The Châtelperronian of Les Tambourets (Haute-Garonne, France)

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PREFACE AND INTRODUCTION

Les Tambourets is an archaeological site in the northern (French) foothills of the Pyrénées mountains. It is an open-air site, rather than a cave or rockshelter site, located on an ancient terrace on the right (south) bank of the Garonne River, just upstream from the junction of the Garonne and its much smaller tributary, the Volp River. Detailed information about the location and geological context of Les Tambourets is given in Chapter 1 of this monograph.

The archaeological excavations reported on here took place about four decades ago. As noted by one of the anonymous reviewers of the original manuscript, this means that the monograph "must be considered as an archive,...a testimony of what *had* been done." Why has it been prepared for publication now rather than several decades ago? The answer lies primarily in the development of the technology relating to digital publication and diffusion of information. What would now be (and was then) impossible with traditional hard-copy publication can now, through digital publication, provide easily accessible and very detailed textual and graphic information on large Châtelperronian assemblage samples and their context. The emphasis in this monograph is on the description and analysis of the entire body of materials, not just the "type fossils" to which discussion has too often been limited. This is possible because the Paleoanthropology Society has embraced digital technology and put it to work in service to our field.

CULTURAL AFFILATION OF LES TAMBOURETS

The principal prehistoric occupation of which evidence is found at Les Tambourets is Palaeolithic. It is the earliest, or perhaps one of the two earliest, archaeological cultures of the Upper Palaeolithic stage known from France and the Iberian Peninsula. It is called "Châtelperronian," a name derived from the location of the site of Grotte des Fées at Châtelperron (Allier) in east-central France, first excavated in the 1860s (Breuil 1911). It is known also in the

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older literature as Lower Perigordian, *Périgordien ancien*, and Perigordian I. It is, in fact, one of the most informative Châtelperronian sites because there are no underlying Mousterian levels that could have contributed objects to a mixture, there are no overlying Aurignacian levels and no typological evidence of Aurignacian mixture, and indeed there is no evidence of *any* Palaeolithic occupation of the site after the Châtelperronian. The next prehistoric occupation of the area was the Middle Neolithic Chassean of the immediately adjacent site of Terssac (Méroc 1948).

Regardless of the various names that have been given to it, the Châtelperronian has been recognized since the early 20th century by the presence of a distinctive kind of backed stone knife or, perhaps, weapon component, the Châtelperron point (as discussed and illustrated in Chapter 6). That Les Tambourets is a Châtelperronian site can be seen most clearly in the typological inventories given in Table 3-6 in Chapter 3. In the excavated assemblage sample from Archaeological Level 1, Châtelperron points (n=28) account for 3.89% of the sample. In the samples collected from the surface by Méroc, the frequencies of Châtelperron points vary between 3.82% in his Area 3 and 12.30% in his Area 1. This present monograph does not include a comparative typological study, but the very complete study of Francis Harrold (1978) documented the accuracy of the Châtelperron assignment of Les Tambourets. According to Harrold (1978: 407–408), Les Tambourets was one of the 14 most reliable Châtelperronian sites as judged by size and assemblage integrity.

Although the first published description of the Tambourets Châtelperronian, including the first published drawings of characteristic artifacts, did not occur until 1963 (Méroc 1963a: 64, Fig. 1, 65, 67), specialists in French Palaeolithic prehistory were well aware of Les Tambourets as a Châtelperronian site for decades before that—from at least 1936. In September 1936, the 12th Congrès Préhistorique de France was held in Toulouse and Foix, and Louis Méroc was a member of one of the organizing committees. Various members of the Society brought artifacts, photos, and other objects of archaeological interest to exhibit them to the attendees at the Congress. Méroc took to Toulouse, where the first sessions of the Congress were held, a collection of quartzite artifacts of various ages he had collected from the surfaces of terraces of the Garonne (Schleicher 1937: 67). These pieces were the subject of the short paper he presented at the Congress (Méroc 1937). What is of interest here, however, is that when the later sessions of the Congress met in Foix, Méroc exhibited there what he described as an "abundant series" of Palaeolithic objects from Les Tambourets (Méroc dossier, p. 68). Méroc noted that almost all the prehistorians who looked at these materials agreed that they were "Perigordian 1".[1] Méroc's use of this terminology and the significance of the fact that Denis Peyrony was one of the specialists who examined the artifacts can be understood in the context of the 1930s. Peyrony (1933) had just a few years earlier proposed that assemblages with Châtelperron points represented the earliest phase of a "Perigordian" archaeological tradition that was in some way ancestral to later Perigordian assemblages with Gravette points. Peyrony's published work concerned, for the most part, sites in Dordogne (the center of the Périgord region), but the fact that he recognized Les Tambourets as a representative of the earliest Perigordian—noted specifically by Méroc in his notes (Méroc dossier, p. 68)—is significant for the history of the field. Méroc noted further that François Bordes and Hallam Movius, prehistorians of a later generation, reached the same conclusion when they examined his collection from Les Tambourets decades later.

In sum, it can be said that for more than three-quarters of a century Les Tambourets has been generally considered to be an important Châtelperronian site, but its lithic industry has been understood in only the most general terms. Publication of this present monograph is intended to change this situation.

BACKGROUND TO THE EXCAVATIONS

Two of the anonymous reviewers of the original submission version of this monograph suggested that it needed some kind of account of the historical context of my excavations at Les Tambourets, including an explanation of why I wanted to excavate there and what kinds of methodological choices I made. Both referees considered that such material would be of value to the history of our field, and both suggested that the material might best be presented in an informal style. The paragraphs that follow here are my attempt to implement these very helpful suggestions.

I first saw the site of Les Tambourets in February of 1964. Professor Hallam L. Movius, Jr., of Harvard University, who would soon become my dissertation director, was spending the academic year in France directing the laboratory analysis of materials excavated at the Upper Palaeolithic rockshelter of abri Pataud, in Les Eyzies, Dordogne. I was one of several students working with Movius in the Pataud laboratory that winter. On occasion, Movius and his wife, Nancy, would make weekend trips to visit colleagues doing Palaeolithic archaeology in southern France, seeing their sites, and looking at the artifacts that had been excavated. When it was logistically possible, Movius invited students working with him to go along on these trips, considering it part of their professional training. The trip in February 1964, first to Toulouse and then to Cazères, was to visit Louis Méroc, the regional director of prehistory for Midi-Pyrénées, and to see the large, open-air Châtelperronian site of Les Tambourets, from which Méroc had been collecting surface materials for decades. The principal archaeological level at the site was exposed in a roadcut (†Méroc and Bricker 1984: 47, Fig. 1), and Méroc had cleaned the vegetation from a short section of this cut[{a64001}] in order to demonstrate the site's stratigraphy to Movius and his students.[2]

The archaeological potential of Les Tambourets, almost completely unexcavated as of the 1960s, was obvious. On several occasions following that first visit, I talked with Méroc about the site and its possible importance in understanding "the Perigordian," as we then thought of it (†Méroc and Bricker1984: 45), but I had at that time no notion of trying to work there myself. Indeed, the next time I saw the site was in August 1969, when my wife and I were in the region so that I could study Gravettian materials in the Musée d'Aurignac as part of my dissertation research. We were accompanied by another doctoral student of Movius who was considering work with the Tambourets collections as a possible dissertation project. My job, during a brief side trip from Aurignac, was to make the initial introduction of the other student to Méroc, which was done.

Less than two years later, by the spring of 1971, two things had occurred that started the chain of events that took me back to Les Tambourets. First, Movius's student who had been considering work with Tambourets materials changed dissertation topics, moving completely out of Palaeolithic archaeology. The second event was the death, on 18 July 1970, of Louis Méroc. In early April of 1971, Movius wrote to me in New Orleans, where I was in my second year of university teaching as well as in the final throes of dissertation writing, suggesting that it might very well be possible for me to begin a program of *excavation* at Les Tambourets if I wanted to make the attempt (*in litt.*, Movius to Bricker, 12 April 1971). He had broached this idea in a letter to Georges Simonnet, a friend and long-time archaeological collaborator of Méroc's, and he had received a very positive reply to this suggestion. Because I was going to spend some weeks in France during the summer of 1971, Movius suggested that we make a trip south during July to meet with Simonnet, check on the current condition of the site, and, if possible, meet with Jean Clottes, who had just been appointed to replace Méroc as regional director of prehistory (*in litt.*, Movius to Bricker, 26 April 1971). I was, of course, absolutely delighted by Movius's initiative and the very exciting prospect of excavating at Les Tambourets. We did in fact make the July trip to Haute-Garonne, and the long process of applying for permissions and material support was set in motion.

