F France

F 1 Veaux near Malaucene
F 2 Murs
F 3 Gordes, valley of Largue
F 4 Valley of Largue
F 5 Mourre de la Cabane
F 6 Vigne du Cade
F 7 Cennes-Monesties
F 8 Mur-de-Barrez, Bellevue
F 9 Commercy

F 10 La Petite-Garenne
F 11 Les Martins
F 12 Grand Pressigny
F 13 Lumbres
F 14 Champignolles
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F 18 Jamericourt
F 50 JABLINES, “LE HAUT-CHÂTEAU”, SEINE-ET-MARNE DISTRICT

The Neolithic flint mine at Jablines, “le Haut-Château” (Seine-et-Marne)

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The territory of Jablines occupies a substantial part of a vast bend in the Marne, 30 km east of Paris; here the river cuts through the Paris basin Tertiary limestone plateau, forming a valley which can be over 7 m deep. Where the bend is tightest, erosion has exposed an outcrop of Saint-Ouen limestone containing siliceous deposits which were extensively exploited by local Neolithic populations.
Fig. 1. F 50 Jablines, “le Haut-Château”. Aerial view of the mine. The dark spots are mine shafts (Photo Brunet/Charpentier/Lanchon).

HISTORY OF RESEARCHES

The site was excavated between August 1989 and September 1990 as part of a rescue project in advance of TGV North and Interconnection railway construction. Well known to collectors since the turn of the century, the site had been interpreted as a vast flint-working area (Martin and Hue 1909; Roche 1973). It was only in 1981 that it was recognised as a flint mine, after a small-scale rescue operation by the Direction des Antiquités (Bulard, Degros and Tarrête 1986). Aerial photographic survey in 1987 spectacularly revealed the site’s full extent (Fig. 1). On the basis of these photos, the total number of mine-shafts threatened by construction work over 3.5 ha, which represents roughly 20% of the surface area of the mine (Fig. 2), was estimated at about one thousand. Topsoil was mechanically removed over the entire area threatened, 500 m long and 60 to 70 m wide, revealing seven hundred and sixty-six mine-shafts and allowing precise definition of the northern and southern edges of the mine.
GEOLOGY OF DEPOSITS

Several deep geological trenches revealed five seams of flint, two of which were exploited in the Neolithic. These seams are horizontal, but they occur at a greater depth towards the South because of the presence, above the Saint-Ouen limestone, of increasingly thick (from 0 to over 5 m at the edge of the excavated area) sandy marl deposits. Erosion has in fact cut diagonally through the local geology, which explains the varying depths of flint and the disappearance of the uppermost seam in the northern part of the site.

CONDITIONS OF EXCAVATIONS

Despite the considerable measures adopted to deal with the site, such a large quantity of features could obviously not be examined exhaustively in the time allotted (one year). It was thus necessary to make choices concerning the number and location of features to be excavated. A sample of ten groups of ten adjacent mine-shafts was selected on the basis of their surface shape and position in the study zone.

It was not possible to follow this plan since several excavation and safety problems arose. Firstly, the depth of features increased gradually from north to south, from 2 m to over 7 m to reach the main seam, substantially adding to excavation time. Secondly, the limestone-marl bedrock proved to be very unstable, collapsing on several occasions during excavation. Large numbers of props and timber shoring had therefore to be installed, considerably hindering the understanding and drawing of underground features, but without guaranteeing total safety. Another solution was eventually applied: the access shafts were dug and drawn in the normal manner, and then all the surrounding bedrock was removed by machine down to gallery roof level. This new method not only guaranteed total safety, but also facilitated excavation of the galleries and reduced the time involved. In the end fifty-eight extraction features were completely excavated.

THE EXTRACTION FEATURES

Initial spatial analysis revealed three main sectors: a northern zone (A), where clearly separated groups of features could be distinguished, a central or "empty" zone (B) with only a few identifiable extraction features, and finally a southern zone (C) with a uniform distribution of features. This triple division corresponds not only to different morphological types of feature, but also to at least two major raw material exploitation systems.
A. the northern zone contains:

- simple extraction pits (Fig. 3:1), on average 1.5 m deep; located on the northern edge of the mine, these are the simplest flint extraction features.

- chambered features (Fig. 3:4) consisting of a vertical shaft 2 to 2.2 m deep, with one or several quite large extraction chambers halfway down, where two people could work together kneeling.

- bell-shaped features (Fig. 3:5) with a vertical shaft 1 to 1.50 m deep, the base of which is worked in all directions, forming a cone. The last blocks of flint were merely worked loose, giving the walls a cellular appearance.

