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## Multidimensional analysis of the archaeological discoveries from the multiphase Palaeolithic site at Mitoc-Malu Galben

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### 7.1 The site (Vasile Chirica)

The multiperiod site of Mitoc-Malu Galben was first reported by N. N. Moroșan, who described its archaeological and geographical stratigraphy. During 1956 and 1957, after some stratigraphic surveys, the existence of several Mousterian and Aurignacian occupation levels was demonstrated (Nicolăescu-Plopșor & Zaharia 1959; Nicolăescu-Plopșor *et al.* 1959). Research was resumed in 1978 and is continuing as a consequence of the importance of the archaeological discoveries (Chirica 1995).

The site is situated on the left bank of the Ghireni brook, about 400m before its junction with the river Prut.

A cooperation has been established with Prof. K. Honea at De Kalb University, Illinois, U.S.A. (who made possible most of the absolute chronological determinations; Honea 1994) and also with Prof. M. Otte of the University of Liege and Dr P. Haesaerts of the Royal Institute of Natural Sciences in Brussels. Publication of the Mitoc-Malu Galben monograph is being undertaken with these collaborators.

The geological stratigraphy of the site has been established with the cooperation of P. Haesaerts. The Belgian specialist has identified the existence of several pedo-climatic cycles inside which the occupation levels are placed (Haesaerts 1993). By corroborating the archaeological and geo-pedological information, the quasi-permanent character of the habitation between 32,000 BP and 17,000 BP has been established, after which the site was definitively abandoned.

Before our cooperation with the Belgian specialists, we had determined the main coordinates of the archaeological stratigraphy. Thus, the four Gravettian habitation levels are placed at the following coordinates:

level I	-7.10m	sq. L10	-8.10m	sq. L2
level II	-6.40m	sq. L10	-7.10m	sq. L2
level III	-5.60m	sq. L10	-6.50m	sq. L2
level IV	-4.00m	sq. L10	-5.25m	sq. L2

We have presented these coordinates because of the inclination of the whole sediment both on the E-W and N-S directions.

Pedologically, P. Haesaerts has included the Gravettian levels I and II in the L1 and L2 units, finding that this double loessic deposit expresses a periglacial climate, a fact noted by us (Chirica 1989). L1 is separated from L2 by a very cold and well differentiated sequence. L2 seems to belong to a slight climatic improvement. The absolute chronology has helped establish the time coordinates of human habitation at Mitoc-Malu Galben.

#### 7.1.1 The Gravettian habitations

Level I is dated between 28,910±480 BP (GrN-12636) and 27,150±750 BP (GrN-12635). Its character is indicated by the archaic nature of the lithic materials: 54 end-scrapers of which two are on retouched blades, six on flakes and three on retouched flakes, three on retouched blades, two 'appointee' blades, one backed bladelet (microgravette), one la Gravette unifacial point and many other flakes and blades.

Level II is dated between 26,900±45 BP (GrN 14037) and 25,140±210 BP (GrN-14036). The lithics consist of 33 end scrapers, of which 4 are on retouched blades and one double, three angle burins and one burin-end scraper, five retouched blades and three 'appointee', one Mousterian side scraper, refitted and converted to an angle burin, one la Gravette point. Complex no. 27 also belongs to this habitation level, at 7.10m, inside which the cortex amulet was discovered (Fig. 7.1). This amulet is the first Palaeolithic piece of art discovered in România and is dated to 26,700±1040 BP (GX-9418; Otte & Beldiman 1995).

Levels III and IV are dated to 24,820±150 BP (GX-9425) to 23,490±280 BP (GrN-15805), and 20,300±700 BP (GrN-14031) to 19,910±990 BP (GX-8724). They contain a larger number of pieces that are specific to the Gravettian culture: backed bladelets and la Gravette points, as well as other common tools such as scrapers and burins of different types.

