V. The Working Group's Excavations

1. Aims and objectives

During Waterbolk's 1964 investigations it became apparent that the Rijckholt mine field must be of an extent hitherto unknown. In the plateau trench a good many filled-in shafts were discovered. In the trial trench adjacent to the Grand Atelier a few shallow niches were visible which could possibly represent mining galleries. If this was the case, then it could be assumed that more shafts must exist between these galleries and the mine field on the plateau, 150 metres distant (WATERBOLK 1994).

Opportunities for underground research were out of Prof. Waterbolk's reach. Such an investigation could only be carried out by asking professional miners to join. Then the specially formed 'Prehistoric Flint Mines Working Group' of the Dutch Geological Society, Limburg Section, offered its services. For a large part, this group comprised well-trained miners and technicians of the Limburg collieries, who were familiar with local geology and who were interested in the archaeological aspect of the investigations. This team offered its free time and energy for which they received no compensation over a number of years. When permission was granted to the working group it was duly noted that there were no funds available for this research, which meant that the team itself had to work out where to acquire the necessary means.

The main goal of the excavation was to demonstrate the feasibility of driving an underground reconnaissance tunnel across the mining area and examine the thus exposed mining galleries from there. The choice of a horizontal reconnaissance gallery was based on the fact that the flint layer crops out in the 'Grand Atelier'.

2. Working methods during the excavation

On May 21, 1964, W.M. Felder contacted Staatsbosbeheer in order to obtain permission to continue the excavation carried out by Waterbolk at Rijckholt-St. Geertruid. The next day, during an excursion of the Dutch Geological Society, members of that society were asked to join in the excavation of the prehistoric flint mines at Rijckholt-St. Geertruid. After the first preliminary permits had been granted, on June 6, 1964 the excavation was started. None of the members had ever participated in an excavation, but they did have mining experience and were trained in geology. It was for the first time that miners were about to excavate prehistoric mines.

By mutual agreement it was decided to dig a tunnel between the two excavation sites on the plateau and on the wooded slope, respectively, where Waterbolk had encountered flint mining activities (Fig. 5). The tunnel was to follow the level of the prehistoric flint mines as closely as possible. We started clearing the dumped material at the lowest of Waterbolk's excavation sites, from where the tunnel had to be driven. Since only wooden props were available, a wooden structure was built at the entrance of the tunnel. On June 13, 1964 the first three timber props were placed in the tunnel; it was thought desirable to dig a trench as a ramp for the wheelbarrows that were used for the transport of excavated material.

At first, two wheelbarrows were available. When one of these was filled up it was pushed outside, making way for the other. To make sure that this ran smoothly a platform was made in front of the ramp, the so-called wheelbarrow loop.

The work method was adapted to the available financial means, especially during the trial excavation. During this excavation virtually no money was available. Unavoidable costs such as lighting and tools were borne by the members themselves. This explains why we had only manual tools such as hammers, saws, pickaxes, shovels and a very large saw for cutting limestone. Later, a grant-in-aid from the Dutch Organization for Pure Scientific Research allowed us to pay 50% of the mining costs. All other costs were covered by sponsorship, in kind or otherwise.

The first props placed were made of wood as at that time no other material was available. Being miners, we knew that timber in fact was an inferior material, as it goes mouldy in a short period of time and rots in underground workings. Timber supplied by the State Forestry

Fig. 10 Prehistoric gallery with the original fill of chalk rubble.

Service was felled at the site as required. It was also clear to us that at a later stage the timber props must be replaced by steel ones. The size of the wooden roof props placed in the tunnel during the trial excavation corresponded to that of the steel replacements, viz. width and length of 2 m.

On July 4, 1964 the first prehistoric gallery became visible. The fill of galleries consisted of loose chalk rubble and thus differed clearly from the solid limestone, which greatly facilitated their recognition (Fig. 10). That the galleries, which were generally not higher than 60 centimetres, were largely filled was a surprise to some of the participants. They had expected to find empty galleries.This showed that different views were held on working methods in the prehistoric flint mines. A lot had yet to be learnt and discovered. After unearthing the first gallery a fence was placed at the entrance of the tunnel, in order to prevent unwanted visitors from disturbing the prehistoric workings. Despite all our efforts to obtain more information in the literature on prehistoric flint mining and methods of excavation employed, we did not come across any report of an excavation executed from a tunnel. Excavations described in the literature did not give any or only few answers to the many questions we had at that time. We had to find out for ourselves how to proceed with this excavation and to rely on mining experience gained in the Limburg collieries.

After discovery of the prehistoric galleries we started to excavate the loose rubble from them (Fig. 11), and then the first remains of prehistoric tools (stone picks) were found (July 7, 1964). These artefacts were called *hakken* (picks) because in our opinion, they had been used in this way. From the very start we thought it necessary to measure these finds three-dimensionally, using the exploited flint layer as a base. The method of measuring, however, changed over the years, which will be described elsewhere.

The chalk rubble was cleared from the gallery by means of a modified shovel with short handle and a flat, curved blade. At times it proved easier to use our hands and feet instead. The loose rubble was shoved backwards and pushed further away using our feet. Eventually it was loaded into a wheelbarrow and taken outside. Outside the tunnel it was dumped to be taken away by the State Forestry Service.

