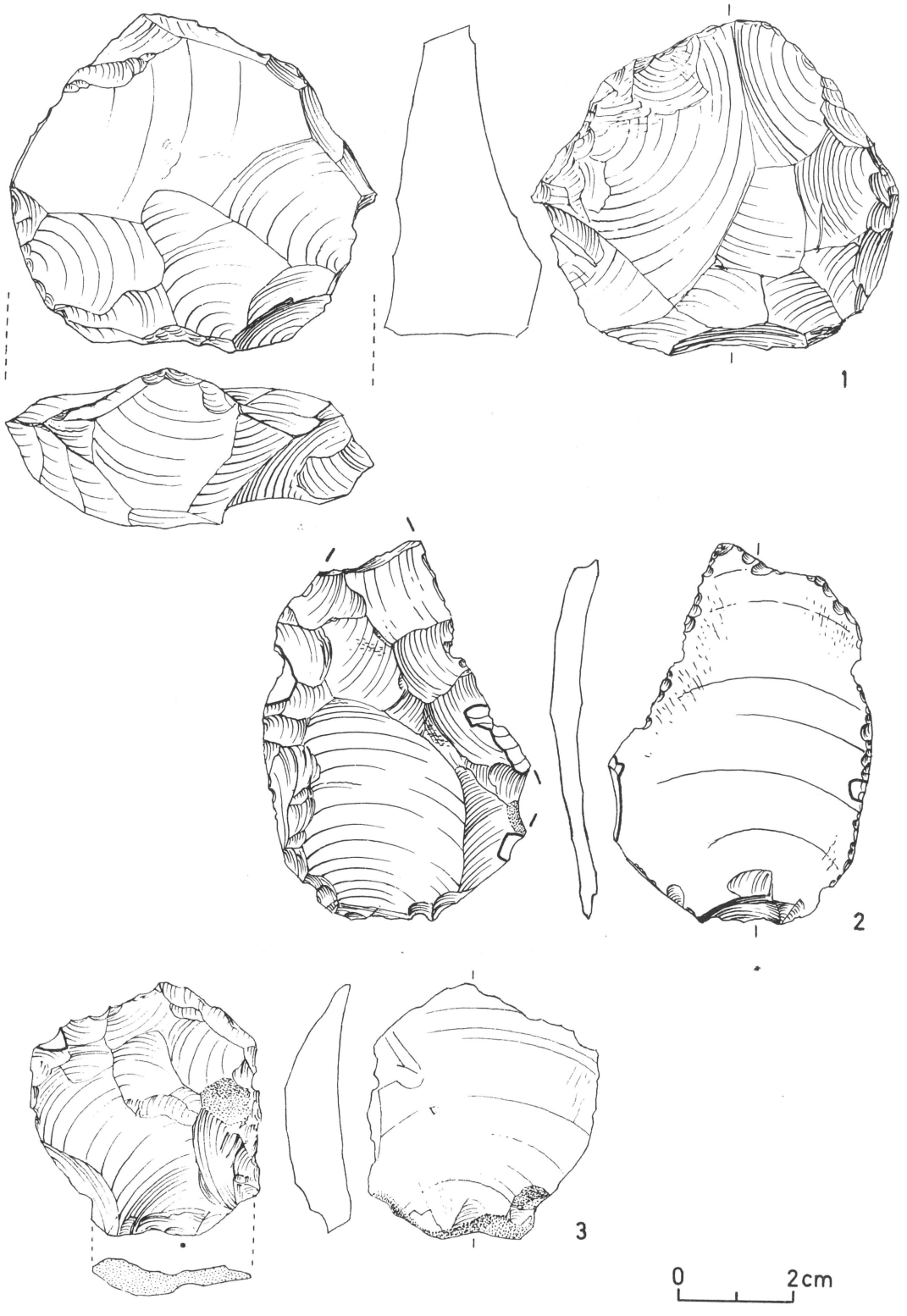

Fig. 8. 1 Levallois core; 2, 3 levallois flakes. 1 Drost collection, 2 Lagerwerf collection, 3 B.A.I. collection. Collected on the gravel dumps at Vogelenzang/Leccius de Ridder, but originating from Kwintelooyen. Drawings by Mr. H.R. Roelink, B.A.I.