The computer analysis of all the finds and features (workshops, hearths, rich faunal remains *etc.*) has allowed us to estimate that, beginning with the first

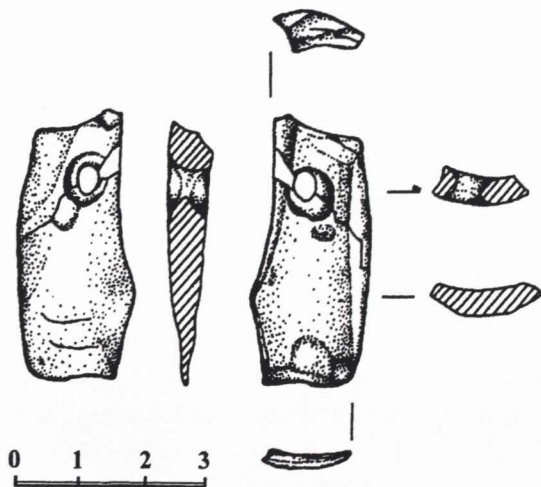


Figure 7.1: Pendent/Amulet from Mitoc-Malu Galben (after Otte & Beldiman 1995, fig. 1).

Aurignacian habitation and finishing with the Gravettian, the site was inhabited for almost 12,000 years, because we have found sporadic remains of habitation between the four Gravettian levels.

The Aurignacian habitations can be found in lithic units LM1, LM2 and LM3, and in three humiferic horizons: H1, H2 and H3. Sedimental cycles 8 to 12 have been identified, each with two strata, a and b, the upper and lower respectively.

This part of the profile includes four metres of grey clay deposits. The three humiferic horizons, with decreasing intensity, are each characterised by a good integration of the humus with the mineral matter and show remains of intense biological and human activity. It is worth noticing that the sediment analysis corresponds to the absolute chronological dates:  $29,400 \pm 310$  BP,  $30,920 \pm 390$  BP,  $31,100 \pm 900$  BP and  $31,160 \pm 550-510$  BP, which leads us to believe that Mitoc is the oldest Aurignacian habitation (in the classic, European meaning) in the whole Carpathian region.

The fauna of both categories of habitation — Gravettian and Aurignacian — is composed of common species: *Equus caballus*, *Bos primigenius*, *Bison priscus* and *Cervus elaphus*. The Aurignacian levels also comprise *Gulo gulo*, *Megaceros giganteus*, *Rangifer tarandus* and *Elephas* which indicates the existence of a swamp zone near the site, and also of a vast steppe.

The Aurignacian hearths are larger than the Gravettian ones, and not so well organised. Some have been subject to deterioration by the same causes that affected the faunal remains — small geological local processes, soil acidity, and limestone accumulations in the organic matter zones. Each large concentration of lithic and faunal materials had at least one hearth, usually with no special arrangements.

As well as the hearths, the knapping workshops are an important component of the habitation complexes. They are large, occupying 2–6 squares with 2m sides, e.g., the workshop situated in squares F–G 4–6, at  $-10.70$  to  $-10.80$ m. On its  $24\text{m}^2$  surface

there has been found a mass of silex pieces at different knapping stages along with faunal remains and a hearth.

The cores show preparation procedures using side crests and oblique knapping planes. The knapping products and the supports show remains of preparatory crests. The blades are not numerous, but as the cores, they have characteristics specific to the Aurignacian; there is an intention to make burins on flakes, by massive detachings found on cores. Inside this small complex have been identified: 15 massive denticulate tools, 17 burins on massive supports (eight dihedral, one mixed multiple, six carinated, two bussed), 15 carinated end-scrapers, three flat end-scrapers on blade, seven burins on blade, (four truncated and three on retouched truncation), 350 unretouched blades, 16 cores and a large quantity of waste products.

Generally speaking, the lithic inventory of the Aurignacian concentrations is relatively poor, because we are in a workshop-habitation, but is varied enough and it has the typical characteristics of the classic Aurignacian. A huge quantity of knapping waste, pre-cores and cores in different knapping stages, preparation flakes as supports and unretouched blades have been discovered. Cortical products are present in great numbers, demonstrating that the whole sequence of knapping took place inside the habitations.