There were two reasons why I welcomed the opportunity to excavate at Les Tambourets, in particular, more than at some other site. The first reason belonged in the realm of the "old archaeology" of culture history, typology, and chronology. Les Tambourets was a Châtelperronian site—Méroc's surface collection left no possible doubt about this—but in southwestern France in the 1960s, the Châtelperronian was usually called "Lower Perigordian" or "Perigordian I." This terminology reflected a culture-historical model that had first been proposed in the 1930s by Denis Peyrony (1933, 1936). The model was somewhat modified but strengthened and extended by the work of the prehistorians at the Université de Bordeaux, Denise de Sonneville-Bordes (for example, 1966) and François Bordes (for example, 1968b), and of others, including Hallam Movius (for example, 1963). This was, at the time, the dominant culture-historical paradigm for anyone in southwestern France doing Upper Palaeolithic research, and this included me. Furthermore, at the start of the 1970s, with my dissertation research essentially completed, I was an expert on what was being called the Middle and early Upper Perigordian (the Early Gravettian of today), having studied excavated materials of this age from the abri Pataud and other major sites in southwestern and eastern France for my dissertation research. Therefore, the prospect of investigating the earliest Upper Palaeolithic beginnings of "the Perigordian" with newly excavated materials was irresistible.

The second reason I was anxious to excavate at Les Tambourets had to do with, if not quite the "New Archaeology," at least a newer set of concerns than just those of culture history. I was becoming increasingly aware of reports in the Palaeolithic literature of attempts to discover intrasite patterns and loci of human activity by investigating the lateral distribution patterns of occupational debris and features. The work of André Léroi-Gourhan and his group at the Magdalenian site of Pincevent in northern France was beginning to show what could be discovered if it was looked for (for example, Léroi-Gourhan and Brézillon 1972). At the abri Pataud, where I was based throughout much of the later 1960s, an early study along these lines was the investigation by Movius (1966b) of the locations and contents of hearths in the Aurignacian and Upper Perigordian archaeological levels. What was of more direct relevance to me was my observation over a period of weeks of Robert Whallon's work in the Pataud lab collecting data for his study of lateral distribution of artifacts in Level 2 at Pataud, the results of which were included in later publications (Whallon 1973, 1974). These were techniques I definitely wanted to employ at any site dug by me, but I wanted to use them at an open-air site, not a rockshelter. The idea, widely shared at the time, was that the spatial arrangement of human activities on a "living floor" was seriously constrained by the physical limits of a rockshelter or cave, whereas in an open-air site the patterning would, to a far greater extent, reflect cultural preferences rather than physical constraints. Les Tambourets seemed to offer a great opportunity for such investigations. Thanks in large measure to the original impetus of Hallam Movius and then the firm support of Jean Clottes, the program of excavation was able to start in the summer of 1973.

FIELDWORK AT LES TAMBOURETS

Methodological Considerations

Our excavations at Les Tambourets took place during three summers—a small test excavation or *sondage* in 1973 and larger, more extensive excavations in 1975 and 1980, as discussed further below. In addition, detailed information is provided in the preliminary reports designated (TDocs 07, 11, 14, 18, 19). Photographs taken at the site during the excavations are included here as Appendix E of this monograph. Also, in this preface and in Chapter 1, photographs that illustrate the discussion in the text are signalled as superscripted file names (hyperlinks) enclosed in curly brackets. This pdf and the appendices pdf must be in the same folder for the hyperlinks to work properly.

During September through December 1978, while on sabbatical leave from Tulane University, I studied the Méroc surface collection in Toulouse. The first results of this study were published in †Méroc and Bricker (1984, included here as TDoc09), and the final results are reported in this present monograph. Field prospecting for sources of the flint used at Les Tambourets was done during a week in June 1977 and, very briefly, in November 1990; the results of this prospecting are reported here in Appendix D.

At the start of the test excavation in July of 1973, a grid was established, and this was extended in later seasons. Each grid unit contained 4m^2 (2m on a side). The grid was aligned with the southern edge of the field in which the test excavation was located ("Area 3" in the terminology explained in Chapter 1), which meant that the grid is slightly divergent from the cardinal directions. The grid's "north" is about 9° west of true geographic north. A site zero was established as the top surface of a metal pole set deep in the ground within the hedgerow on the southern edge of the field, well beyond the limit of ploughing. (Fortunately, the site zero pole remained in position throughout all the excavation seasons.) The elevation of site zero was determined by survey from a geodetic benchmark (elev. +270.27m) located about 200m distant from the site zero pole, at the intersection of the road to Gensac (D.62) and the road to Le Plan (D.8, formerly D.6). The elevation of the site zero was determined to be +270.43m, and all artifact depths and other measurements were recorded as the appropriate number of centimeters below this site zero.

The sediments along the southern edge of Area 3, where almost all the excavations took place, consisted of a rather shallow plough zone that had affected the top of a loessic sediment (a sandy-clayey silt, whose clay content increased with depth) of varying thickness, in the base of which occurred the Châtelperronian archaeological level (as discussed in detail in Chapter 1). Secondary alteration of the sediments underlying the archaeological level had resulted in the formation of small to medium ferromanganese concretions that, although friable, were quite hard. The concretions usually underlay the archaeological level, but sometimes they extended up into it. All these circumstances governed how the excavations were done and with what implements. Beneath the plough zone, which was removed rapidly with shovels and small picks, the sediments were fine-grained except for concretions and occasional water-rolled cobbles; because of the geological context, the latter were treated as manuports. Most of the excavation in this kind of sediment was done with hooks (*crochets*) of various sizes and very small picks.[a75130 a75137 a80070 b800312] The *crochets* and the mini-picks had been made to order for Hallam Movius in the 1950s and 1960s for use at the abri Pataud. Because Movius's Pataud excavations were finished by the time I started work at Les Tambourets, these specialized excavation tools were lent to me by Movius. Trowels were used only in Test Pit Alpha (see Figure 1-11 in Chapter 1), where the loessic sediment had a greater clay content.

Except for some early experiments with both dry screening and flotation, the results of which were not productive, the sediments were not screened. Very small lithic fragments (chips) were not retained. The informal criterion was that if a lithic fragment was smaller than the nail on one's little finger and showed no signs of retouch, it was not retained and its location was not recorded. An exception to the size criterion concerned burin spalls; if a piece could be recognized as a burin spall (as discussed in Chapter 12), it was retained and catalogued no matter how small it was.[3]

Because of the acidity of the enclosing sediments, all excavated objects not demonstrably intrusive into the Châtelperronian archaeological level (for example, sherds of Medieval ceramics) were lithic artifacts or manuports. All flint objects other than chips and non-flint lithics whose shape had been modified in some way (i.e., artifacts, not just manuports) were retained and catalogued. During the excavation of an archaeological level, the artifacts that were to be catalogued were left in place, on short pedestals if necessary,[a75046 b800310] and photographs were taken of the artifact scatter in that excavation unit. Before being removed from the ground, an artifact was assigned a catalogue number, and its location in space was recorded in three dimensions (Cartesian coordinates) to the nearest centimeter.[b751922 b800606] The frame of reference for the lateral coordinates was the individual 2m x 2m grid square: a N-S coordinate, the distance from the north wall or boundary of the square measured at a right angle[b801120] to that boundary, and a W-E coordinate, the distance from the west wall or boundary, measured again at a right angle. The third coordinate was the depth below site zero of the surface on which the object was resting. Depth was measured using a Wye level and a ranging pole[a80044 b800314] (objects from the abri Pataud lent by Hallam Movius). Other properties recorded during artifact recovery included the so-called Trench and Square designation of the grid unit in question, the stratigraphic subdivision in which the object was found, the "attitude" of the object (flat-lying, on edge, vertical, etc.), and a preliminary description given by the excavator (to be confirmed or modified in the cataloguing, all of which was done by me). A "Trench" was a north-south column of adjacent grid squares designated by Roman numerals; "Square" referred to a west-east row of grid units designated with upper-case letters (shown, for example, in Figure 1-6 in Chapter 1). The stratigraphic units recognized during the excavation of Les Tambourets are listed and described in Chapter 1. Except for the removal of the plough zone, excavation was done by horizontal exposure (*décapage*) within what could be recognized as natural sedimentary bodies (*couches*). Where such sedimentary bodies were thick, excavation was done in 5-cm-thick horizontal spits.

Catalogue numbers, assigned from a "numbers book" and marked on the artifacts while they were still in the ground,[b753708] were kept track of during the washing and drying processes.[b750908] Once the artifacts were dry, the catalogue numbers were marked on the pieces with India ink,[b750910] and the numbers were subsequently covered with transparent nail polish. The catalogue number, a unique identifier, stayed with the piece from excavation, through cataloguing and study, to—for some—eventual illustration in unpublished or published reports.