From the outset it was obvious that first the prehistoric galleries had to be surveyed and

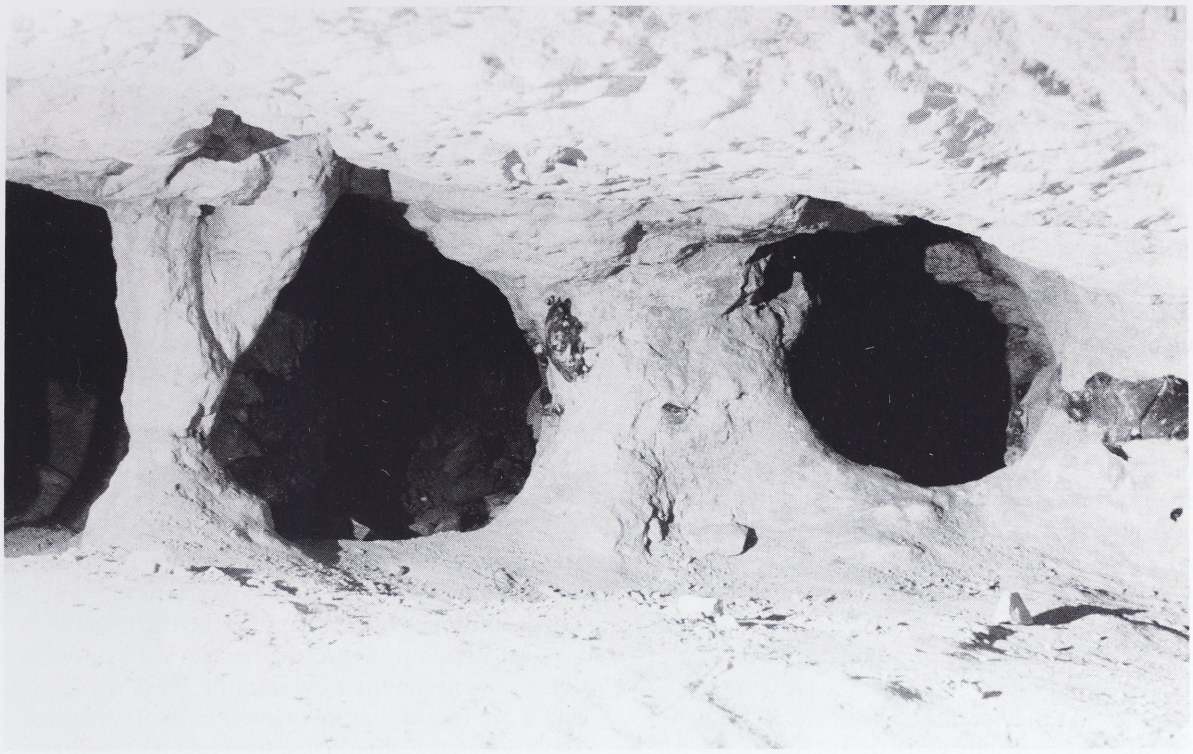

Fig. 11 Cleared prehistoric gallery with pillars left standing for safety reasons.

measured, before work on the tunnel could proceed. After all, by digging a tunnel, portions of the prehistoric galleries would be destroyed. Thus we were soon forced to measure not only the finds but also the galleries.

While clearing the galleries it was discovered that between the various galleries there were points of connection too small to crawl through. These we called 'breaches' (Dutch: *vensters* = windows) since they offered an insight into an adjoining gallery (Fig. 11).

In addition it proved increasingly more difficult to remove material from the gallery as this was emptied further and further. After some two metres had been cleared a second man was needed to transport the excavated rubble to the exit. Later we came up with a solution, in loading the material onto a long narrow sledge-like chest on towing runners and by pulling this outside using thick ropes. By also attaching a rope to the rear end the empty chest could be drawn back in again. Such a chest was called a *hond* (= dog) in the mining trade. Later these 'dogs' were made of steel and had wheels. From November 2, 1964 to April 23, 1965 the excavation was largely halted awaiting formal permits of government and *Staatstoezicht op de Mijnen* (State Mines and Quarries Inspectorate) to come through. In this period a small group of people reflected on how to proceed with the investigations of the prehistoric galleries and shafts. To attract less attention to our activities which took place mainly on free Saturdays, we from then on worked on Friday night.

Not until November 2, 1964 did we start work on a shaft (Shaft 1). Until that time, we had no good idea of what a shaft looked like. Thus it happened that a shaft was not recognised instantly but much later: Shaft 73 was the first to be discovered, but only much later recognised as such. Further difficulties in recognising shafts were encountered. Occasionally, solution structures were mistaken for a shaft.

Each working day again the newly discovered phenomena were discussed by the group, making sure that each participant was familiar with our changing views. Methods of working were continually adapted to these new ideas. Thus not only the recording procedure changed, but also the excavation itself. For descriptions of methods, not yet influenced by experience gained later, reference is made to publications which appeared during the time of excavation (RADEMAKERS 1964).