The lithic tools include: 62 carinated scrapers, four thick-nosed, 28 on (retouched) blade, 14 on flake, six burin-end-scrapers, 42 carinated burins, 48 dihedral, 11 on retouched truncation, 18 angle, three mixed multiple, 18 denticulated tools, 15 side scrapers, two Levallois flakes. 98% of these pieces are made of Prut silex and are middle-sized (Fig. 7.2).

Comparisons may be made with other sites which begin during the Upper Palaeolithic in the Carpathian region, including the discoveries at Ripiceni-Izvor (Botoşani), Mitoc-Valea Izvorului, at the Brânzeni cave (Bessarabia) and at Buşag (Oaş county).

In our opinion, the finds from the earliest sites



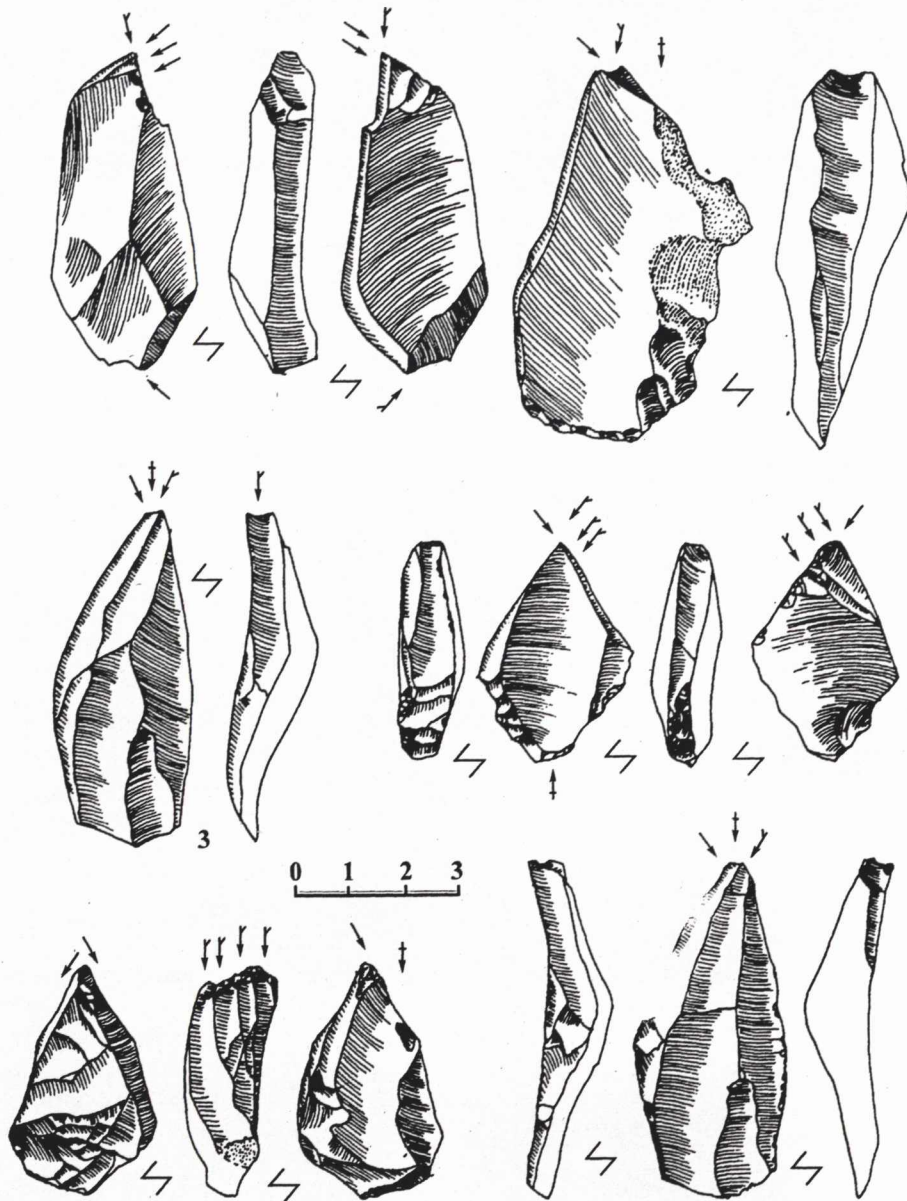


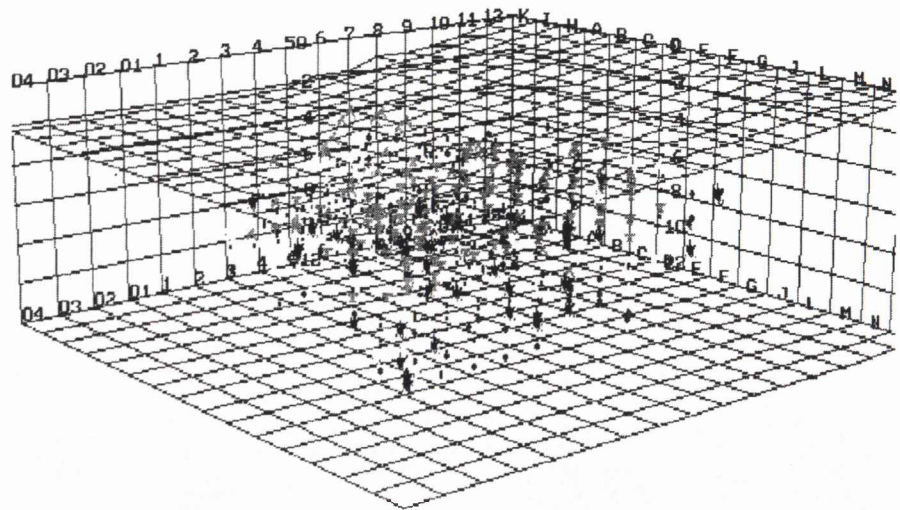
Figure 7.2: Some examples of Aurignacian lithics discovered at Mitoc-Malu Galben (after Chirica 1995, fig. 9).

force us to reconsider some old and recent opinions, according to which discoveries belong either to the Aurignacian culture, or to the Brăzeni. Re-analysing these materials, we have identified a Ripiceni-Brăneni culture, dating to the period of transition from the Middle to the Upper Palaeolithic. The classic Aurignacian may be documented in the region using the discoveries at Mitoc-Malu Galben and possibly the finds at Buşag and Cetăţica I-Ceahlău.

## 7.2 The program (Andrei Cojocaru)

### 7.2.1 Introduction

An archaeological site is three dimensional: the land surface is two dimensional and the third dimension is added by the different depths the pieces are discovered. Paper representations of archaeological sites are usually flat and do not give a complete picture of the site, which would be helpful in the analysis of the site — for example, for identifying the different habitation periods. Even when pictures do show the spatial distribution of the discoveries, they are limited to a single point of observation.