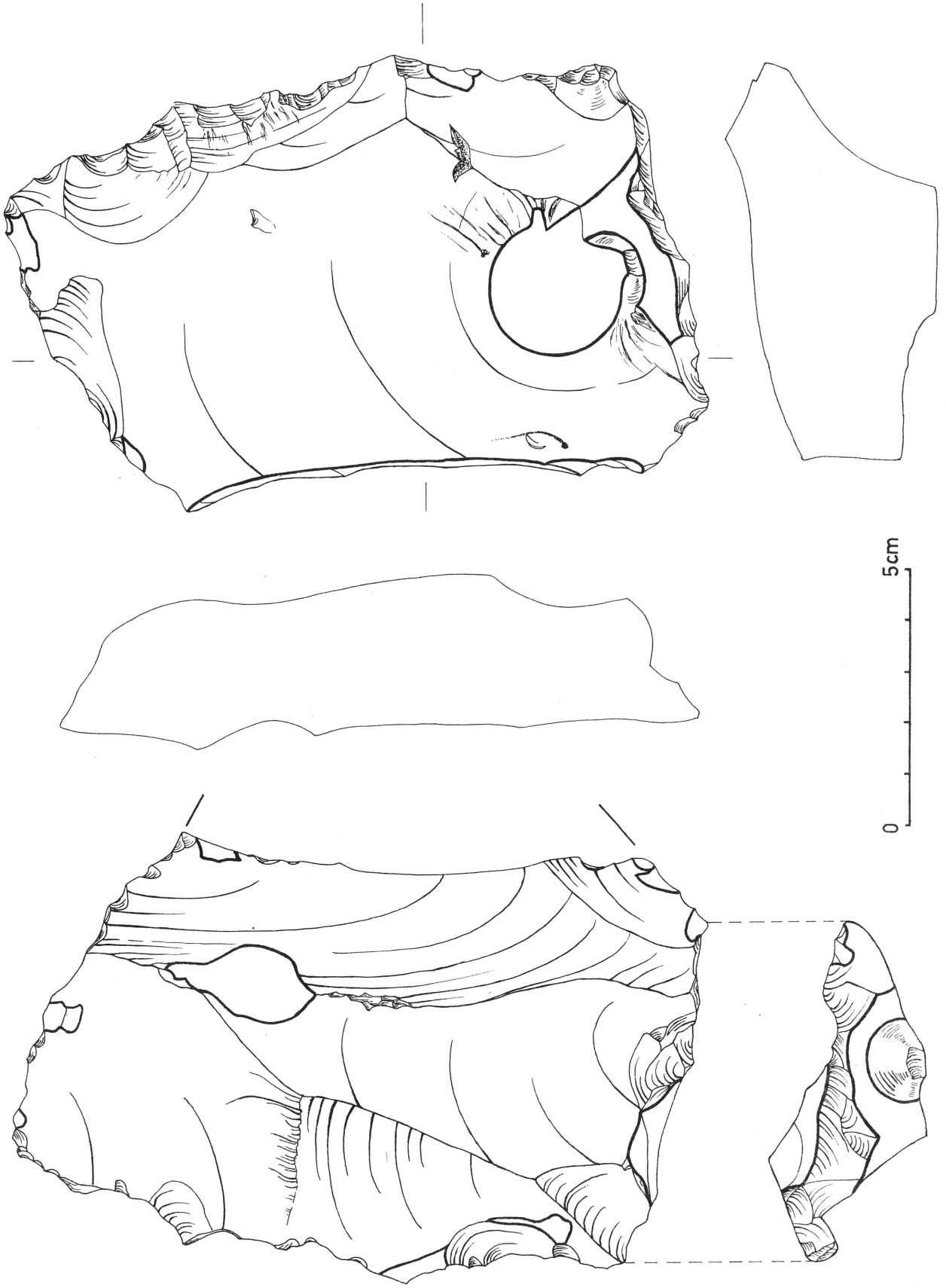

Fig. 9. Broken large levallois flake. B.A.I. collection. Collected on the gravel dumps at Vogelenzang, but originating from Kwintelooyen. Drawings by Mrs. Jasmina Milojković.

3; fig. 7 - 1,2),

101 flakes (of which ca. one-third can be described as "Clacton flakes"; only a few appear to have been produced by soft percussion).

Most of the artefacts have a (slight) gloss (not wind-gloss), are scratched (sometimes very coarsely) and have a brown patina. Of this material about 14 % is not or hardly rolled, and 6 % is extremely rolled. The rest is slightly to moderately rolled.

During the collecting by the B.A.I. near the factory Vogelenzang there appeared to be a clear connection between the number of finds made per day and the number of very large stones that were transported : the greater the number of finds, the greater the number of boulders. These large stones would have originated from the lowermost layer of unit 5, thus giving the impression that the finds too would have come from that unit. The number involved are however only small, so this "correlation" cannot be considered as significant. This association was however confirmed by the excavations.

It can be taken as an estimate of magnitude that at the sieves next to the factory during this period (with usually a total of 3 to 4 collectors present) approximately 1 find per 100 cubic metres of sand and gravel was made, while it should be remembered that by no means all finds would have been noticed (especially not very small artefacts).

A number of smaller collections of amateur archaeologists could be viewed superficially. Among these the following items were noted : 5 points, at least 5 scrapers made out of flakes, 2 artefacts with Clacton notches, 2 choppers, 2 levallois flakes (including one severely rolled), 4 levallois cores, at least 3 other cores, 7 blades or blade-like flakes (one retouched), several dozen flakes (including several retouched). Some of these finds may in fact originate from the two quarries near Rhenen. For additional illustrations of finds see the publications of Franssen & Wouters (1977, 1978-a, -b, -c, 1979, 1981-a).

6. 3. Isolated finds in the Kwintelooyen quarry

Most of these finds were collected by the B.A.I. during the summer of 1980 (a total of 24), while two collectors (Mr. C. Lagerwerf, Mr. C. Cup) provided 6 more. Furthermore, during a reconnaissance in 1978 two flakes were found, one isolated at the foot of a slope (at B in fig. 10), and one *in situ* from a coarse deposit (probably unit 5; at A in fig. 10).

The finds collected by the B.A.I. were actually found all over the quarry, although there were a couple of places where a number of artefacts were found relatively close together (1-5 on fig. 10). These were places, however, where there was much gravel (at the foot of slopes), and where we often searched.

The finds (total 32) can be described as follows :

1 probable rough-out of a hand-axe made out of a large flake (fig. 11),

1 Mousterian point (fig. 12 - 2),

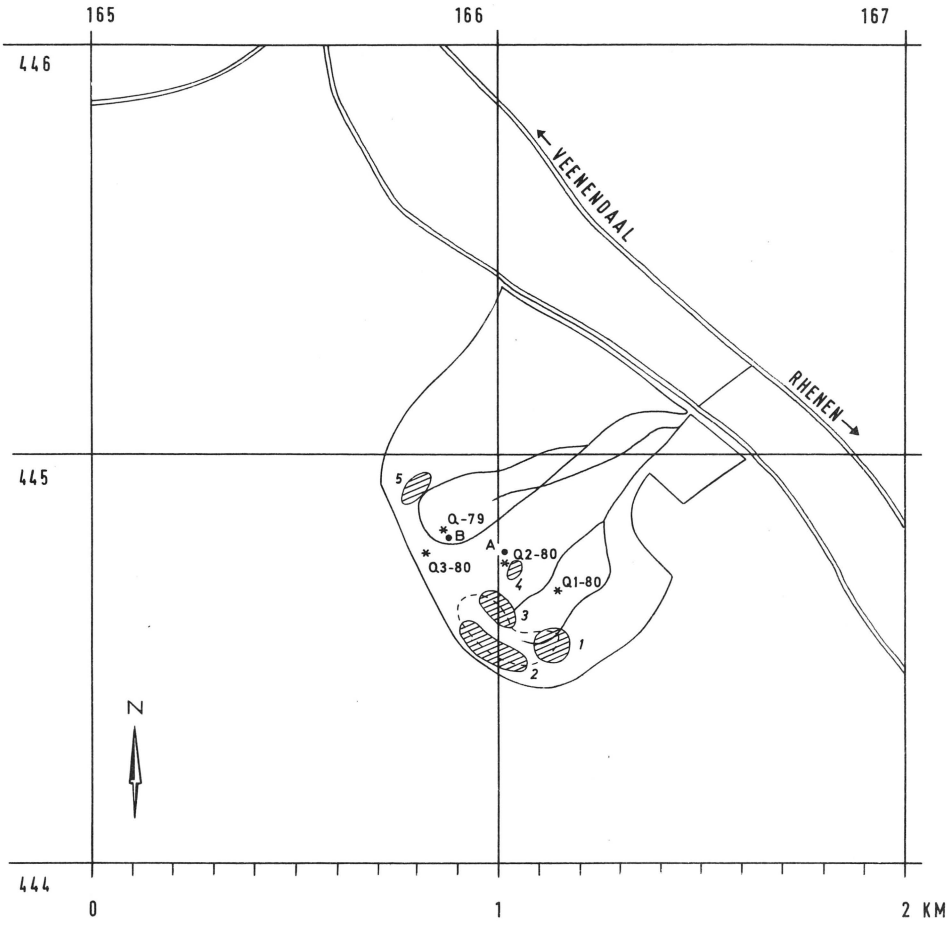

Fig. 10. Sketch-map of the Kwintelooyen pit. Q-79, Q1-80, Q2-80, Q3-80 excavation sites of the B.A.I.; A, B findspots of 2 flakes found during the reconnaissance in 1978; 1-5 spots where several stray finds were found relatively close together by the B.A.I. in 1980. Drawing by Mr. J.M. Smith, B.A.I.