It soon became clear to us that the prehistoric galleries had been filled with chalk spoil from other galleries. The prehistoric miners thus

saved themselves the trouble of transporting the chalk to the surface. For this reason, we were later even more surprised to find empty galleries rather than backfilled ones. Despite the fact that in the beginning some participants assumed the loose material to have been brought to the surface, it appeared more difficult now to come up with explanations for an empty rather than a filled gallery. Naturally all kinds of theories were proposed, which subsequently were compared with excavation results. Only then could such a theory be more or less accepted by the whole group.

Since an empty gallery often lay between two shafts we eventually assumed that this had been left empty as a safety measure. From then on, these empty galleries were called 'safety exit' or 'safety gallery'. At other sites the last working spot in the mine was not filled either.

On October 30, 1964 the first snail shells were found on top of the fill of prehistoric galleries. The shells appeared so fresh that some of us doubted that they could be prehistoric. Later similarly 'fresh' shells were found inside the fill so that there could be no doubt as to their prehistoric age.

At shaft 10 many shells were found. Here it appeared impractical to collect all shells separately as had been done before with all earlier finds. It was decided to take a large sample and study this at home. The excavation was halted temporarily at that site until the results of the study became available. At home, the sample was placed in a large tub with water, in order to float all shells and bones. Thus all finds could be scooped up easily with a sieve. Later it turned out that all material containing snail shells had been included in this large sample; no further finds were made in Shaft 10.

On October 14, 1966 near Shaft 15 a large number of snail shells and animal bones were encountered. A sample was taken for analysis at home. It appeared to contain twenty-one remains of rodents and 160 shells. During subsequent excavation of Shaft 15 samples were taken at all levels and studied (Report 7). The same was done of course in all subsequent shafts (Report 32).

On November 15, 1964 for the first time charcoal was found in the fill of Shaft 4. It was obvious that this had been thrown in from above. On December 19, 1964 Prof. Waterbolk himself came to view the find circumstances of the charcoal. Nowhere did we find any traces of underground fires (hearths), which is why we assumed the charcoal to have been dumped.

On November 26, 1964 we reached van Giffen's 1923 excavation. This was readily apparent from the way the gallery had been filled at that site. In the fill there were pieces of wood and paper.

During excavation of the first galleries we regularly encountered bones of small animals (possibly mice). At first, we assumed that the mice had crept in from the sides and could thus not be considered prehistoric finds. At Shaft 10, however, we discovered that relatively many bones occurred in a sandy fill which had probably been washed in. The bones were thus of the same age as this 'washed in' layer. We then also noted that the snail shells were found in positions that they could only have reached by crawling there. We had to conclude that live snails and mice had fallen into the open shafts in prehistoric times. Remarkable also were a few hazelnuts in the fill: how had these got there? Later we found that mice lived in the prehistoric galleries that we had cleared. They had dragged about spent flash bulbs. We even found these in galleries that we could not have entered previously. In this way we learnt to be extremely careful in drawing conclusions and in not littering the site.

Upon completion of the trial excavation (April 23, 1965) it was decided that each member from then on would himself measure all finds and enter details on so-called 'finds forms'. Later it appeared, however, that these forms had been filled in in different ways according to experience and knowledge of the person involved.

It will be clear by now that the views held by the various participants on prehistoric flint mining were and remained different, even after lengthy discussions held during breaks. One of the points, for example, from the very start was whether the prehistoric miners' picks had handles or not. Not until after the discovery of voids (October 14, 1966), with calcified wood on the floor of the void, did the discussions about this become less frequent. We assumed these voids to represent decayed handles.

On April 23, 1965 the official permit to excavate was obtained; now we could try to obtain funding and contact firms for supply of material. On May 14, 1965 we were able to start anew by replacing the timber props by steel

Fig. 12 The modern tunnel dug right across the prehistoric mining area after having been secured with steel supporting props.

ones (Fig. 12) and on May 22, 1965 rails and tip carts could be transported to the excavation site. On June 11, 1965 we experienced a large-scale roof collapse in the tunnel as a result of replacing the props. The clearance of this collapsed material, the supply of all kinds of material and the construction of rails took until September 18, 1965. Subsequently, an iron fence was placed at the entrance and a hand-operated winch at the end of the rails to be able to pull the filled tip carts out of the tunnel. The wheelbarrows had become superfluous. On August 20, 1966 an old motor scooter engine was built in to replace a winch at the end of the rails.

During deepening and widening of the tunnel entrance (November 26, 1965) a number of prehistoric stone picks were found on the floor which showed that while erecting the wooden entrance structure we had not recognised the underlying prehistoric gallery. This was explained as follows: loose rubble from a collapse lay on top of the fill of the gallery. Further it was determined that the prehistoric miners had dug into the fill of the workshop, since one of the galleries had been deepened at the end to the level of the fill of the 'Grand Atelier' and had then been filled with chalk rubble. We concluded that the Atelier had been filled before this gallery was started.

On November 5, 1965 we excavated the tunnel further, at which, at 12.30 pm, a human skull was found (see Section 7.5.1 and Report 5).

In digging the tunnel and placing steel props we proceeded as follows. First the prehistoric galleries exposed in front were studied and measured, after which we continued in the usual way in mining. At the front, a space was cleared for a new prop. After that the so-called leader rails were advanced and on the leader rails the so-called hood was placed, and eventually two props were placed below the hood. To finish packing irons were positioned between the former and the new construction, which prevented material from collapsing from the roof and walls. Finally the leader hooks (three on each side), to which the leader rails were attached, were all pushed ahead one prop. The distance between individual supporting props was a metre. After completion of the above, the tunnel had thus progressed a metre. After every three metres, rails, and later conveyor belt, were extended.