These features are clustered together in spatially distinct groups of varying size. A single seam of flint was rather unintensively worked. The surface diameter of features is always quite small (from 1.2 m to 2 m), for a depth of 2 m.

B. Within and on the edge of the “empty” zone, a few features consist only of a vertical shaft with a concave base, about 3 m deep (Fig. 3:3). Since they are not worked, they were probably reconnaissance pits for flint, untouched here because of local fluctuations in the seam. They are therefore unfinished features.

C. In the southern zone however the shape and organization of features is very different. The access shafts are 4 to 7 m deep (Fig. 3:6-8), with diameters of at least 2.5 m. They cross a first seam of flint, exploited in secondary fashion or ignored; the lower flint seam was systematically extracted by a system of radiating galleries, with a maximum height of 70 cm, and varying in length from 1.5 to 7.5 m; narrow passages frequently link the galleries to each other and to those of neighbouring features. The features form a very uniform pattern, resulting in maximum exploitation of flint below ground (Fig. 4). Study of the fills showed that the galleries were not all dug at the same moment, the spoil from the latest being used to backfill the earliest. The development of underground exploitation must in certain cases have posed technical problems for the Neolithic miners. An obvious example is the solidity of gallery ceilings, which would have been under considerable pressure, given their width and depth. In the deepest features the positions of props were revealed by sockets in the floor and (or) ceiling (Fig. 4, stars). These often contain large numbers of charcoal fragments.

The sections of the shafts show phases of natural filling, due to the collapse of sides and overhangs, alternating with phases of deliberate backfilling, especially in features where both flint seams were worked (Figs 5–6).

In the central part of the excavated area, there was some reworking of the edges of extraction features. This renewal of exploitation could indicate either the use of the site by another group, or temporary abandonment of mining.

The development of a three-dimensional drawing system for the extraction features served not only to visualize the scale and intensity of flint mining, but also to
Fig. 3. F 50 Jablines, "le Haut-Château". Variability of extraction features in the mine (all features shown at the same scale).
Fig. 4. F 50 Jablines, "le Haut-Château". Exhaustive extraction in the deep shafts (St. 1061 and 1111). The stars represent the position of the props.
Fig. 5. F 50 Jablines, “le Haut-Château”. Stratigraphic section of feature 894, showing the two levels of extraction and a fill combining natural layers (X, XIV) and deliberate backfilling (XI, XXII).
measure the volume of each feature and assess its efficiency. The latter refers to the original relationship between the quantity of flint extracted and the volume of sterile fill. The quantity of flint extracted per feature varies from 0.1 m³ to over 5 m³. The efficiency of excavated features varies from a minimum of 2% (for the smallest pits) to a maximum of 18% (for the largest features with galleries).

The features were dug and blocks of flint extracted with special antler mining tools. Although the limestone marl bedrock’s plasticity posed a number of excavation and safety problems, it also resulted in remarkable preservation of marks on gallery walls.

Detailed analysis of these reveals how flint blocks were extracted: in the short galleries the flint seam is at floor height, and blocks were worked loose by leverage; in the longer galleries, which were systematically overlaid, flint was extracted by undermining. The possible use of wooden tools is also indicated by this analysis. Traditional extraction tools of flint such as picks were not identified, however.
THE PRODUCTS

Almost all the finds are knapping waste and unusable fragments of tabular flint blocks. Most of the raw material was in fact worked on site, as can be seen from a number of preserved debitage areas and the thousands of flakes and splinters in the fill of shafts. This waste has been analysed for characteristic manufacturing attributes for refitting. As a result, all the production sequences have been understood through identification of their main stages. Large numbers of flaked axes were produced on the site in two distinct modules: a large module averaging 0.30 m in length, and a small module including axes from 0.10 to 0.17 m long.

The first module is represented by all the phases of the production sequence; products were abandoned at all manufacturing stages. Production was undertaken in several easily identifiable stages:

— 1: initial working of blocks by removal of several large, extensive flakes on one side and one face;
— 2: bifacial debitage on the same side, creating a first ridge. Flakes are cortical, often short and thick (Fig. 7);
— 3: preparation continues with the working of an extremity which will usually become the axe’s cutting edge. This debitage phase is also bifacial. From this stage onwards, in certain cases, the cutting edge is shaped by removal of large blades;
— 4: the second side is shaped after the cutting edge, in the same manner as the first side: a series of flakes is removed from one face, then the second is worked;
— 5: the other extremity is then flaked in order to link up with the first side;
— 6: a first phase of regularization then takes place. Flaking is extensive, to remove areas of cortex on the middle of the blocks, and often lopsided (déjeté). The aim here is to remove all major irregularities on the blocks, such as surface fractures. The cutting edge is usually formed by a series of blade removals on one face. It is difficult to estimate the number of successive regularization phases needed to finish the axe pre-form;
— 7: the last phase involves final smoothing of the profile by removal of small flat flakes. This makes the ridges rectilinear and the cross-section uniformly convex (Fig. 8).