Fig. 11. Probable rough-out of a hand-axe, made out of a large flake. Isolated find from the Kwintelooyen pit. B.A.I. collection. Drawing by Mr. H.R. Roelink, B.A.I.

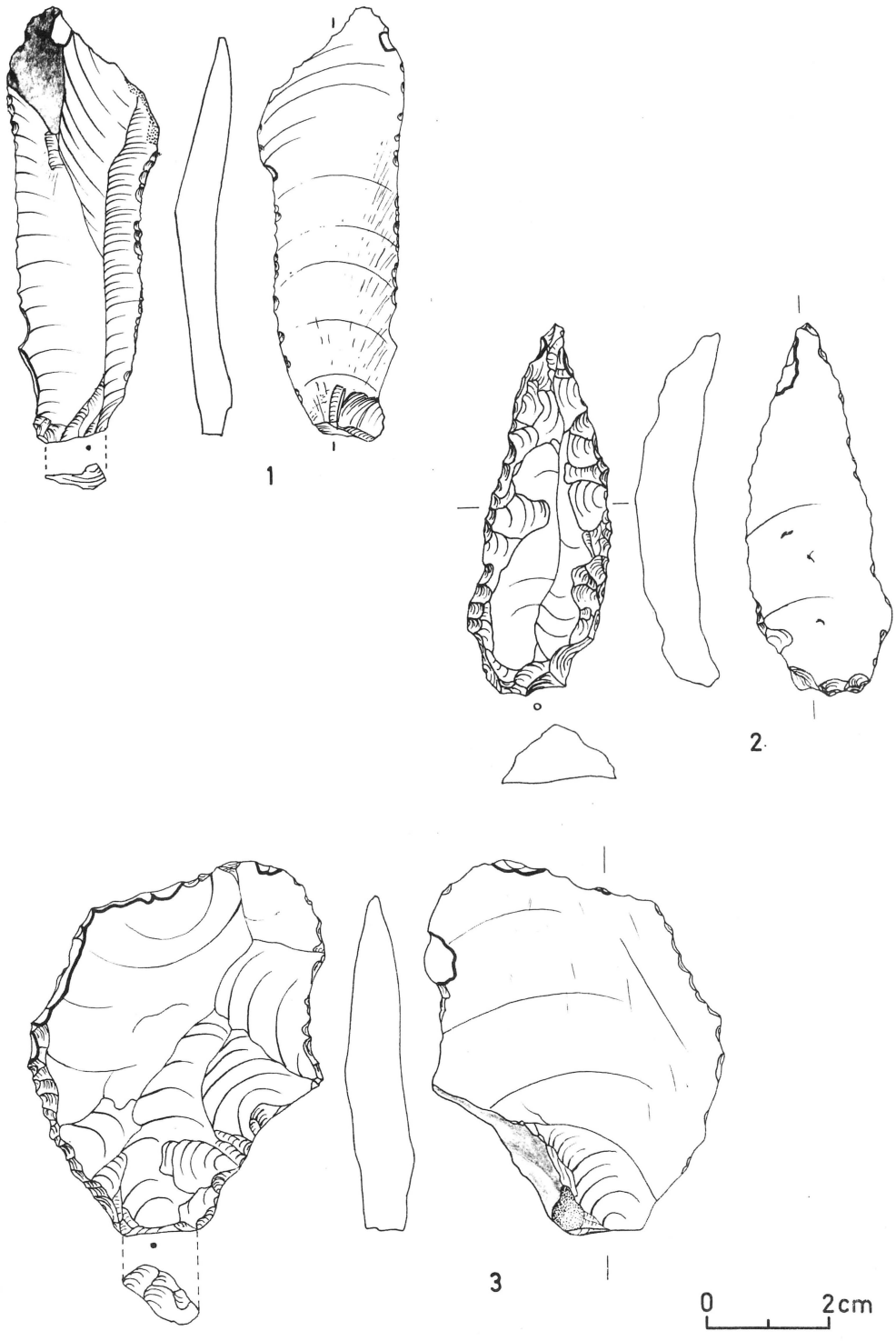

Fig. 12. 1 Regular blade (unrolled). B.A.I. excavation Q-79. Drawing by Mr. H.R. Roelink, B.A.I. 2 Mousterian point, 3 levallois flake, partly retouched. Isolated finds from the Kwintelooyen pit. B.A.I. collection. Drawings by Mrs. Jasmina Milojković.

2 scrapers made out of flakes (one straight, one concave),
2 levallois flakes (one retouched) (fig. 12 - 3),
3 cores (non-levallois),
1 blade-like flake,
22 flakes (including one definitely coming from unit 5, and another most probably so).

6. 4. Excavation finds

Following the report of the amateur archeologist Mr. C. Lagerwerf, in the autumn of 1979 an excavation was carried out in the Kwintelooyen quarry. Lagerwerf, together with several friends, had collected a number of finds close to the spot where previously a "Clacton flake" had been found (isolated at the foot of a slope, at B in fig. 10) during the reconnaissance of 1978. The finds made by Lagerwerf *et al.* include :

1 chopper (of quartzite) (fig. 13 - 1),
1 (probable) scraper made out of a natural piece of flint,
1 core (non-levallois),
6 flakes (including several very small ones).

Of these finds 7 definitely originate from the lowermost metre of unit 5 (including the chopper), while the others were found isolated on the slope, but most probably come from the same layer. Of these finds 2 are not or hardly rolled, the rest slightly to moderately. One of the not noticeably rolled artefacts is a small flake, composed of a kind of flint practically identical to that of the blade recovered later during the B.A.I.-excavation. The chopper is moderately rolled.

During the B.A.I.-excavation a total of 13 definite artefacts and one possible artefact were found; they were present within the lowermost three-quarters of a metre of unit 5 (of which 7artefacts within the lowermost 0.5 m, see fig. 14). Five artefacts were damaged or broken, presumably due to frost-splitting, as a result of which recent-looking fracture surfaces have sometimes been produced.