Work in the tunnel was initially done using manual tools only. We used steel pickaxes and special saws formerly employed in the extraction of chalk blocks for building. Later (January 21, 1966) we obtained from the Atlas-Copco firm a compressor enabling the use of a pneumatic hammer for breaking up the chalk.

Late in 1965 prop 18 was placed at the end of the tunnel. Late 1966 the tunnel was 39 metres long and a year later 97 m, late 1968 113 m, late 1970 123 m, and at the end of 1971 the greatest length of 137 m had been reached.

On January 19, 1968 part of the excavated area collapsed. In part, this was a result of increased mechanisation causing the tunnel to progress rapidly in length. We noted that, in future, we would have to support better the excavated galleries, especially near the tunnel.

Illumination underground consisted at the beginning of paraffin lamps. Later we had a car battery at our disposal to feed tunnel lights, while for working in the galleries electric miners' lamps were used. In the end we obtained an electric generator (December 2, 1965) to ensure the total electricity supply. This also enabled us to regularly recharge the batteries of the miners' lamps.

While clearing the prehistoric galleries it proved necessary to have supporting props in some places. Initially timber was used. Later we had a blacksmith saw iron tubes into pieces and weld iron plates to the ends. These were our iron props, which put a halt to the rotting of timber in the prehistoric mines. Only in the more unstable places did we use steel props similar to the ones used in coal mining.

By digging a tunnel (twice over at the beginning, first in timber, then in steel), the soil's equilibrium had been heavily disturbed. The cleared galleries there became so unstable that we were forced to line them entirely. Therefore we used (half)cylinder segments which in collieries were used to transport coal vertically downwards.

More than once we experienced difficulties with solution pipes. These gravel/sand pipes are dissolution funnels occurring in the chalk, filled with collapsed material from the top soil. Very often this material kept on falling behind us during tunnel construction. To avoid further collapse we had to drive iron plates in over the last hood so that a roof of iron plates arose, underneath which a new hood could be placed. In spite of all precautionary measures we experienced more collapses near these solution pipes and had to work long and hard to secure everything anew.

Between props 22 and 23 (February 19, 1966) the first fault was encountered in the chalk and immediately behind it a very large gravel pipe. Only at prop 27, i.e. 5 metres further on, did we find chalk again as well as a prehistoric gallery. The fault meant that we could not continue horizontally in digging the tunnel. We had to go higher to follow the galleries. Near prop 31 (July 27, 1966) another fault was located and at prop 34 it appeared that galleries were present above the tunnel. This caused serious problems with the railed transport of tip carts, since we had to redirect the tunnel. We decided to find out if we could obtain a conveyor belt.

On November 23, 1966 the first portion of the conveyor belt was delivered and on January 27, 1967 we started taking out the rails and placing the conveyor belt (Fig. 13). Now it had become possible to clear away rubble from all places in the tunnel by throwing it onto the conveyor belt. No people were needed anymore to transport the material outside, which meant an increase in the number of people actively involved in digging.

From January 1, 1967 the number of participants grew to 13, to 15 on July 1, 1967, 19 on December 31, 1967, and in 1968 to a maximum of 23. Digging could thus proceed in increasingly more places.

Initially it was customary that, when something special was found, everyone went there to have a look. As the number of excavation sites increased, this and the discussion of special features declined. The special finds were then examined by only one of the experienced diggers. Naturally, this work method meant that not all workers were and became similarly experienced. Some of us had participated since the very start while others had not. To prevent data from getting lost in this way, a report book was put in the shed (February 19, 1967) in which special features could be entered.

In addition to digging there were of course diverse other activities, such as the measuring of excavated galleries, maintenance of technical equipment and extension of the tunnel. As the excavated area increased so did these activities, with the result that the more experienced diggers had to perform other tasks more often,