The Excavation Seasons and Subsequent Analysis

1973 test excavation, 5 July to 5 August 1973. Work at the site in 1973 was a test excavation (*sondage*), limited by the terms of the permit to an investigation of 8m^2 and a duration of one month. Two 2m x 2m grid squares were excavated from the surface of the plough zone, couche A, to the upper few centimeters of the concretion-rich level, couche C.[a73027] In order to make the best use of the limited time available, the plough zone was removed by hired workmen using picks and shovels. This removal stopped and archaeological excavation began when clearly undisturbed sediment (couche B) was reached. The Châtelperronian artifact horizon, Archaeological Level 1, was encountered just above couche C, at the base of couche B (the stratigraphic units are defined and discussed in Chapter 1). The two grid squares excavated became squares V-A and V-B of the eventual grid in the so-called Main Area of Méroc's Area 3. The 1973 excavations were co-directed by me (Harvey Bricker) and J.-F. Alaux, a prehistorian from Albi (Tarn), and the paleoenvironmental research was overseen by Henri Laville, a geologist at the Université de Bordeaux I. Excavation personnel during all or part of the one-month project were Harvey Bricker, Victoria Bricker, Amy Gardner, and Arden King. Some financial support was provided by the Tulane University Senate Committee on Research. More detailed information about the 1973 work at Les Tambourets is to be found in the preliminary report to the French government (TDocs 18 and 19).

The main results of the test excavation may be summarized as follows:

- The excavation located and clarified the stratigraphic position of an *in situ* Châtelperronian archaeological level just north of the artifact-bearing exposure in the Gensac roadcut explored by Méroc.
- The excavation demonstrated the absence in that part of the site of any Palaeolithic archaeological level later than the Châtelperronian (a conclusion previously reached by Méroc for the entire site based on his surface collection).
- Collection of sediment samples by Henri Laville permitted the start of paleoenvironmental investigations, pursued subsequently by Laville for sedimentology and by Marie-Madeleine Paquereau for palynology.

1975 excavation, 10 June to 20 August 1975. The work during the summer of 1975 was the principal excavation season at Les Tambourets. A total of 44m^2 was excavated, in both the Main Area and in test pits east and west of it. The grid units opened in the Main Area, 32m^2 in all, were II-B(N), III-B(N), IV-B, IV-C, V-C, V-D, VI-B, VI-C, and VII-B. Test Pit Beta (4m^2) was located east of the Main Area (see Figure 1-6 in Chapter 1). The Alpha Complex (8m^2), comprised of Test Pits Alpha, Alpha Extension-1, and Alpha Extension-2, was west of the Main Area (see Figure 1-11 in Chapter 1). The 1975 excavations were co-directed by Harvey Bricker and Henri Laville, and, as in 1973, J.-F. Alaux of Albi was associated with the direction. Excavation personnel present[a75134] during all or part of the 1975 season included the following 16 persons: Harvey Bricker, Victoria Bricker, Arden King, Isabella King, Jacqueline Brind, Joe Cooper, A.P. (Fred) Fowler, John Fowler, Marco Giardino, Marla Hires, Barbara Holmes, Louise Lepie, J.C.M. McNee, Paul Ossa, Cliff Samson, and Jeanne Trapolin. The program of excavation and subsequent analysis was supported by U.S. National Science Foundation grant SOC75-11142 to Tulane University (H.M. Bricker, Principal Investigator). More detailed information about the 1975 work at Les Tambourets is given in the preliminary report to the French government (TDoc14) and the report to the U.S. National Science Foundation (TDoc 11).

The main results of the 1975 excavation season were:

- The series of excavated, provenienced Châtelperronian artifacts was greatly enlarged.
- The excavation of a deep geological test pit in square V-C allowed the sampling by Henri Laville of deposits—couches D (lower part) through M (upper part)—older than those sampled in 1973, giving greater time depth to the paleoenvironmental context of the Châtelperronian occupation.
- In addition, the geological test pit demonstrated the absence in that part of the site of any prehistoric occupation earlier than the Châtelperronian of Archaeological Level 1—i.e., there was no underlying Mousterian.
- With the assistance and using the equipment of David Lubbell (University of Alberta), who visited the site briefly on his way to fieldwork in North Africa, the field of Méroc's Area 3 was surveyed, and zones where the loess containing the Châtelperronian archaeological level was still in place were delimited (see Figure 1-5 in Chapter 1).
- Test pits placed to the east and west of the Main Area showed that the Châtelperronian archaeological level was extensive along the southern edge of Area 3 and that the Pleistocene land surface on which the occupational debris had been deposited had a greater slope to the west than the modern surface.
- Traces of possible artificial structures were found in the lateral distribution patterns of Archaeological Level 1 artifacts in the Main Area, identifying the need for further excavation in a few specific grid units.

1980 excavation, 24 June to 7 August 1980. This was the last season of excavation at Les Tambourets, and the scope of the work was limited to the attempt to answer some specific questions that had been raised by the results of the 1975 excavations. The questions concerned the stratigraphic and typological relationships among Châtelperronian occupations in different parts of the site, as well as the reality of the suspected artificial habitation structures in the Main Area of Area 3. Within Area 3, 8.4m^2 were excavated in the Main Area (see Figure 1-6 in Chapter 1), in grid units II-A(NE), II-B(SE), III-A, III-B(S), and IV-A(NW). West of the Main Area, an additional 6m^2 were excavated in three 2m x 1m test pits—Test Pits 3W1, 3W3, and 3W5 (see Figure 1-11 in Chapter 1). Finally, a 2m x 1m test pit, Test Pit 2E1, was excavated at the eastern edge of Méroc's Area 2 (see

Figure 1-4 in Chapter 1). The total area excavated in 1980 was, therefore, 16.4m^2. The 1980 excavations were co-directed by Harvey Bricker and Henri Laville. The following excavation personnel were present during all or part of the 1980 season: Harvey Bricker, Victoria Bricker, Arden King, Isabella King, Michelle Dubois, Thomas Michael Kelley, R. Sandlin Lowe, Mark Steinmetz, Cliff Samson, and Carolyn Watts. Some financial support was provided by the Tulane University Council on Research and by the Conseil Général de la Haute-Garonne. Additional information about the 1980 excavations at Les Tambourets is given in the preliminary report to the French government (TDoc07).

The main results of the fieldwork in 1980 may be summarized as follows:

- The exposure of the lateral distributional anomalies in the Main Area suspected of defining artificial structures was completed. The analyses and eventual diagnosis of these anomalies are discussed in Chapter 4.
- The relationship between the Châtelperronian archaeological levels in the Main Area and the Alpha Complex—and thus between the time of occupation and the onset of emplacement of the loessic sediment—was clarified by the stratigraphies of Test Pits 3W1, 3W3, and 3W5, as discussed in Chapter 1.
- The excavation of Test Pit 2E1, although very limited, demonstrated the existence of a deeply buried Châtelperronian archaeological level well downslope from Area 3, near the unnamed stream that separates Les Tambourets from the much smaller Châtelperronian site of Rachat (see Figure A-1 of Appendix A). The archaeological level in Test Pit 2E1 is similar to Archaeological Level 1 in both typology and stratigraphic context, but the test excavation of 1980 was far too limited to permit any firm conclusions to be drawn.

The typological and distributional analyses of the archaeological materials and the paleoenvironmental analyses reported in the monograph were carried out over a period of nearly 40 years, between 1973 and 2011. The statistical analyses of the chipped lithics were done at Tulane, mostly in the 1980s, and they were not redone later (the results of factor analyses, discriminant analyses, etc. are not going to change so long as the input data remain the same). Some chapters, of course, had to be updated in recent years to take new findings into account, most particularly the work on the Tambourets materials reported by Réné Scandiuzzi in his 2008 master's thesis. Chapter 2, on the dating of the Châtelperronian at Les Tambourets, was written entirely after 2010.

EXCAVATION RECORDS AND LOCATION OF COLLECTIONS

The principal excavation records for Les Tambourets include the excavators' notebooks, the artifact catalogue, and on-site photographs. The excavators' notebooks were notebooks with sewn bindings; no pages could be added or easily removed. Each TR-SQ grid unit (for example, VI-C) had a separate notebook. The contents included: a) brief accounts, by date, of the work done in that unit; b) provenience information (catalogue number, Cartesian coordinates, stratigraphic subdivision, attitude) for each artifact removed from that unit; c) the excavator's preliminary description of each artifact (to be revised, if necessary, by me in the final cataloguing); and, d) survey data on natural or artificial surfaces exposed by excavation (for example, surface of Archaeological Level 1). Copies of all excavators' notebooks were deposited in the Dépôt de Fouilles de la Circonscription de Midi-Pyrénées, which during the relevant years was located in downtown Toulouse (25, rue de la Dalbade). Another copy was retained by me.