The 14 finds can be described as follows :

1 "*bec*"-like tool with Clacton notch (fig. 13 - 3) made out of a large ("Clacton") flake,
1 straight scraper made out of a natural piece of flint (fig. 13 - 2),
1 cf. (micro-) levallois flake,
1 very regular blade (fig. 12 - 1),
9 flakes (including 4 which can be described as "Clacton" flakes),
1 possible scraper made out of a (frost-split) fragment of a natural flint.

In addition, during the excavation 2 artefacts were found by Mr. Lagerwerf in the (artificial) slope : 1 flake *in situ* (in the lowermost 0.5 m of unit 5) right next to the excavation site, and 1 flake, found not *in situ*, at some distance from the excavation site, which however most probably originates from unit 5 (personal communi-

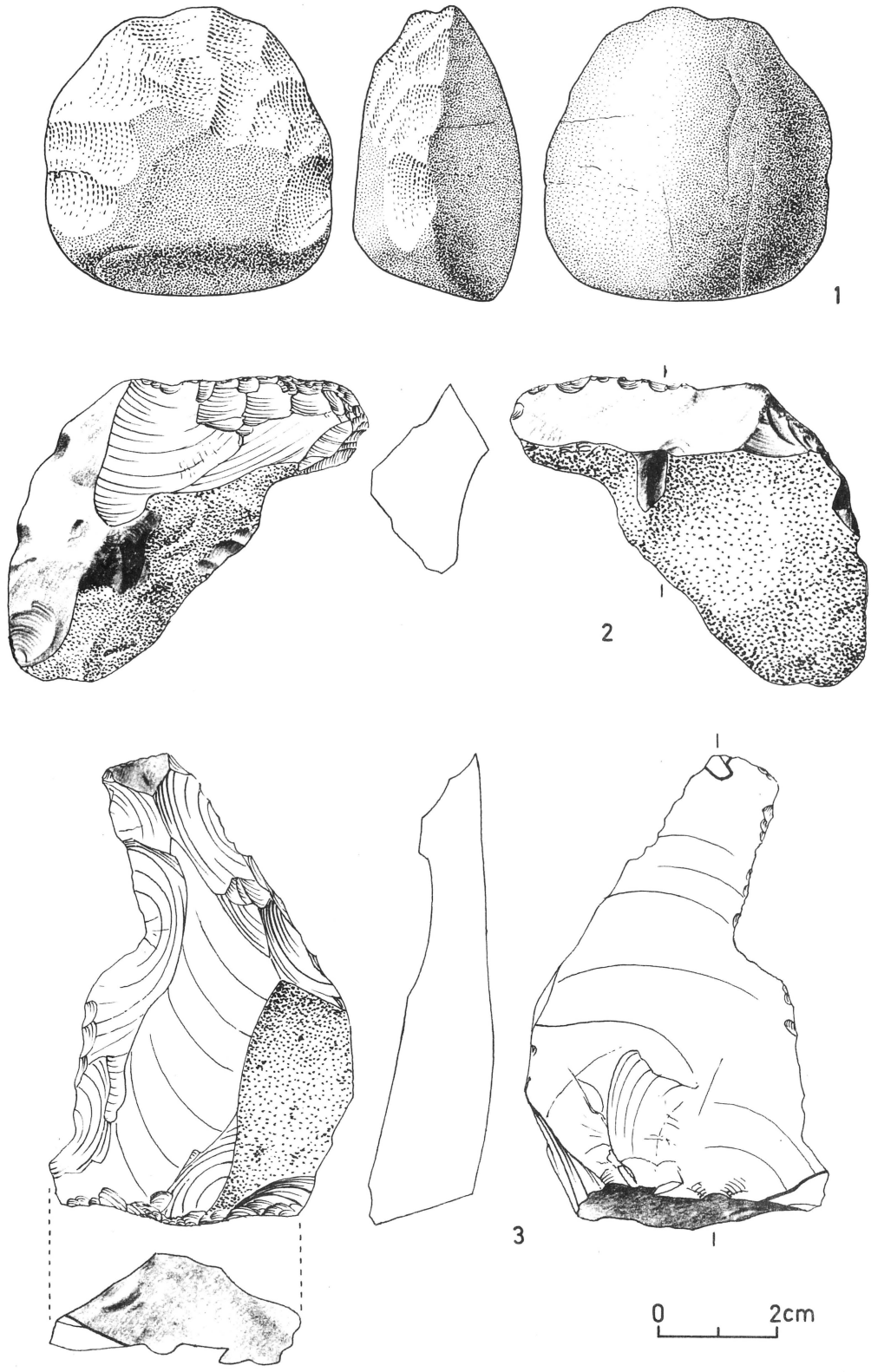

Fig. 13. 1 Chopper, quartzite. Collected by Mr. M. Köppen *in situ* from unit 5 in the Kwintelooyen pit near the excavation site Q-79. Lagerwerf collection. 2 Straight scraper made out of a natural piece of flint, 3 "*bec*"-like tool with clacton notch. B.A.I. excavation Q-79. Drawings by Mr. H.R. Roelink, B.A.I.

cation G.H.K. Ruegg). Finally, during the excavation a severely rolled "Clacton" flake was found isolated on the surface (of an artificial plateau).

Disregarding the last-mentioned find, the following can be said about these finds. Two artefacts (the blade and a "Clacton" flake) are not noticeably rolled, 8 are slightly rolled, while the rest are moderately rolled. Most of the artefacts have in addition a brown patina, a slight gloss and scratches; the blade however is hardly patinated and has no scratches either. None of these artefacts is severely rolled.

The density of finds at this spot was approximately : 1 artefact per 1.8 cubic metre of sediment.

In 1980 there followed a second excavation campaign in the Kwintelooyen quarry. The aim was mainly to try to find an answer to the following question : do artefacts occur more or less everywhere in the quarry within the lowermost layers of unit 5, and if so what is the density of finds elsewhere? In 3 different places (Q1-80, Q2-80 and Q3-80 in fig. 10) gravel was sieved from the lowermost metres of unit 5.

At Q1 only 1.5 cubic metre of gravel could be sifted, too small a quantity to permit any meaningful conclusions - only one possible artefact was found.

At Q2 ca. 15 cubic metres of gravel were sifted from the lowermost 2 m of unit 5 (fig. 15). As a result 10 definite artefacts (all flakes) were found. In addition one artefact was found on the slope of dumped material at this spot; this artefact probably also originates from the lowermost metres of unit 5. A very small flake (length 1.3 cm) comes from ca. 1.8 m above the base of the gravel, 2 small flakes (1.6 and 2.2 cm in length) from ca. 1.2 m, while the remaining artefacts come from the lowermost metre (2 from ca. 0.7 m, 2 from ca. 05 m, 1 from 0.3-0.5 m, 1 from ca. 0.2 m, and 1 from 0.05-0.1 m above the base).