**Figure 7.3:** Screenshot of the Mitoc-Malu Galben visualisation program.

F1 for help

A computer can be used to provide an interactive three dimensional representation, its advantage over paper is interactivity: the ability to view the site from many different angles, which could help with the site analysis (Colley *et al.* 1988; Reilly *et al.* 1988).

As a preliminary approach to this problem, a program that tries to build such a representation has been written for a special case, namely the Mitoc-Malu Galben site, in Romania, district of Botoşani. In due time, this could be expanded to a more general application which would provide a representation for the findings at any site.

### 7.2.2 Technical data

A 3D wireframe graphics engine has been developed. This program module can display some types of three dimensional data (namely line segments, bitmaps and texts) using perspective or a 'users view' projection. That is, the image displayed on the screen looks reasonably close to how a person would see a scene with his/her own eyes.

The way to do this is to take a point in space with three coordinates:  $x$ ,  $y$  and  $z$ . To simplify the problem, we assume that the viewer is at the coordinate system origin, the  $y$  axis goes up and the  $z$  axis is parallel to the computer screen. Then the screen coordinates of our point should be (Watkins & Sharp 1992, p. 152):

$$\text{screen}x = \frac{z \times \text{EYE}}{x}, \text{screen}y = \frac{y \times \text{EYE}}{x}$$

where EYE is a constant which measures the virtual distance between the user and the computer screen we are projecting on. For a realistic view, it should be chosen so that the screen is seen at an angle of about

70 degrees, but this is not mandatory. This engine uses an EYE value of 100 for a 640 pixel wide screen the which gives satisfactory results.