The artifact catalogue was compiled gradually in a separate set of sewn-binding notebooks as excavation, washing, numbering, and final description of the artifacts proceeded. A digital version of the complete catalogue is included in the database accompanying this monograph.

Photographs, both black-and-white and color slides, were taken on the site during the course of the excavation. Copies of selected black-and-white prints and duplicates of selected slides were given to the Dépôt de Fouilles in Toulouse to be included with site records. Digital versions of selected photographs are included in Appendix E of this monograph.

In addition to the excavation records created during the field seasons, excellent sources of information about what took place on the site when the work was in progress are the preliminary reports to the French government and the report to the U.S. National Science Foundation on the grant funding for the 1975 season. These unpublished reports are included in full as TDocs07, 11, 14, 18, and 19.

After each of the three excavation seasons, the French authorities authorized the temporary shipment of the artifacts recovered to Tulane University in New Orleans, Louisiana, on a brief study loan. At the expiration of each of the three study-loan periods, all the archaeological materials were returned to France, where they were curated at the Dépôt de Fouilles in Toulouse (the location at that time of the Méroc collection from Les Tambourets as well). These materials are at present (2013) located at a new Ministry of Culture depository elsewhere in Toulouse. Inquiries may be addressed to Monsieur le Conservateur Régional de l'Archéologie, DRAC, 32 rue de la Dalbade, BP 811, 31000 Toulouse, France.

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—to my wife, Victoria Bricker, who took time out from her own research to help me with mine. When the need arose, she was one of the excavators. In addition, she ran the on-site lab,{b751814} scheduling and supervising the washing, marking, and bagging of the artifacts to get them ready for cataloguing.

—to J.-F. Alaux and Henri Laville, my co-directors, for sharing the planning and execution of the research.

—to Henri Laville (again) and Marie-Madeleine Paquereau, for undertaking the paleoenvironmental research.

—to Arden King, a senior faculty colleague at Tulane University, and his wife Isabella, who came to Cazères to help us during all three excavation seasons.{b800314 b800418} The presence and advice of Arden, a veteran of archaeological excavations in both the southeastern U. S. and the state of Washington, were much appreciated.

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—to Philippe Méroc, who supplied information about his father's work at Les Tambourets and who made available lodging for my wife and me in a family house in Cazères during the 1980 excavations.

—to the land-owners of Les Tambourets during the years of the excavations, the Yvon Dubois family{a80066} and the Pierre Portet family, who gave their permission for the work to be done, followed the progress of the dig with interest, and gave us not only every possible assistance, but also their encouragement and friendship.

—to the people of Cazères, with whom all of us came into contact on a daily basis, particularly the Ponsaty family of the Hôtel-Restaurant "Au Cochon de Lait", the home base of the excavators.{b753816}

—to those Tulane University graduate students who, usually as part of their research assistantships, helped me with various aspects of the study of the Châtelperronian in general and of Les Tambourets in particular: Richard Beavers, John Casale, Edward Frame, Marco Giardino, Myriam Huet, Gail Peterkin, Stephen Sieracki, Gabrielle Vail, and Suzanna Yorgey.

—to Deborah Olszewski, fellow Palaeolithic archaeologist, who so carefully and effectively prepared the materials about Les Tambourets for on-line publication in *PaleoAnthropology*.

—to François Rouzaud, Jean Vaquer, and Suzanne Puech, administrative and research staff at the Dépôt de Fouilles in Toulouse, who helped make the sabbatical semester I spent there both profitable and pleasant.

And, finally, I acknowledge again my very special debt of gratitude to the two archaeologists who made possible my work at Les Tambourets—to Hallam Movius,{a73041 b751524} who trained me in Palaeolithic archaeology and who set in motion the train of events that got me to Les Tambourets, and to Jean Clottes,{b752501} who took a chance on a young, untried, foreign archaeologist and who never wavered in his support.

ENDNOTES

1. In his notes (Méroc dossier, p. 68), Méroc listed the prehistorians who had viewed the Tambourets artifacts at the Congress in Foix. They were: Karel Absolon, le Comte Henri Bégouën, Severin Blanc, l'abbé Henri Breuil, Philippe Héléna, Homer Kidder, Fernand Lacorre, le Commandant François-Charles-Ernest Octobon, Emmanuel Passemard, Denis Peyrony, Elie Peyrony, and Joseph Vézian. According to Méroc, all but one of these specialists agreed with a "Perigordian" designation. The dissenter was Héléna, who considered the material Neolithic. If Méroc's report is correct, the agreement of Octobon is of note, because it was Octobon who, in the first published mention of Les Tambourets (Institut International d'Anthropologie 1924), called it Neolithic on the basis of his own surface collecting (†Méroc and Bricker 1984: 46).
2. Superscripted notations in curly brackets are hyperlinks to supplemental images contained in Appendix E.
3. There are no *lamelles Dufour* or very small bladelets, twisted or not, retouched or not, in the excavated series from Les Tambourets or in the Méroc surface collections.

CHAPTER 1
STRATIGRAPHY AND PALEOENVIRONMENT

I. THE GEOLOGICAL CONTEXT

The archaeological site of Les Tambourets is situated on Pleistocene terraces overlooking the confluence of the Volp and Garonne Rivers (Figure 1-1), just at the northern boundary of the Petites-Pyrénées mountain chain where it has been cut through by the Garonne. That part of the geologic history of the region (Carte géologique 1970, 1971, 1974, 1977) that is directly relevant to the Upper Palaeolithic occupation of the site dates to at least as far back as the Cretaceous Period, at the end of the Mesozoic Era. A series of fluctuating marine transgressions and regressions that had begun earlier in the Mesozoic continued in the Cretaceous. This meant that the region was on several occasions covered by an inland sea, at the bottom of which were deposited various sediments that eventually became rock. Some of these rocks are limestone, within which were developed bands and nodules of flint. For example, a near-shore facies of limestone (the Nankin Limestone) that was deposited by a retreating sea at the very end of the Cretaceous contains a kind of flint that became an important source of raw material for tool manufacture by the eventual human inhabitants of the region. The return of the sea at the beginning of the Tertiary Period[1] (of the Cenozoic Era) created more flint-bearing limestone of relevance to later human occupants—for example, the so-called Sublithographic Limestone that formed in shallow-water estuarine or lagoonal contexts during the Paleocene Epoch, the first epoch of the Tertiary Period.

By the later part of the second epoch of the Tertiary, the Eocene Epoch, the long history of cyclical marine transgressions into the area had ended, and a time of mountain-building had begun. By the end of the Eocene, the major phases of the orogeny that created the Pyrénées mountains had occurred (Carte géologique 1974: 2). The northernmost part of the folded and faulted mountain chain, the so-called northern sub-Pyrenean zone (Taillefer 1974: 14), includes the Petites-Pyrénées mountains, which are formed, in the region near Les Tambourets, of the gently folded rocks of Cretaceous and Paleocene age discussed above (Carte géologique 1971). The rapid uplift of the Pyrénées started a cycle of prolonged and pronounced erosion of the newly