One flake is moderately rolled, 6 are slightly rolled, and 3 are not noticeably rolled. The three non-rolled flakes have no brown patina either, while the rolled ones do. Two of the three non-rolled flakes appear to have been struck from the same core. The artefact that was found isolated on the slope of dumped material is a severely rolled "Clacton flake". The density of finds at Q2 was : 1 artefact per ca. 1.5 cubic metre of gravel.

At Q3 7.6 cubic metres of gravel were sieved from the lowermost metre of unit 5. Q3 is situated ca. 100 m away from the excavation site of 1979 (Q79); it is probable that there is no thrust plane between the 2 spots (according to Mr. G.H.J. Ruegg). Here a total of 7 definite artefacts were found (1 at ca. 65 cm, 1 at ca. 40 cm, 1 at ca. 20 cm, 3 at ca. 15 cm, and 1 at ca. 10 cm above the base of the gravel layer). Three artefacts are moderately rolled, the other 4 slightly. Five smaller flakes, one larger bladelike flake, and a broken smaller blade are present. The density of finds at Q3 was ca. : 1 artefact per 1.1 cubic metre of gravel. At the beginning of February 1981 Mr. Lagerwerf (with several friends) sieved an additional quantity of gravel (somewhat more than 1 cubic metre) from the lowermost 40-50 cm of unit 5

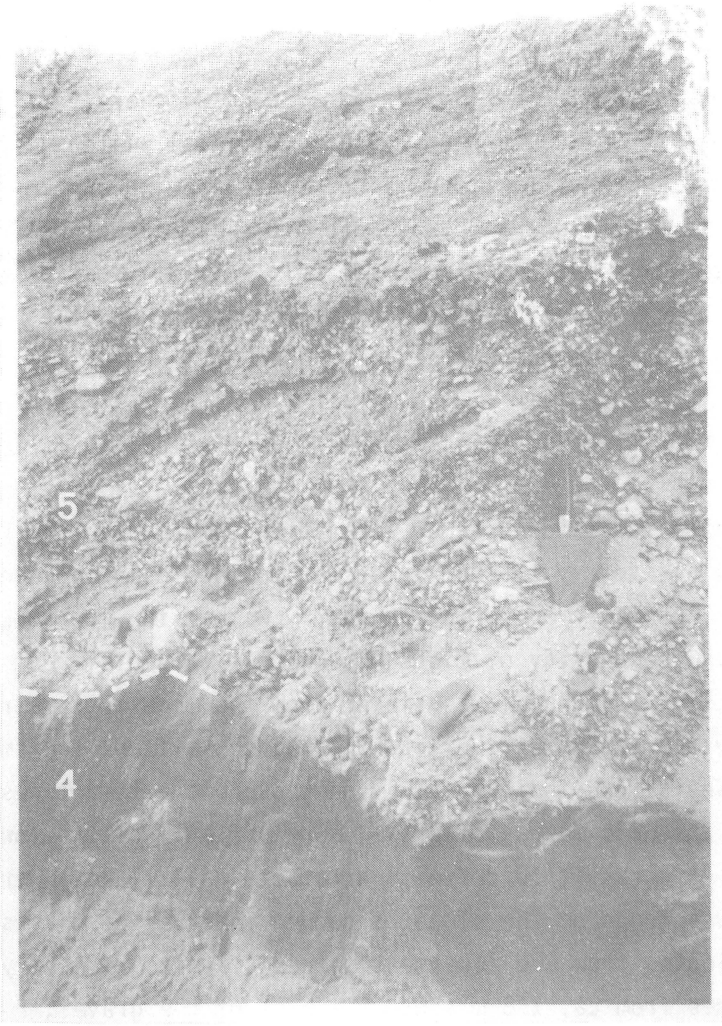

Fig. 14. Excavation profile at Q-79 in the Kwintelooyen pit. Sediments of the lithological units 4 and 5 are visible. Middle Paleolithic artefacts have been recovered here from the lowermost gravel layers (0.75 m) of unit 5. Photo by Mr. D. Stapert, B.A.I.

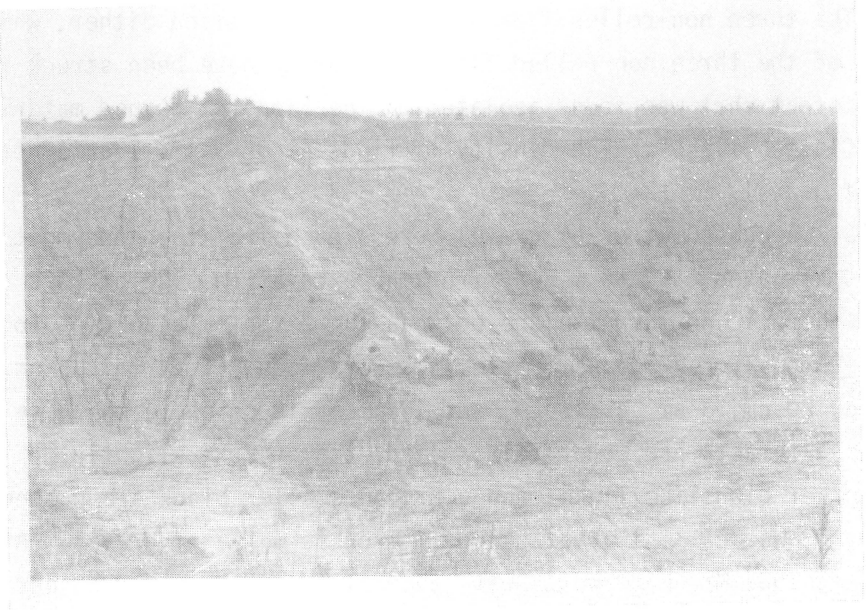

Fig. 15. B.A.I. excavation site Q2-80 in the Kwintelooyen pit. Photo by Mr. D. Stapert, B.A.I.

at a spot close to A (in fig. 10). As a result 7 finds came to light : 1 fragment of a bifacially worked artefact (probably a hand-axe), 1 straight scraper made out of a flake, 1 broken levallois flake, 1 blade, possibly retouched in part and 3 flakes. One of the finds is not or hardly rolled, 1 moderately, and the others lightly. The density of finds was obviously rather high at this spot.