Replacement of a hard by a soft hammer takes place between removal of cortical shaping flakes and removal of sub- or non-cortical flakes, the thinner butts of which are either smooth or faceted. The upper faces of the latter indicate multidirectional debitage.

Flakes are thin and extensive with a curved profile. Use of indirect percussion is shown only by thin, concave butts.
Fig. 7. F 50 Jablines, "le Haut-Château". One of the first stages of production of flaked axes: bifacially worked tabular block.
The small module axes outnumber the large ones. The production sequence phases are identical, but the initial blanks are more varied, since some axes are made on large flakes.

The largest axes were certainly destined for export either in roughout or flaked form. There are no signs of polishing having taken place on the site. This was probably done on the sites where the axes were used.
Ordinary tools (scrapers, side-scrapers, etc.) are also present. They must have been used, possibly like some of the small axes, for activities related to mining (production and maintenance of wood and antler tools).

NATURE AND DATING OF THE MINE

A characteristic of the Jablines mine is the morphological diversity of extraction features: a flint seam is exploited in one area by simple open-cast pits 1.50 m deep, and 500 m away by vast galleries accessible by a shaft 7.50 m deep. This is not unusual, since the morphology of extraction features is adapted to the physical conditions of a given site (nature of the bedrock, depth of flint, seam thickness, etc.). When natural conditions vary considerably, as at Jablines, the types of extraction feature are also quite variable; this can be observed on mines which have been extensively investigated, such as Spienes in Belgium (Hubert 1988), Krzemionki in Poland (Borkowski et al. 1989) and Grimes Graves in England (Felder 1981).

Furthermore, recurrence of the same types of feature shows that mining activity took place under the same technical conditions, most of the time the best ones possible for the locality, in an intensive and continuous manner. This is exactly what is shown at Jablines by the pattern of features with galleries.

A coherent series of seventeen $^{14}$C dates places the excavated part of the mine in the Middle Neolithic II (Michelsberg/Chasseen horizon). The range is from 4284 to 3495 cal BC, indicating a date of around 3800 cal BC (3000 BC uncalibrated). Use of these dates to determine the internal chronology of the mine is dangerous (uncertainty of $^{14}$C dating, artificially linear nature of the part of the site excavated). Nevertheless, it is worth noting that the earliest dates generally concern the features in the southern half. These are the deepest features, where mining was most intensive and almost all the seam exploited. The presence of earlier ceramic sherds (Cerny Culture) in a secondary position in the shaft fills could reflect an older phase of mining, outside the excavated area. One can thus envisage that the source was discovered and initially worked on the steepest part of the slope, where flint must have outcropped.

Considering that the extent of the mine was naturally defined to the east and west by relief, that the mine virtually includes the outcropping flint seam to the north, and that technical or other constraints limited its extension southwards, it appears that the miners exploited almost all the accessible parts of the site.

DIFFUSION OF PRODUCTS

One of the site's characteristics is the mass production of flaked axes, probably intended for diffusion and use over a wide geographical area; this aspect of production is fundamental because it opens up the possibility of examining problems
of diffusion and exchange on a broader regional scale. However it is worth recalling that some flint was taken off the site in unprepared or lightly prepared form, as is shown by the estimates of raw material extracted by feature.

Analysis of product diffusion should operate at two levels:
— the settlement(s) directly involved in working the mine could be identified by comparative study of lithic material; the presence of varying quantities of raw material, debitage and tools in Haut-Château flint, in relationship to distance from the mine and to other kinds of evidence (number of antler tools, for example) would be good clues. This implies of course sound knowledge of local and regional settlement patterns contemporary with use of the mine, which is far from being the case at present. No Middle Neolithic II settlements have been excavated or even discovered in the immediate surroundings.
— the longer distance diffusion of products from the mine could initially be studied by mapping the distribution of Haut-Château axes. The main difficulty here is their identification. It is possible that all or some of the axes made at Jablines were polished before use, and Saint-Ouen flint rapidly acquires patina. This double transformation considerably hinders identification.

A further difficulty is the actual recognition of products from the Haut-Château mine. Far from being an isolated case, it is now known to belong to a mining complex which includes a dozen identical sites, all of which were probably exploiting different seams of Tertiary flint of similar aspect and colour. Study of the diffusion of products from Jablines would have to involve a comprehensive programme of analysis of these seams and their use.

REFERENCES