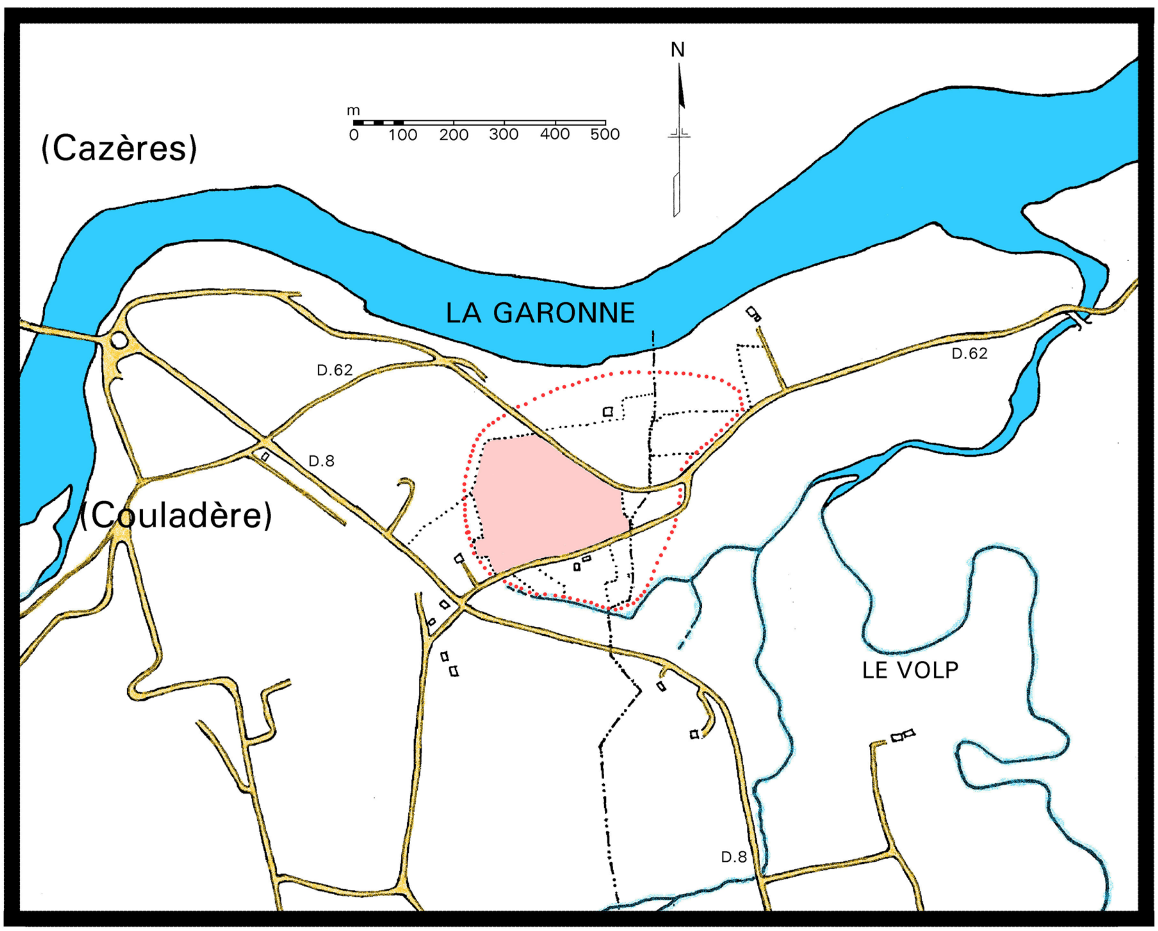


Figure 1-1. Location of the site of Les Tambourets (communes of Couladère and St.-Christaud, Haute-Garonne, France), on the right (south) bank of the Garonne River, south of the city of Cazères and east of the town of Couladére, near the confluence of the Garonne and the Volp. Locations of roads and structures are as of the 1970s. The irregular area delimited by red dots is the approximate maximal extent of the Châtelperronian artifact scatter at Les Tambourets (see Figure 1-4 for further details). The polygon shaded in light red is the field shown in Figure 1-5.

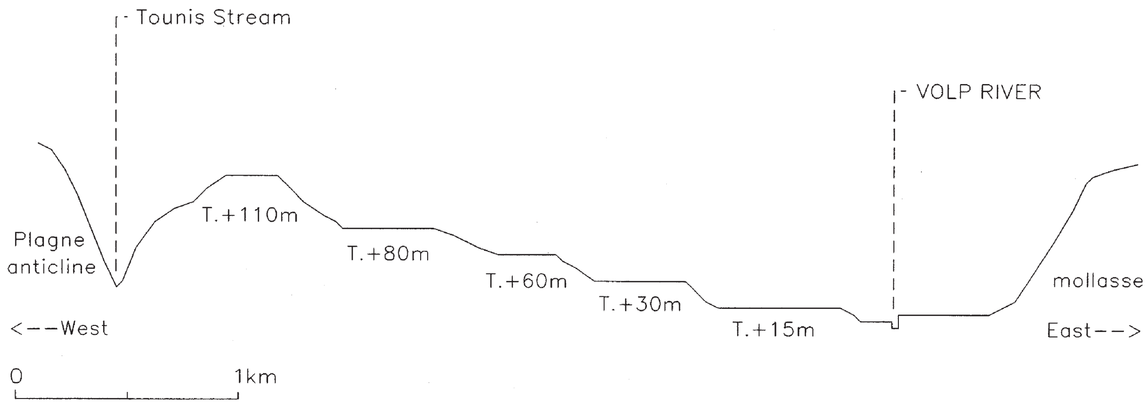


Figure 1-2. Idealized and simplified transverse profile of the Volp Valley ca. 2km upstream from Les Tambourets (adapted from Méroc 1969: 26, Figure 8).

formed areas of high relief. The abundant detritus that was the product of this severe erosion accumulated to great depths at the foot of the highland zone during the Oligocene and Miocene Epochs of the Tertiary.[2] These thick deposits of alluvial, lacustrine, and littoral sandstones, shales, and conglomerates are known collectively as "molasse" or "mollasse" (Carte géologique 1974: 2). Such deposits, which simply buried many pre-existing landforms, make up some of the hills in the immediate vicinity of Les Tambourets (Carte géologique 1970, 1977) and, indeed, constitute the bedrock substrate at the site itself (Méroc 1969: 28).

The modern landforms of the region have been created by erosion, specifically by the actions of the Volp and Garonne river systems. Erosion has been going on since the emergence of the land in the Eocene, but the present shape of the landscape owes the most to the processes of erosion that took place during the Pleistocene Epoch of the Quaternary Period. It was during the Pleistocene that glaciation of the Pyrénées, on a scale far greater than that of the present, provided streams draining the highlands with seasonally increased hydraulic flows and detrital loads that allowed them to model the valleys in significant ways. The river terraces on which the site of Les Tambourets is located were formed by such processes during the Pleistocene. The Pleistocene glaciation of the Pyrénées produced abundant meltwater streams that provided the principal source areas for the fine-grained sediments that, after having been carried some distances by the wind, accumulated at lower elevations as periglacial loess. It is in such a body of loess that the Upper Palaeolithic archaeological level at Les Tambourets occurs.

Although Les Tambourets overlooks both the Garonne and the Volp Rivers, it is with respect to the geomorphology of the latter, smaller valley that the location of the site is best understood. The Volp is a very short stream (25–30km in length) that rises just east of Montesquieu-Aventès (Ariège) in low foothills that form the boundary between the Plantaurel chain, to the east, and the Petites-Pyrénées chain, to the west. After flowing west through the famous Magdalenian cave sites of Les Trois Frères and Le Tuc d'Audoubert (Bégouën and Breuil 1958), the Volp turns generally north, traversing the Petites-Pyrénées in a steep, very narrow valley until it reaches the modern town of Le Plan, ca. 5km from its confluence with the Garonne. In its lowermost 5km, the Volp has created a series of terraced landforms that are most fully represented on the left (west) bank of the river. The Volp Valley is here ca. 3.5km wide. It is confined on the west by a ridge of the Petites-Pyrénées chain that is, structurally, the Plagne anticline, made up of rocks of Cretaceous and Paleocene age. On the east, the valley is confined by the sharp relief of the Oligocene and Miocene "molasse" formations that divide the valley of the Volp from the valley of the Arize, to the northeast.

The terraces of the lower Volp and their relationships to prehistoric industries were studied by Louis Méroc. His transverse profile of the valley ca. 2km upstream from Les Tambourets (Méroc 1969: 26, Figure 8) is shown here in simplified form as Figure 1-2. According to Méroc (1969: 24–25), the terrace system is developed on underlying "molasse" sediments of Miocene (Burdigalian) age. The surfaces of the Volp terraces are concordant with those of the Garonne terraces in the immediate region. The oldest Volp terrace, +110m, may contain in the alluvial deposits that cap it some rolled quartzite objects of Acheulian type (1969: 25). The +80m terrace is capped by at least three superposed "*limons*" (=sheets of silty/clayey sediment), the lower two of which have weathering horizons at their summits and Acheulian tools within them (1969: 27, Figure 9a). Little of the +60m terrace is preserved, and its archaeological contents, if any, are unknown; it is, however, capped by a loess body that is probably identical to that capping the +30m terrace (1969: 25).