It can be stated that (probably everywhere) in the Kwintelooyen pit there are relatively many artefacts present in the lowermost 1-2 m of unit 5, especially at the base, with a density of finds of on average ca. 1 artefact per 1.5 cubic metre of sand and gravel, but locally more (the average thickness of the layers investigated varied, however, between the different excavation sites). There are no indications at present of the presence of finds in layers other than those of unit 5 (but it is much more difficult, even impossible, to demonstrate with certainty the absolute absence of finds in a certain layer, than to demonstrate the presence of finds). The average density of finds in unit 5 that has been observed so far is too small to permit the collection of large quantities of artefacts from this layer under controlled conditions. Moreover from a geological viewpoint there appears to be little chance of coming across any primary *in situ* finds. Considering the entire pit, however, it is evident that unit 5 must contain tens of thousands of artefacts. The large collections that have been and are still being collected on the gravel dumps at the factories can therefore very well be explained as having originated from unit 5.

It is clear that the observed density of finds would have been greater if only gravel from the lowermost decimetres of unit 5 had been sieved. Most of the finds come from the lower part of the gravel layer, while the higher finds are mostly fairly small artefacts. This suggests that the finds were picked up by the river that deposited the lowermost layers of unit 5, and that they were therefore already present beforehand. This does not necessarily mean, however, that the finds were left behind a *very long* time before then; the presence of a not inconsiderable proportion of unpatinated and unrolled artefacts makes this improbable.

7. PROVISIONAL INTERPRETATIONS

Franssen & Wouters (a.o. 1978c, 1979) report that 3 artefact-bearing levels are present in the three quarries, of which 2 are (brown of red) loam layers.

The rather general occurrence of a number of phenomena on most of the flint artefacts from the Kwintelooyen quarry (and also on the artefacts from the two pits near Rhenen) appears to conflict with an origin in loam layers : rolling, scratches (sometimes very coarse), brown patina. Artefacts enclosed in loam layers will generally be neither rolled, nor scratched, and not or hardly patinated.

The frequent occurrence of the phenomena mentioned is far more indicative of a layer of coarse gravel as the artefact-bearing level. It is therefore satisfying that the B.A.I.-excavations have shown that the lowermost 1-2 metres of unit 5 contain

relatively many artefacts - these are the most coarse layers (sandy gravels) that are exposed in the Kwintelooyen quarry (see for more comments on the stratigraphical allocations by Franssen and Wouters : Stapert, 1981b).

It can be said that the collections from the gravel dumps, the isolated finds from the quarry, and the excavation finds (from unit 5) are reasonably comparable, as far as the patination, scratching and degree of rolling are concerned, and typologically too, which is an argument against the existence of several artefact-bearing levels.

The degree of rolling within the different groups of artefacts can be summarized as follows :

	finds from the dumps	isolated finds from the quarry	excavation finds
not/hardly rolled	14 %	17 %	17 %
slightly/moderately rolled	80 %	76 %	79 %
severely rolled	6 %	7 %	4 %
total no.	152	30	47

In view of the fact that unit 5 was deposited by a fast-flowing river, involving the washing-out of earlier sediments, the following hypotheses are possible :

I. all artefacts originate from older layers (in this case unit 4 and/or layers that have disappeared);

II. some originate from unit 4 and/or layers that have disappeared, and some were left behind in the valley after the deposition of unit 4, i.e. shortly before or during the deposition of unit 5;

III. all artefacts date from after the deposition of unit 4, and were left behind in the valley shortly before or during the deposition of unit 5.

Three observations argue against hypothesis I :

1. the occurrence of artefacts that are neither rolled nor patinated;
2. the occurrence of distinct Middle-Palaeolithic artefacts (levallois-flake, -blades), while in any case the lithological unit 4 must be regarded as being probably far too old to have contained these (see under 3);
3. the absence of any finds made by us so far in unit 4. During the State Geological Survey investigation too (larger) flint were never found in these layers (personal communication Mrr. G.H.J. Ruegg).

An argument in support of hypothesis II is the occurrence of artefacts that give a typologically older impression (the chopper, the "*bec*"-like tool, the so-called "Clacton flakes"). This is however no absolute argument - similar forms also occur within the Middle-Palaeolithic and later phases of prehistory. An argument against hypothesis II is observation 3, that supports hypothesis III. Another independent argument for hypothesis III is possibly the fact that in all layers below that of unit 5 practically no coarser gravel occurs. For it is clear that the artefacts occurring within unit 5 have been fashioned out of the larger rolled (Meuse) flints that are

present in these layers. In older layers this raw material for the production of artefacts is not present, so any artefacts that my be present in them must have been transported from elsewhere. To summarize : hypothesis I is extremely improbable; hypothesis II cannot be excluded, but hypothesis III clearly seems to be the most probable at this moment. This would indicate as a possible dating one of the interstadials of the Saalian.

With hypothesis II these is, however, also the possibility that layers dating from the Holsteinian and/or Elsterian, that as a result of erosion are no longer present, have contained artefacts that are now to be found in unit 5. The fauna is perhaps indicative of this possibility (see under 5). Typologically this is difficult to establish, however, while it is otherwise clear that in any case many artefacts are more or less equally as old as the deposit in which they are present (on the basis of the presence of ca. 15 % unrolled artefacts, and the levallois core-technique).

The chance of making primary *in situ* finds within the gravel layer of unit 5 appears to be very slight from a geological point of view in the Kwintelooyen quarry.

If we now survey all the archaeological material that is now known to us from the Kwintelooyen quarry, then we can make the following general remarks. The tools account for ca. 9 %, with the scrapers predominating (ca. 50 % of the tools). Remarkable are the *blattförmiger Schaber* and the scrapers made out of natural pieces of flint. In addition there are also points, several *disques*, several choppers (mostly of quartzite), Clacton notches, and also hand-axes, but these are scarce. Among the non-tools there are relatively many so-called "Clacton flakes", and only a few soft percussion flakes. The levallois technique is represented, although levallois cores and flakes to not occur in large numbers. Remarkable is the relatively frequent occurrence of sometimes retouches (levallois) blades or blade-like flakes (8 to 9 %), which are sometimes very regular. None of the finds is burned.

In our opinion the material can be interpreted archaeologically as representing only one tradition, namely early Middle Palaeolithic. (The Middle Palaeolithic is defined here as the period of the Old Stone Age, as characterized by the distinct presence of the levallois core-technique).