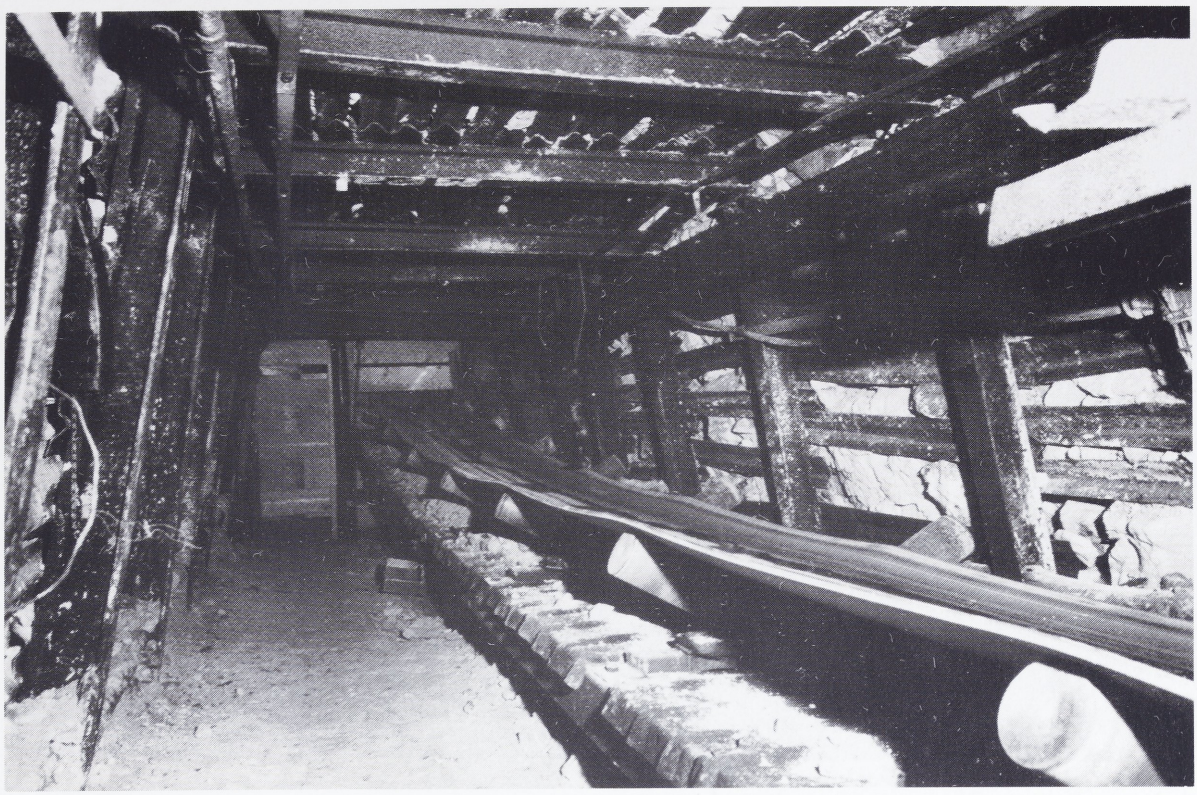

Fig. 13 The conveyor belt in the tunnel.

while more and more inexperienced people did the actual digging. Naturally, a kind of supervision by the more experienced diggers was adhered to.

Finds made during the excavation at first comprised almost exclusively stone picks. Fragments of such were soon recognised (at least the larger amongst them). After the first void in the fill of a gallery had been found (October 14, 1966), more voids were encountered (see Report 6). The same holds true for hammerstones. W.M. Felder had found a hammerstone on the tip outside the mine (June 18, 1966); on July 7, 1967 a hammerstone was collected from the mine. After this discovery many more followed (see Report 36).

On December 4, 1964 a concentration of stone picks, 15 pieces in all, was found in a small area (50 by 50 centimetres). Later we referred to such concentrations of stone picks as 'hoards' (Fig. 14). As soon as we had recognised hammerstones we found these more often in such hoards.

On discovering the hammerstones we soon assumed that some of these had been used to resharpen blunt picks. Unfortunately we did not look for the small flakes that were produced in the process. We did look for larger flakes, which in general were plotted. In the galleries only very few flakes were found. The majority were collected from the fill of shafts.

From the very beginning we distinguished three main types of stone picks. According to shape, these were referred to as triangular, quadrangular and axe-shaped picks. In spite of the fact that we later recognised all kinds of shapes (Report 24) we stuck to these names during the excavation.

The first deer antler was found on April 28, 1967. The number of deer antlers found during the excavation remained very low (Report 11). At Shaft 11 three niches were discovered from which flint had been extracted at two metres above the regular flint bed exploited (October 28, 1966).

Rope marks at the shaft's mouth were not recognised until very late (February 5, 1971). At Shaft 49 very clear and and deep rope marks were found (Fig. 21). Subsequently, vague marks were also seen in shafts that had been excavated earlier.

In Shaft 24 for the first time a strong concentration of flint waste was encountered