It is the +30m and the +15m terraces that are of the most interest here, because it is on these two terraces that Les Tambourets is located. Study of roadcuts through various parts of Les Tambourets allowed Méroc to sketch a section (Méroc 1969: 27, Figure 9b) of the +30m terrace as it is represented at that site (Figure 1-3). According to Méroc, the rocks of the "molasse" (level 4 of the diagram) are covered directly by cobble-rich alluvial sediments of the Volp (level

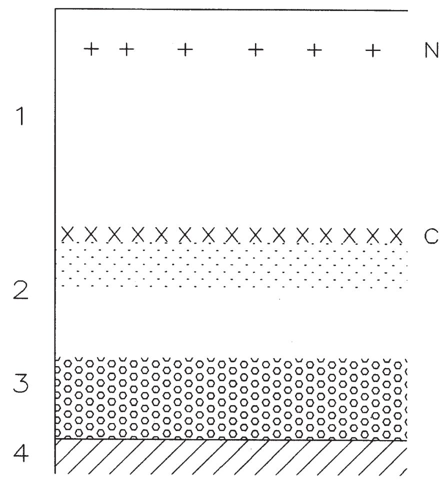


Figure 1-3. Méroc's sketch section of the +30m terrace of the Volp River at Les Tambourets. 1: grayish-yellow limon, *a loess sheet; 2:* limon *with upper zone of ferruginous concretions; 3: alluvial sediments; 4:* molasse *bedrock; N: zone of Neolithic artifacts; C: zone of Châtelperronian artifacts (after Méroc 1969: 27, Figure 9b).*

3) containing rolled Acheulian artifacts. Overlying the cobbles is what Méroc called a "*limon*" (level 2) the uppermost portion of which is a zone of ferruginous concretions. Capping the terrace is a grayish-yellow "*limon*" or loess (level 1) that contains, just at its basal contact with the ferruginous concretions, a Châtelperronian archaeological level and, in its uppermost centimeters, Neolithic artifacts.[3] A second Châtelperronian site on the +30m terrace is Rachat, located only about 300m south of Les Tambourets and separated from it by a small unnamed tributary of the Volp.

The easternmost parts of the site of Les Tambourets are located on the +15m terrace, which, according to Méroc (1969: 25), seems to be capped by the same grayish-yellow loess found on the +30m terrace. On the eastern edge of the +15m terrace, on a narrow tongue of land between the Garonne and the mouth of the Volp, is the Chassean Neolithic site of Terssac (Méroc 1948).

During the decades that Louis Méroc practiced carefully controlled surface collecting from Les Tambourets (†Méroc and Bricker 1984), he divided the site into several areas, as shown in Figure 1-4. Méroc's area designations are used throughout this present study. The northwestern corner of the site, adjacent to the old farmhouse, is Area F (for "*Ferme*"); it is bisected by the new road cut through Les Tambourets in the 1960s.{a73006 a73007 b731410} The west-central portion of the site is Area 3,{a73004} and the southwestern corner is Area 2.{b731407 b731408} Areas F, 3, and 2 are located entirely on the +30m terrace, within the commune de Couladère. The northeastern corner of the site is Area T-T or

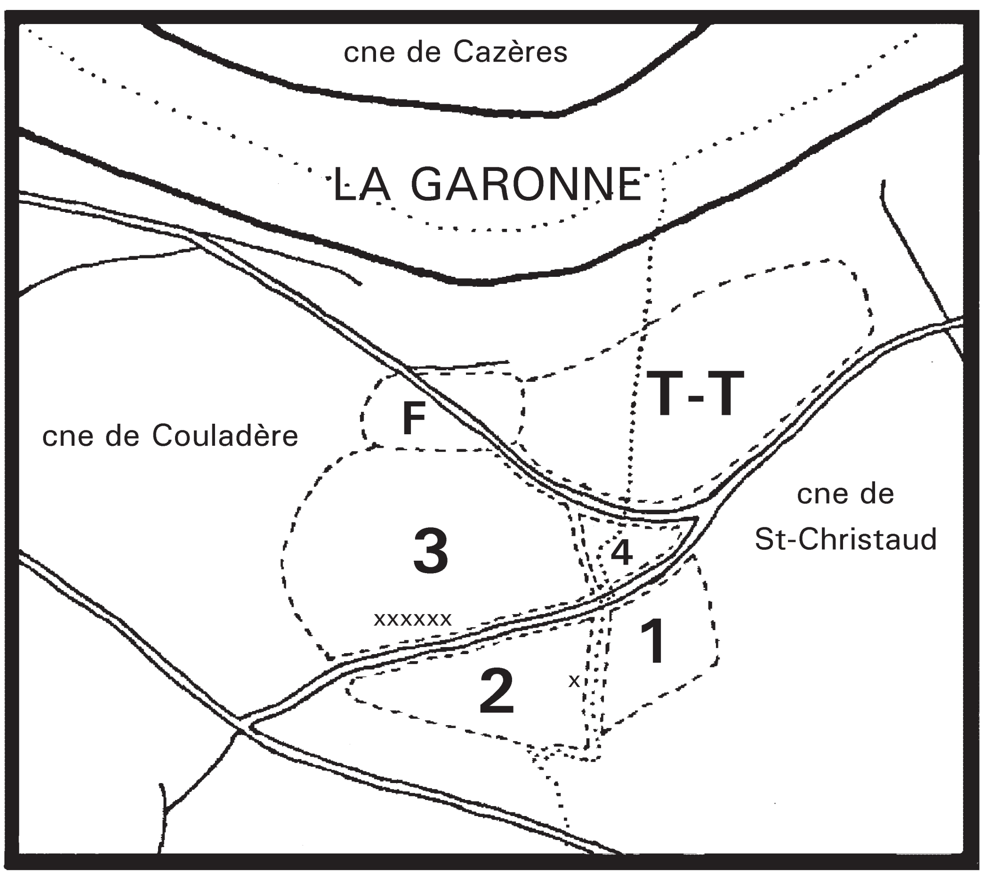


Figure 1-4. Sketch map of Les Tambourets, showing communal boundaries and the approximate limits of the six areas of the site (1, 2, 3, 4, F [Ferme], and TT [Tambourets-Terssac]) as defined by Louis Méroc. The row of "X"s in Area 3 is the location of the excavations of 1973, 1975, and 1980 (see Figure 1-5). The "X" in Area 2 is the approximate location of the test excavation of 1980.