There are various sites in surrounding countries (including Biache-Saint-Vaast : Tuffreau, 1978 and Montières, *basse terrasse* : Tuffreau, 1979) that have been dated to approximately the same time and which are reasonably comparable with Kwintelooyen typologically. Here I would draw attention especially to the already long-known site of Markkleeberg (Grahmann, 1955; Bosinski, 1967). This site forms also from a geological point of view a remarkable parallel with Kwintelooyen - the finds occur within a sequence of layers of sand containing much gravel (and then mainly in the lower part), that was deposited relatively soon before the arrival of the Saalian ice-sheet. Among the flint material the high proportion of (levallois) blades and blade-like flakes is especially striking. Also levallois cores and flakes are present. Many flakes can be described as "Clacton flakes". Hand-axes are very scarce, scrapers are

very scarce, scrapers are the most abundant among the tools, while in addition a number of points and at least one *disque* are present too. In my opinion Kwintelooyen can be classified within a group of sites that are early Middle Palaeolithic, and of which the most striking characteristics are the scarcity of hand-axes and the abundance of blades, while the levallois core-technique is represented. Within the classification customary in Western Europe Kwintelooyen could be ascribed to the Upper Acheulian. Recently Upper Acheulian finds have been excavated in the extreme south of the Netherlands, near Maastricht (Modderman & Roebroeks, 1981). The finds come from Saalian loess deposits, and can probably be dated to one of the Saalian interstadials. Especially striking is the occurrence of levallois blades. A lower level, in fluviatile (Meuse) deposits (perhaps Early Saalian), also yielded finds, including levallois flakes, but so far no blades (Roebroeks, personal communication 1981). This situation is perhaps an argument in favour of the provisional hypothesis of the present author, that (all of) the finds from Rhenen probably have not been washed out of older deposits. The most likely dating, for the meantime, for the finds from Rhenen would therefore be the Hoogeveen interstadial (and/or perhaps the second stadial) of the Saalian.

The geological constitution of the 2 other quarries (near Rhenen) has not been investigated in any detail (see 4). The finds from these quarries do however strongly resemble those from the Kwintelooyen quarry in all respects, so it can provisionally be assumed that we are concerned here with the same layer as in the Kwintelooyen quarry.

In addition it can be mentioned that this ice-pushed ridge has yielded comparable finds elsewhere too, e.g. from Huizen (obtained by suction-dredging from the IJsselmeer), at least 3 sites near Hilversum, and several sites elsewhere (Stapert, 1981-c). Finds from *after* the Saalian ice cover are also known from the *surface* of this (and other) ice-pushed ridge(s), but appear to be more scarce (Stapert, 1981-c). It is clear, that the (younger) coarser deposits of the Urk Formation are for over great distances very rich in artefacts, dating from the Early Middle-Palaeolithic.

8. SUMMARY

From 3 sand-pits in an ice-pushed ridge near Rhenen (Central Netherlands) several thousands Palaeolithic artefacts have become known in recent years. This ice-pushed ridge consists of fluviatile deposits, that were pushed up by the Saalian ice-sheet, dating from the Early and Middle Pleistocene. In the course of several excavations in the Kwintelooyen quarry several dozen artefacts were recovered from a gravel layer (deposited by a fast-flowing meandering river), that can be dated in the Middle Saalian. For the finds made during the excavations the density of finds was somewhat more than : 1 artefact per 1.5 cubic metre of gravel and sand. The chance of making primary *in situ* finds appears to be very slight from a geological point of view. The

material can be described archaeologically as early Middle Palaeolithic (Upper Acheulian). Among the tools (ca. 9 %) the scrapers are predominant (ca. 50 %). In addition there are smaller numbers of points, *disques*, choppers, Clacton notches and rarely handaxes. Levallois flakes and cores occur in relatively small numbers, but (levallois) blades and blade-like flakes are relatively abundant. The site of Markkleeberg can be indicated as a clear parallel. The possibility that the artefact-bearing gravel layer also contains finds that have been washed out of older (now disappeared) layers (e.g. Holsteinian) cannot be excluded, but cannot be established with any certainty either.

ACKNOWLEDGEMENTS

For their part in the realization of this article I am greatly indebted to the following persons and institutions. Mr. C. Lagerwerf, Mr. H. Drost, Mr. A. Knöps, Mr. J.M. Leinders, Mr. H. Kars, Mr. G.H.J. Ruegg, Mr. J.G. Zandstra, Mr. J. De Jong, Mr. T. van Kolfschoten, Mr. R. Borman, Mr. W.J. van Tent, Mr. H.R. Roelink, Mr. J.M. Smit, Mrs. J. Milojković, Mrs. E. Rondaan-Veger, Mrs. S. van Gelder-Ottway, Mr. W. Roebroeks, the members of the department Zuid-Veluwe and Oost-Gelderland of the A.W.N., and several B.A.I.-students and friends.

Biologisch-Archeologisch Instituut
Groningen

REFERENCES

BORDES F., PRAT F. 1965. Observations sur les faunes du Riss et du Würm I en Dordogne. *L'Anthropologie* 69, pp. 31-46.

BORDES F., LAVILLE H., PAQUEREAU M.-M. 1966. Observations sur le Pleistocène supérieur du gisement de Combe-Grenal (Dordogne). *Actes de la Soc. Linn. de Bordeaux* 103, série B, no. 10, pp. 3-19.

BOSINSKI G. 1967. *Die mittelpaläolithischen Funde im westlichen Mitteleuropa* (= Fundamenta A/4). Köln/Graz.

BOSSCHA ERDBRINK D.P., MEIKLEJOHN C., TACOMA J. 1979. An complete, probably neanderthaloid femur from the Grebbeberg in the Central Netherlands. *Proc. Kon. Ned. Akad. Wetensch.*, serie C, vol. 82, pp. 409-420.

DOPPERT J.W.CHR., RUEGG G.H.J., VAN STAALDUINEN C.J., ZAGWIJN W.H., ZANDSTRA J.G. 1975. Formaties van het Kwartair en Boven-Tertiair in Nederland. In : W.H. Zagwijn & C.J. van Staalduinen (eds.), *Toelichting bij geologische overzichtskaarten van Nederland*. Haarlem, pp. 11-56.

FRANSSEN C.J.H., WOUTERS A.M. 1977. Archeologisch onderzoek van stuwwallen in de provincies Gelderland en Utrecht. *Archeol. Ber.* 1, pp. 1-25.

FRANSSEN C.J.H., WOUTERS A.M. 1978a. Kort bericht over een recent gevonden skelet van de bosolifant in relatie met het Midden-Acheuleen. *Westerheem* 27, pp. 13-19.

FRANSSEN C.J.H., WOUTERS A.M. 1978b. Recente vondst van een Midden-Acheuleen vuistbijl. *Westerheem* 27, pp. 67-69.

FRANSSEN C.J.H., WOUTERS A.M. 1978c. Beknopt voorlopig rapport over het Oud-Palaeolithicum in Nederland. I. Gelderse en Utrechtse stuwwallen. *Archeol. Ber.* 4, pp. 4-38.

FRANSSEN C.J.H., WOUTERS A.M. 1979. Monografie over het Oud-Palaeolithicum in de Nederlandse stuwwallen. Deel I. *Archeol. Ber.* 6, pp. 5-141.