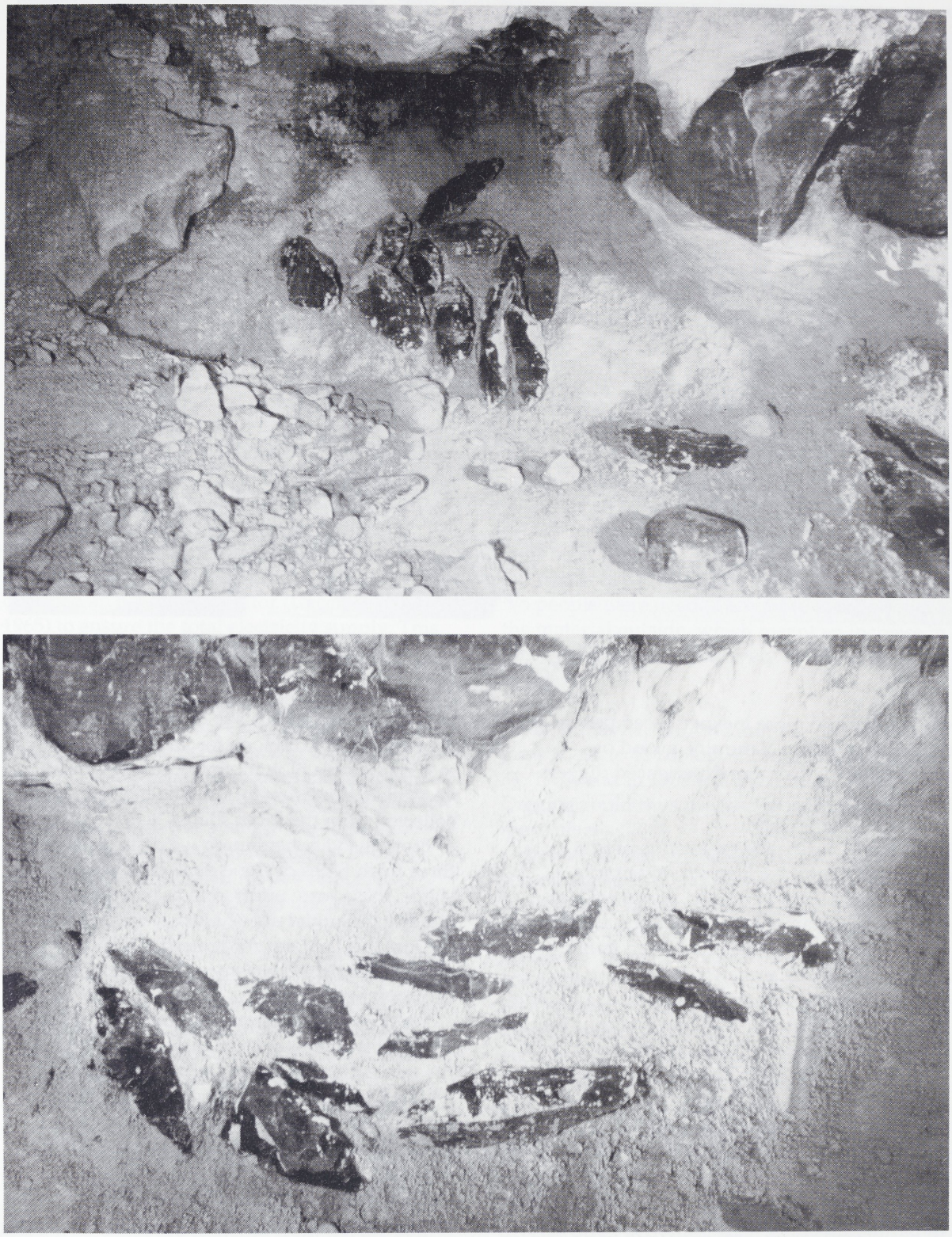

Fig. 14 Two of the stone pick 'hoards' encountered in the galleries.

(called the 'china cabinet'). Subsequently, flint waste was found in more shafts, and included cores.

The fill of a shaft generally consisted of a layer of chalk rubble, on top of which rested material thrown in from the surface. At times,

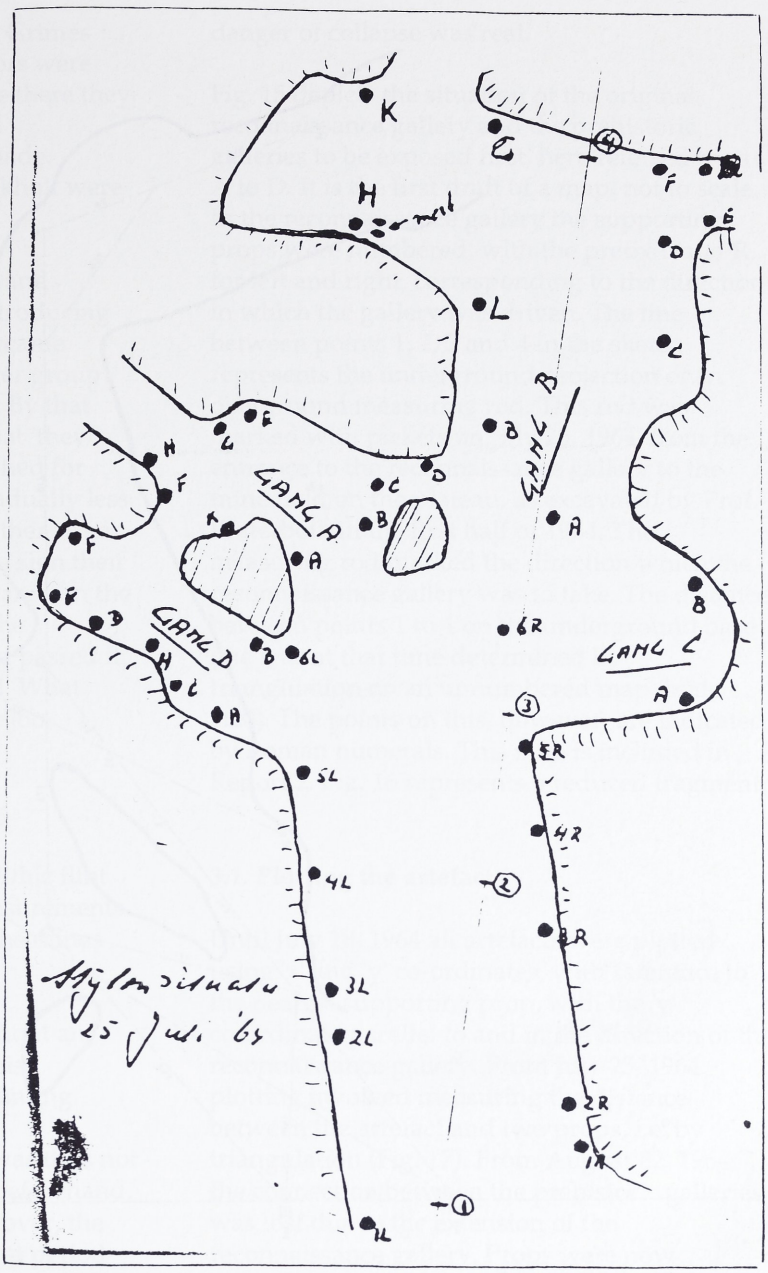

Fig. 15 First field sketch of the map drawn during the trial excavation.