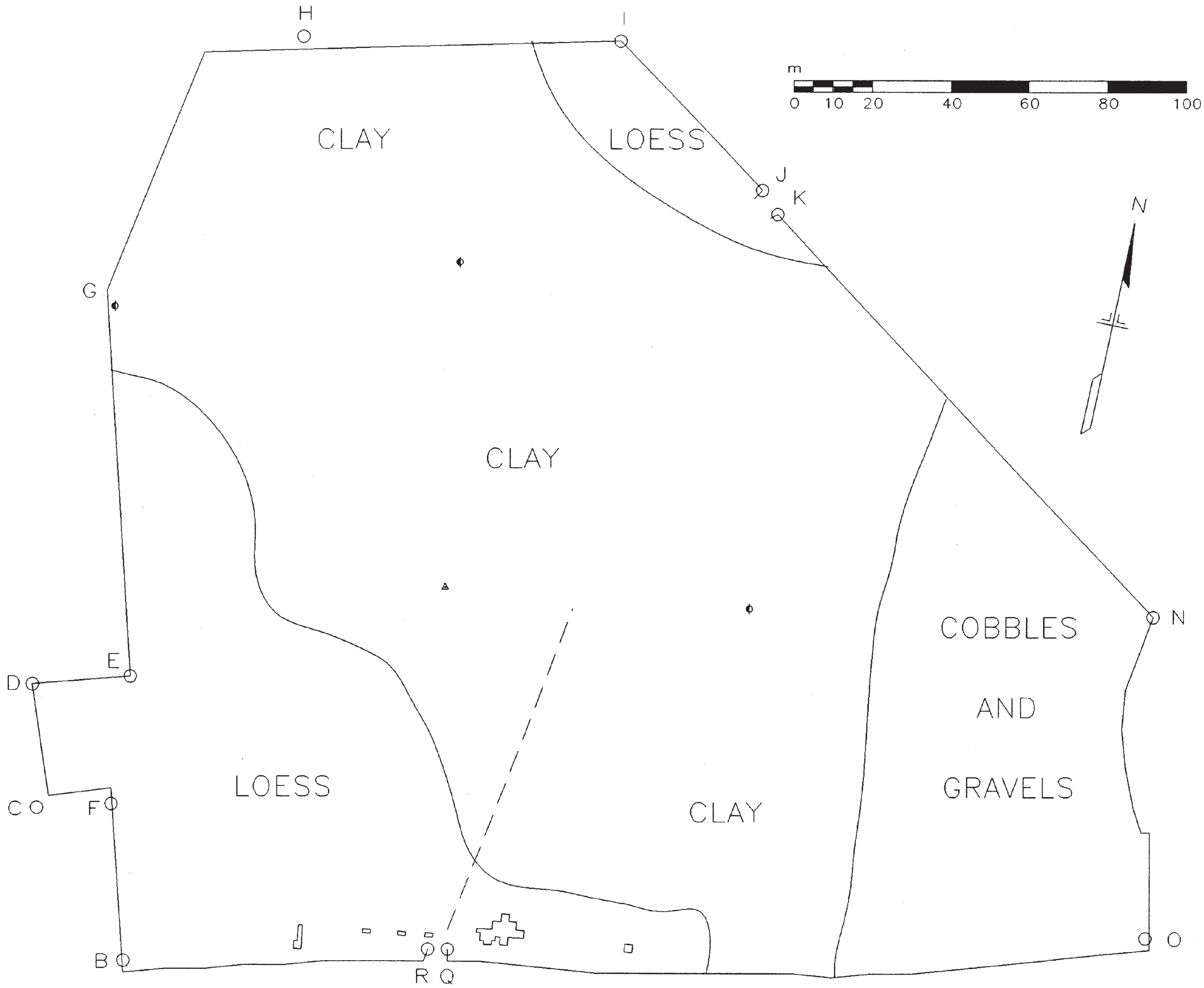


Figure 1-5. Map of the field at Les Tambourets containing all of Area 3 and part of Area "Ferme," showing the location near the field's southwestern corner of excavations in 1973, 1975, and 1980 and of the kinds of sediments exposed at the surface (based on a plane-table survey done in 1975 by Harvey Bricker and David Lubbell). Three small half-filled circles mark the positions of concrete utility poles. See text for additional explanations.

"Tambourets-Terssac."{b731409} As defined by modern surface scatter, it is an integral part of the Châtelperronian site of Les Tambourets, but it is contiguous with the Neolithic site of Terssac to its northeast. Area T-T lies mainly within the commune de Saint-Christaud, but part of it is in the commune de Couladère. The commune boundary (see Figure 1-4) through Area T-T marks the original position of the eastern edge of the +30m terrace; this is not completely obvious today because the central portion of Area T-T was graded following World War II to achieve one large, regularly sloping field spanning what were originally two terrace surfaces. Area 4 is a small triangular field in the east-central portion of the site, and Area 1 is the southeastern corner. Both Areas 4 and 1 are entirely on the +15m terrace; Area 1 is in the commune de Saint-Christaud, and Area 4 is split between both communes.

II. THE MAIN AREA IN AREA 3

The Main Area is located along the south-central and southwest border of Area 3 (see Figure 1-4; Figure 1-5), in what was a single large cultivated field during the excavation seasons of 1973–1980. An opening to the field{a73001 a73002 b731201 b731202} between points R and Q in Figure 1-5 gave access to what had been an unpaved road leading northeast to the farm, known locally as "la métairie,"{b731410} that provided the name for the area of the site called "Ferme" by Méroc. After the new highway, part of route D.62, cut through the site in the 1960s, the farm road led nowhere, and it was ploughed up in later cultivation. The opening between R and Q was still a main entry point to the field for wheeled vehicles, a major convenience during the archaeological excavations.

The Main Area, immediately east of the former farm road, comprised Trenches II through VII and Squares A through D (Figure 1-6). Other excavations in Area 3 were designated test excavations, and they are discussed in Section III of this chapter, below. The excavated portion of the Main Area formed an irregular polygon. A total of 48.4m^2 were excavated, including ca. 42.9m^2 of the Châtelperronian archaeological horizon. The difference in area, ca. 5.5m^2, represents the area of the archaeological level within the excavated polygon that had been lost to the historic-age ditch that cut through Trenches VI and VII (see Section II-N, below).

The following description of the stratigraphic sequence encountered in the Main Area (Figure 1-7) is based on: a) the observations of the archaeologists during the three seasons of excavation; b) archaeological mapping and backplotting information resulting from laboratory analysis; c) the field observations made by the late Henri Laville at the times of geological sample collection in 1973[a73037] and 1975;[a75069 a75073 b753410] and, d) the results of sedimentological analysis done by Laville on the samples collected. (The results of the sedimentological analyses are discussed in Section V of this chapter, below.)

A. Couche A

Couche A (thickness: 25–40cm) is the plough zone. In the Main Area, it is a predominantly silty sediment of dark yellowish-brown color.[a73069] Throughout its entire thickness there are occasional cobbles and smaller stones as well as cultural material of various ages in disturbed context—chipped flints, potsherds, brick fragments, etc. Although Les Tambourets adjoins the Middle Neolithic (Chassean) site of Terssac (Méroc 1948) and although a Middle Neolithic occupation of Les Tambourets itself is well documented by the Méroc surface collection from the site (†Méroc and Bricker 1984), none of the artifacts found in couche A of the Main Area can with confidence be assigned to the Neolithic on typological criteria.

B. Couche B

Couche B is a predominantly silty loessic sediment of dark grayish-brown color.[a73057 b730622 a75070 b752616 b752726] The deposition of this level in the Main Area was primarily the result of aeolian action. It is the remaining lower part of a once thicker loess body whose upper portion has been removed by later erosion. The thickness of the remaining part varies between ca. 25cm and 40cm, depending on the relationship between the slope of couche B and the slope of the modern surface. Couche B is thinnest toward the northern and western extremities of the Main Area (for example, ca. 24cm along the western edge of II-B and ca. 28cm along the northern edge of V-D) and thickest toward the southern and eastern extremities (for example, ca. 39cm along the southern edge of III-A and ca. 37cm along the eastern edge of VII-B).

The content and structure of couche B vary with depth. Described by Laville as a sandy-clayey silt at the (truncated) top of the level,[b752724] its clay content increases toward the base. Its consistency becomes firmer toward the base, and its structure becomes more clearly angular. Throughout its thickness, it contains rare and widely dispersed ferromanganese concretions whose color varies from rusty dark reddish-brown to black. In general, the (always low) frequency of concretions increases with depth;[a75074 b752728] their absolutely highest frequency occurs, however, just below the middle of the couche.

Both the sedimentological analyses of H. Laville and the palynological analyses of M.-M. Paquereau (see Section V, below) demonstrate that the paleoenvironmental conditions recorded in couche B are more complicated than its field description would suggest. The upper part of the loess body and the lower, more clay-rich part bracket a thin middle zone in which evidence of a brief time of milder, more humid climate is recorded in the pollen and the sediments. This brief climatic amelioration is what Paquereau (1978: 142, 150) suggested is the local equivalent of the so-called Arcy oscillation, a topic discussed in greater detail in Chapter 2 of this monograph.

Couche B contains archaeological material throughout its thickness. In its upper zone, these materials are very rare and heterogeneous. These include: cracked and unmodified cobbles,[a75008 b750100] at least some of which may be manuports; ceramic fragments (potsherds and fragments of brick and tile) that probably date, for the most part, to the Middle Ages; and, chipped stone artifacts that are probably or certainly Châtelperronian. There is no evidence that this upper part of couche B contains any archaeological level, Neolithic or otherwise, or that any of the artifacts may be considered to be in primary context.

The basal 8–10 cm of couche B contains a dense and concentrated artifact scatter that is designated *Archaeological Level 1* (Châtelperronian) (Figure 1-8). The 10cm or so of couche B immediately above the concentrated scatter contain some widely dispersed artifacts of Châtelperronian type that are considered to be mechanically derived from the immediately underlying archaeological level. This zone above the archaeological level is designated couche B(Basal).