FRANSSEN C.J.H., WOUTERS A.M. 1981a. Het Oud-Palaeolithicum in de Nederlandse stuwwallen. II. Midden-Acheuleen. *Archeol. Ber.* 9, pp. 6-90.

FRANSSEN C.J.H., WOUTERS A.M. 1981b. Artefacten uit het Waalien C. *Archeol. Ber.* 10, pp. 118-123.

GRAHMANN R. 1955. *The lower palaeolithic site of Markkleeberg and other comparable localities near Leipzig* (= Transact. Am. Philos. Soc., N.S., vol. 45, part 6, pp. 509 e.v.). Philadelphia.

JELGERSMA S., BREEUWER J.B. 1975. Toelichting bij de kaart glaciale verschijnselen gedurende het Saalien, 1:600.000. In : W.H. Zagwijn & C.J. van Staalduinen (eds.), *Toelichting bij geologische overzichtskaarten van Nederland.* R.G.D., Haarlem, pp. 93-103.

JONG J. de. 1981. Pollen-analytical investigation of ice-pushed deposits of the Utrechtse Heuvelrug at Rhenen, the Netherlands. *Meded. Rijks Geol. Dienst* 35, pp. 192-203.

KOLFSCHOTEN T. van. 1981. On the Holsteinian? and Saalian mammal fauna from the ice-pushed ridge near Rhenen (the Netherlands). *Meded. Rijks Geol. Dienst* 35, pp. 223-251.

LAVILLE H. 1973. *Climatologie et chronologie du Paléolithique en Périgord : étude sédimentologique de dépot en grottes et sous abris.* Thèse, Bordeaux.

MAARLEVELD G.C. 1953. Standen van het landijs in Nederland. *Boor en spade* 6, pp. 95-105.

MAARLEVELD G.C. 1981. The sequence of ice-pushing in the Central Netherlands. In : J. Ehlers & J.G. Zandstra (eds.), Glacigenic deposits in the southwest parts of the Scandinavian incesheet. *Meded. Rijks Geol. Dienst* 34, pp. 2-6.

MODDERMAN P.J.R., ROEBROEKS W. 1981. Maastricht-Belvédère. *Bull. Kon. Ned. Oudheidk. Bond* (Archeologisch Nieuws) 80, pp. 162-167.

RUEGG G.H.J. 1975. Sedimentary structures and depositional environments of Middle- and Upper Pleistocene glacial time deposits from an excavation at Peelo, the Netherlands. *Meded. Rijks Geol. Dienst* N.S. 26, pp. 17-37.

RUEGG G.H.J. 1981. Ice-pushed Lower and Middle Pleistocene deposits near Rhenen (Kwintelooyen) : sedimentary-structural and lithological/granulometrical investigations. *Meded. Rijks Geol. Dienst* 35, pp. 165-177.

STAPERT D. 1980. Rhenen (gem. Rhenen). *Bull. Kon. Ned. Oudheidk. Bond* (Archeologisch Nieuws) 79, pp. 36-42.

STAPERT D. 1981a. Rhenen (gem. Rhenen). *Bull. Kon. Ned. Oudheidk. Bond* (Archeologisch Nieuws) 80, pp. 56-63.

STAPERT D. 1981b. Archeological research in the Kwintelooyen Pit, Municipality of Rhenen, the Netherlands. *Meded. Rijks Geol. Dienst* 35, pp. 204-222.

STAPERT D. 1981c. Hilversum; Huizen. In : P.J. Woltering, Archeologische kroniek van Noord-Holland over 1980. 13, pp. 205-209.

TUFFREAU A. 1978. Les fouilles du gisement paléolithique de Biache-Saint-Vaast (Pas-de-Calais) : années 1976 et 1977 - premiers résultats. *Bull. de l'Ass. franç. pour l'Etude du Quaternaire* 15, pp. 46-55;

TUFFREAU A. 1979. Recherches récentes sur le Paléolithique inférieur et moyen de la France septentrionale. *Bull. Soc. Roy. Belge Anthrop. Préhist.* 90, pp. 161-177.

VERBRAECK T. 1975. Ice-pushed ridges in the eastern part of the Netherlands River Area. *Geol. en Mijnb.* 54, pp. 82-84.

WATEREN F.M. van der. 1981. Glacial tectonics at the Kwintelooyen Sandpit, Rhenen, the Netherlands. *Meded. Rijks Geol. Dienst* 35, pp. 252-268.

WEE M.T. ter. 1962. The Saalian glaciation in the Netherlands. *Meded. Geol. Stichting* N.S. 15, pp. 57-76.

WEE M.T. ter. 1966. *Toelichtingen bij de geologische kaart van Nederland 1 : 50.000, Blad Steenwijk Oost (160).* R.G.D., Haarlem.

WEE M.T. ter. 1979. *Toelichtingen bij de geologische kaart van Nederland 1 : 50.000, Blad Emmen West (17W) en Emmen Oost (170).* R.G.D., Haarlem.

WEE M.T. ter. 1981. The Saalian glaciation in the Northern Netherlands. In : J. Ehlers & J.G. Zandstra (eds.), Glacigenic deposits in the southwest parts of the Scandinavian icesheet. *Meded. Rijks Geol. Dienst* 34, pp. 7-9.

ZAGWIJN W.H. 1973. Pollenanalytic studies of Holsteinian and Saalian beds in the Northern Netherlands. *Meded. Rijks Geol. Dienst* N.S. 24, pp. 139-156.

ZAGWIJN W.H. 1975. Indeling van het Kwartair op grond van veranderingen in vegetatie en klimaat. In : W.H. Zagwijn & C.J. van Staalduinen (eds.), *Toelichting bij geologische overzichtskaarten van Nederland.* R.G.D., Haarlem, pp. 109-114.

ZANDSTRA J.G. 1966. Zware mineralen- en grindonderzoek van groeve Leccius de Ridder te Rhenen. *R.G.D., Sed. Petr. Dept., Internal Report* 110, 2 pp.

ZANDSTRA J.G. 1971. Geologisch onderzoek in de stuwwal van de oostelijke Veluwe bij Hattem en Wapenveld. *Meded. Rijks Geol. Dienst* N.S. 22, pp. 215-260.

ZANDSTRA J.G. 1975. Sediment-petrological investigations of a boring and an excavation at Peelo (Northern Netherlands). *Meded. Rijks Geol. Dienst* 35, pp. 178-191.

1.- This bone (property of the Museum voor het Onderwijs, Den Haag) has recently been subjected to an analysis by the C14-Laboratory in Groningen. The result was: 1330 ± 110 B.P. (GrN-12079); it now seems clear, therefore, that the bone dates from the Middle Ages.