traces of rain and/or mud wash were clearly visible. Higher in a shaft there was invariably a consolidated layer, which, during the excavation, prevented more material from collapsing behind us. A gravel/sand pipe, on the other hand, did not stop collapsing since there was no consolidated layer there. In general, the presence of chalk in the fill appeared to be a good indication of the presence of a shaft. The fill of solution pipes lacked chalk rubble.

The fill of prehistoric galleries generally consisted of chalk rubble that originated from digging the galleries. Into an empty gallery also other refuse was thrown, such as worn-out tools and unusable flint. There were clear differences in the degree of filling. Some galleries were entirely, others only partially filled and some were hardly filled at all. We characterised these latter as empty. When assembling data during the excavation care was taken to document the percentage of fill. Occasionally a level was discovered in the fill of a gallery which clearly showed that prehistoric miners had crawled about over the fill (crawling floor). These crawling floors were given but little attention during the Rijckholt-St. Geertruid excavation. Here crawling floors are poorly developed only

Fig. 16 Fragment of map illustrating measurements by triangulation.

on account of the crumbly chalk. At Grimes Graves (United Kingdom) these floors were recorded in transverse sections since there they were better developed, and allowed reconstructions of the filling to be made. Transverse sections of the fill at Rijckholt were drawn only in some instances.

As the number of participants grew and mechanisation advanced further, introducing improvements during excavation became increasingly more difficult. The larger group could no longer be reached directly. By that time, participants tended to think that 'they knew it all'. The report book in the shed for jotting down all tribulations was gradually less often used, and was looked upon rather as an attendance register. All they did was sign their names. Fewer and fewer notes appeared on the findsregistration forms over time. The excavation had reached its peak, and passed it, as far as discoveries were concerned. What followed now was more of a routine job.

3. Recording methods employed

During the investigation of the Neolithic flint mines at Rijckholt-St. Geertruid measurements were taken to record the outline of the mines surveyed and to plot artefacts.

The trial excavation was started without any insight into scope and duration of this excavation; eight years in all, not counting conservation.

Documentation of the first finds was thus not based on a procedure agreed upon beforehand, but ad hoc and so provisional. Moreover, the method of measuring during that first period was changed several times and adapted to the way the excavation developed. Annotated original measurements from this period can be found in Report 4.

When working out the measurements for the final plan at the end of the excavation campaign, the first data were indispensable as they could not be repeated. After all, in driving a tunnel (also called reconnaissance gallery, and, later, main gallery), portions of the exposed galleries were inevitably destroyed. Moreover, at that time a few of the small mining units situated at the outer end of the reconnaissance gallery had to be closed off. In this area, tree roots destabilised the already thin cover and the danger of collapse was real.

Fig. 15 depicts the situation of the original reconnaissance gallery and the prehistoric galleries to be exposed first, here referred to as A to D. It is the first draft of a map, not to scale. In the reconnaissance gallery the supporting props were numbered, with the prefix L and R, for left and right, corresponding to the direction in which the gallery was driven. The line between points 1, 2, 3 and 4 in the sketch represents the underground projection of an overground measuring rod. This rod was marked with pickets on July 25, 1964, from the entrance to the reconnaissance gallery to the mine field on the plateau, as excavated by Prof. Waterbolk in the first half of 1964. The measuring rod marked the direction which the reconnaissance gallery was to take. The distance between points 1 to 4 on the underground base line was at that time determined by triangulation on an unnumbered map (scale 1:20). The points on this, however, are indicated by Roman numerals. This map is included in Report 2. Fig. 16 represents a reduced fragment.

3.1. Plotting the artefacts

Until July 18, 1964 all artefacts were plotted using 'x' and 'y' co-ordinates, with reference to the nearest supporting prop, with the 'y' co-ordinate parallel to and in the direction of the reconnaissance gallery. From July 25, 1964 plotting involved measuring the distance between the artefact and two props, i.e. by triangulation (Fig. 17). From August 22, 1964, the connection between the prehistoric galleries was lost due to the extension of the reconnaissance gallery. Props were now identified by using coloured paint. Galleries A to D were renamed Blue, Red, Black and Green, respectively.

As soon as we had a base line in the reconnaissance gallery, this formed the basis for triangulation. Now the position of the supporting props, which up to that moment had been used as measuring points, could be recorded.