After determining the screen $x$  and screen $z$  coordinates, displaying one of the primitives (line, picture or text) is immediate.

The engine can also perform rotations and translations of the data, the corresponding formulas being available in any analytical geometry book, and also in that by Watkins & Sharp (1992, pp. 47-48). Zooming in and out was also implemented.

To make data input easier, all the site data was stored in a dBASE III+ file structure, the details of which are available in many places; in this case, it was obtained from the HELPPC hypertext database, which contains rich collection of information for PC programming.

The floating-point math routines used in this version of the program requires a maths coprocessor. In its current version, the program runs very slowly on anything less than a 486, and requires a maths coprocessor. There are several solutions to this problem, the best being the use of fixed-point math and sine/cosine tables; this was not implemented because of the lack of time, but will be done in a future version.

### 7.2.3 Site representation

To correctly estimate distances, some guiding marks are needed. Beside displaying the actual finds, a grid is also necessary. The site already had a grid (2x2m squares), with a quite weird labelling system. All that was needed was to translate it into machine-readable form and then display it. The land level before excavation is also displayed in green. Displaying these two elements can be turned off, if the screen gets too crowded.



Displaying all the objects exactly as they were would have required a huge amount of data and some more computing power. A simpler solution has been chosen: the objects are divided into six categories, namely workshops, hearths, bones, tools, silex pieces, and a sixth category for anything that doesn't fit in the previous five ones. Each of these categories is assigned its own icon (created in Windows PAINTBRUSH) and only this icon is displayed. For example, the icon for a bone is, of course a bone; the icon for a workshop is an anvil.

Each representation element — the objects found, the grid and the land level — has its own dBASE file which can be edited with almost any database management tool. The format for this file is rather cryptic, but this will change in the future as the program becomes more general.

### 7.2.4 Program usage

This program will run on any IBM PC compatible, provided it is fast enough. The program runs under MS-DOS, but it will migrate to Windows. A 486 or better will work fine. The current version requires only 130K of disk space, but this is likely to go up as the program becomes more complex. The program was developed with Borland C++ 3.1 in three modules.

The program starts by going straight into the 3D representation screen. The view should be self explanatory. The grey lines with green labels make the grid, the green lines show the land level. Each of the pictures corresponds to one object. A picture legend can be obtained by pressing F2. Arrow keys will do a translation along the  $x$  and  $z$  axis. Remember: the  $y$  axis is up! A  $y$  axis translation can be obtained by pressing the Page Up and Page Down keys. Delete and End will rotate the view horizontally (*i.e.*, around the  $y$  axis). Vertical rotations can be obtained with Insert and Home (around  $x$ ) and with [ and ] (open and closed square brackets) for a rotation around the  $z$  axis. Zoom in and out can be obtained by pressing the + (plus) and - (minus) keys. Also pressing shift when pressing those will zoom faster (in bigger steps).

There are three different predefined views: one that gives a general view of the site, and two lateral views. These can be obtained by pressing keys 1, 2 and 3.

Pressing F3 will allow you to select a subset of the objects for display: *i.e.*, only one row or column; press F3 and at the prompt and type the row/column label. If it is a single character, also type a space. The row/column labels are displayed in green at the top and bottom of the grid. Pressing F3 again will redisplay all the objects defined. There is also a help key (F1) which will show you in brief everything that's written in this section of the paper.

### 7.2.5 Suggestions welcome

The program (including the source code) should be available on the CAA WWW server for interested persons. This is only a preliminary version. I plan to expand this to a more general, user-friendly and useful program. This includes speeding it up, making the presentation more readable, porting it under Windows and adding other functions. I am already working on this with Mr. Chirica, but any suggestions are more than welcome.

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