During the remainder of the excavation period the positions of artefacts were plotted using numbered measuring points, as based on trigonometry. The measuring points consisted of metal tokens with serial numbers. New

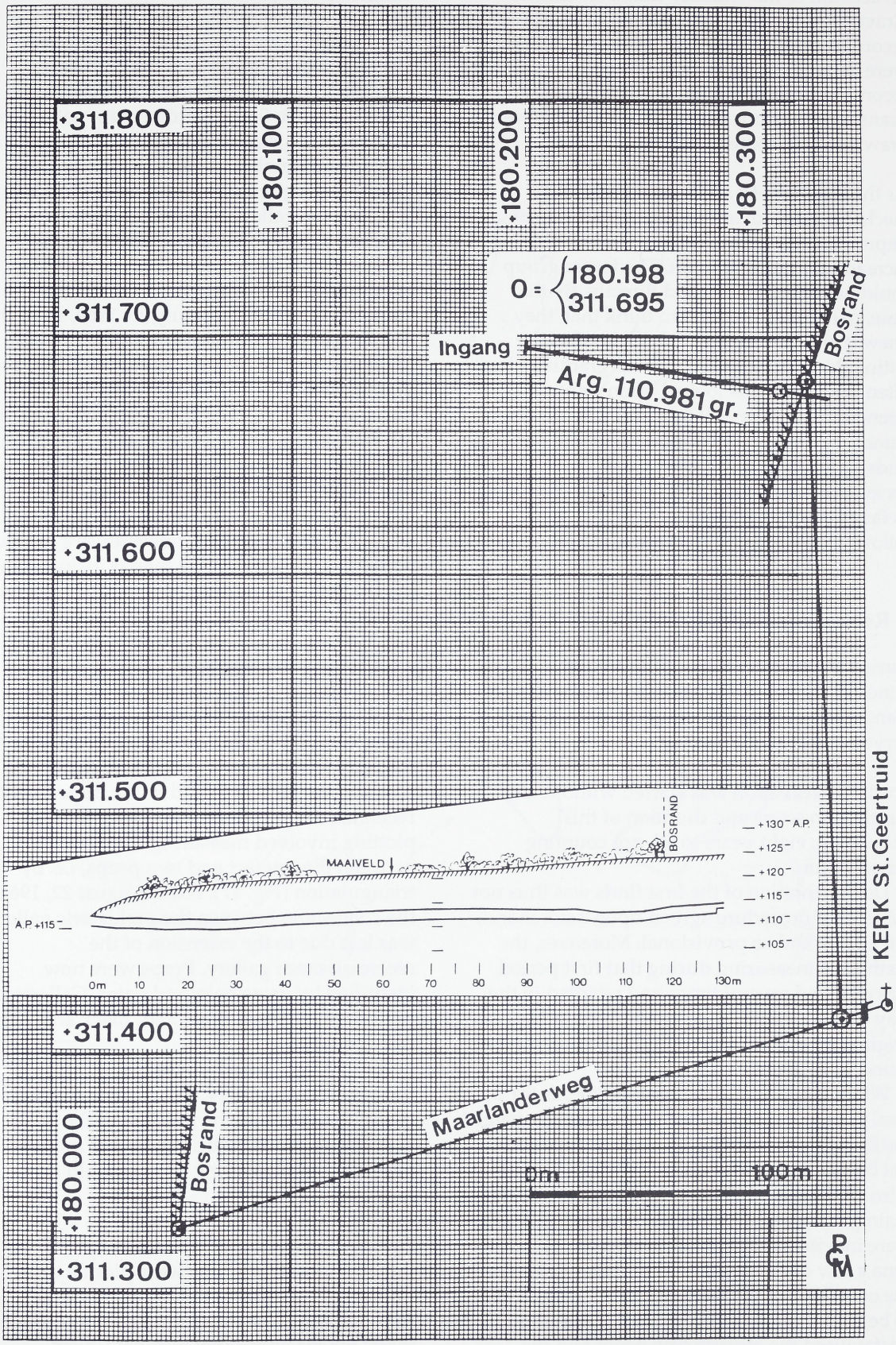

Fig. 17 Location of the tunnel in the Savelsbos as determined by surveying.

measuring points were positioned in such a way that they could be plotted from two previous points. Measurements and a sketch of the situation recording the direction of measurement were entered on a 'registration form for artefacts collected' at the site.

3.2. Plotting the map

All galleries, shafts and solution pipes encountered during the excavation were plotted by triangulation, with reference to the base line in the main gallery. This measuring network consisted of taut strings. Measurements were taken at the average height of the flint layer exploited. The outlines of the shafts were projected on this plane.

On the basis of a field survey during the excavation and a subsequent supplementary survey by the Dutch Geological Survey, a map of the studied portion of the Neolithic mine field was drawn.

The map consists of three sheets, numbered GB-A -8810a to 8810c, at scale 1:50. A filmed copy of these drawings was transferred to the Provincial Depot for Archaeological Finds at Maastricht (Fig. 18). A reduced version in colour, scale 1:400, is included in RADEMAKERS (1998).

3.3. Plotting the main gallery

Upon completion of the excavation and conservation of the main gallery, its position was plotted anew. At the Working Group's request this was done by the Surveying Department of the former state colliery Emma, in collaboration with the group.

These measurements are recorded on the Working Group's drawing no. 199-57-67. Fig. 17 is based on portions of this drawing.

The original has also been transferred to the Provincial Depot for Archaeological Finds, and a copy is included in Report 30.