An important process of post-depositional disturbance that has affected couche B and its contained archaeological level in the past and continues to do so at the present time is the burrowing activity of moles and the subsequent natural infilling of the abandoned tunnels. Fresh tunnels, still empty,[a75048] were encountered frequently in couches A and B during the excavation (indeed, on several occasions, nocturnal tunneling produced brand new mole holes in standing section walls, much to the disgust of the excavators!). Completely filled tunnels, of unknown antiquity, were recognized at the base of Archaeological Level 1 because of the clear contrast between the lighter colored loessic infilling and the darker surrounding sediment of couche C. When first encountered in plan view during the test excavation of 1973, these features were suspected of being filled postmolds,[a73046] but when they were tested by sectioning, that hypothesis was quickly disconfirmed.[a73048] The visual homogeneity of the loessic sediment is such, however, that old filled tunnels cannot be seen and

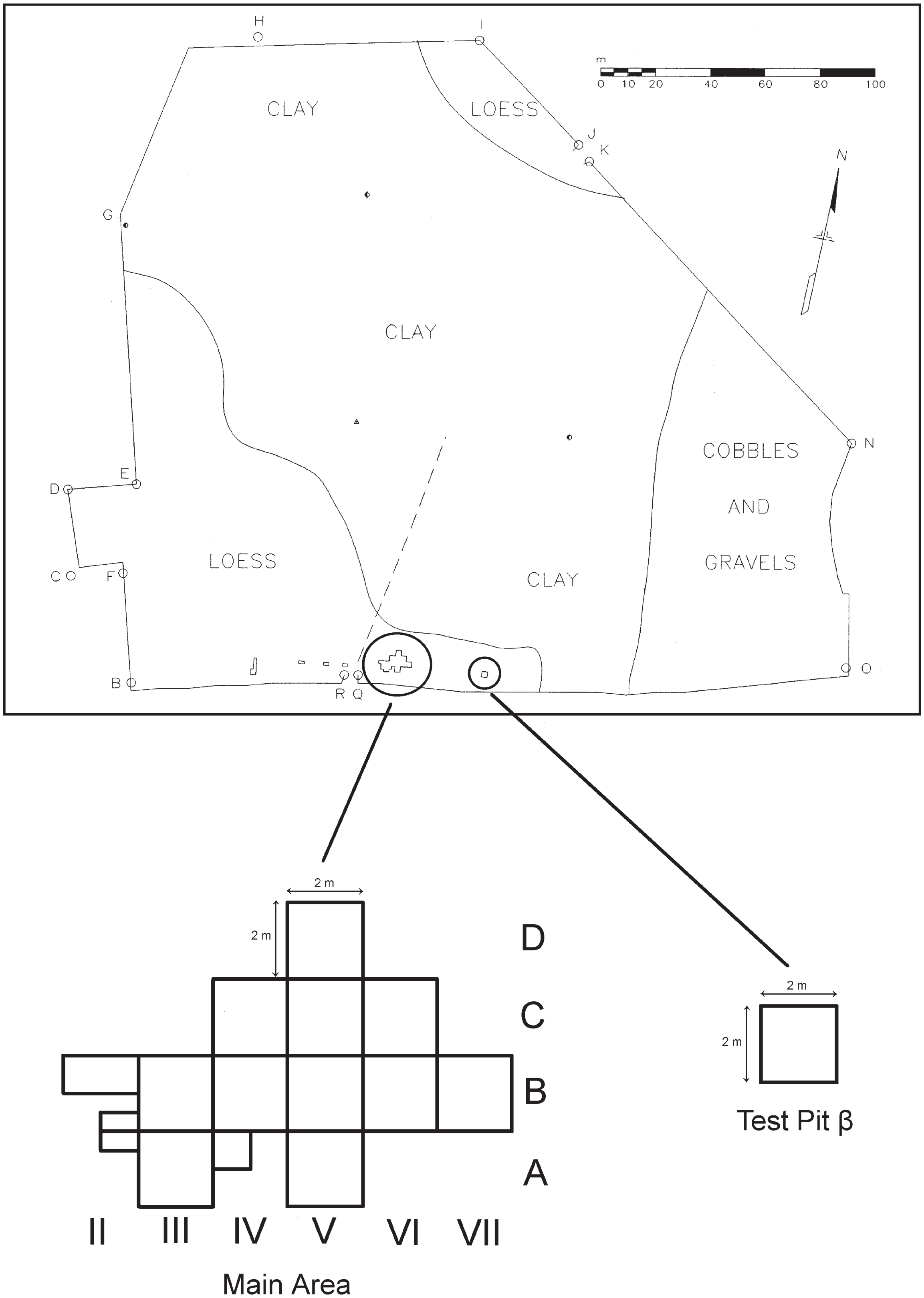


Figure 1-6. Base map shown in Figure 1-5, detailing locations of the Main Area of the 1973–1980 excavations and Test Pit Beta.

followed within couche B itself. It is obvious that the activities of the moles over an unknown but clearly long period of time has been responsible for significant disturbance of the archaeological level and the movement of artifacts in all directions. With specific reference to vertical movement, artifacts have been moved both up and down (the discovery of several small potsherds within the artifact scatter of Archaeological Level 1 is surely an indicator of the degree

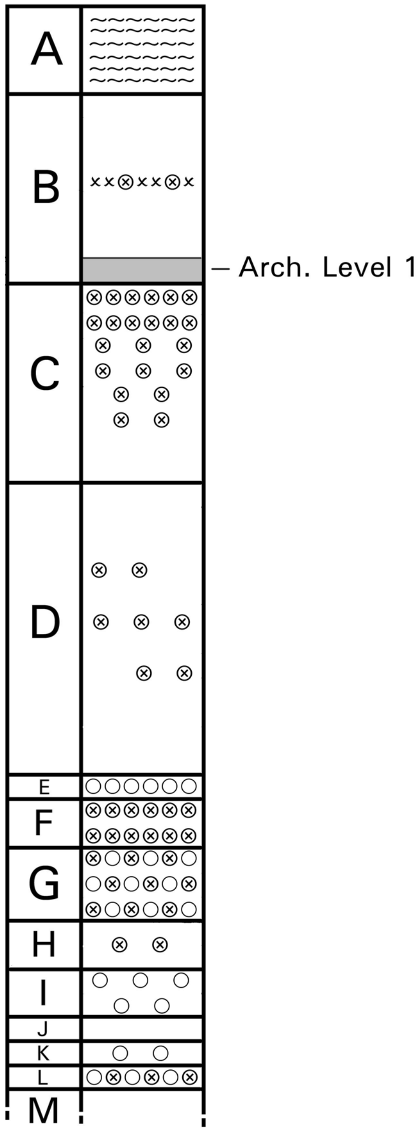


Figure 1-7. Diagrammatic sketch of the stratigraphic sequence in the Main Area of Area 3 at Les Tambourets, based on Henri Laville's geological column in Trench V, Square C. Descriptions of the geological levels ("couches") and their thicknesses are given in the text. The length of the column, from the top of couche A (the modern surface) to the top of couche M, is 2.40m. Open circles represent zones of quartz gravel; circles containing "X"s represent zones of ferromanganese concretions.

of vertical displacement). Additionally, the burrowing activities of the moles, whose tunnels transect both couches C and B, must have played some role in the vertical displacement and mixing of the ferromanganese concretions that are so densely concentrated in couche C (see below). The other major post-depositional disturbance that affected couche B and Archaeological Level 1 is the historic-age ditch in Trenches VI and VII, discussed below in Section II-N of this chapter. The lower limit of couche B is sharp but topographically irregular.[4] In the Main Area (but not elsewhere in Area 3), Archaeological Level 1 rests directly upon the surface of couche C (see Figure 1-8).

C. Couche C

Couche C (25–40 cm) is a silty-sandy clay of very firm consistency. The color of the matrix is yellowish-brown, but it is densely packed with rusty reddish-brown to black ferromanganese concretions that make this sediment appear to be darker and redder than the overlying couche B.[{a73057 b730622 a75070 a75071 a75081 b752616 b752618 b752730}] The sedimentological and palynological analyses (see Section V of this chapter) indicate that the deposition and weathering of these sediments record changing climatic conditions at the beginning of what was formerly called the "Würm recent." The presence of the ferromanganese concretions, abundant throughout couche C but most densely concentrated in its uppermost 15cm, is a sign of the processes of pedogenesis that altered this sediment before the accumulation of the couche B loess.

Except for the geological sample columns, couche C was excavated only in its uppermost 5cm (or, in a few places, 10cm). Rare Châtelperronian archaeological materials are present, frequently lying at a high angle and sometimes found within the fill of old mole tunnels. Such objects are regarded as mechanically derived from Archaeological Level 1.

D. Couche D

Couches D through M were excavated only in one or more of the geological sample columns (see Section V. below), and all are archaeologically sterile.

Couche D (70 cm) is a sticky, plastic, silty-sandy clay of variegated color.[{a75071 b752618 b752732 b752834 b752836}] The base color is yellowish-brown, but it contains, as indications of hydromorphy, both rust-brown and bluish mottles and dark ferromanganese concretions. The ferromanganese concretions are generally less abundant here than in couche C, but they are unequally distributed throughout the 70cm thickness.

E. Couche E

Couche E (<5cm) is a thin, undulating band of quartz gravel in a matrix of silty-sandy clay very similar to that of the overlying couche D.[{a75072 b752620 b752838}]

F. Couche F

Couche F (10cm) is a silty-sandy hydromorphized clay very similar to that of couche D but with very abundant ferromanganese concretions.[{a75072 b752838}]

G. Couche G

Couche G (15cm) is another silty-sandy hydromorphized clay, but the proportion of sand is greater here than in any level above or below it.[{a75072 b752838 b752900}] Both quartz gravel and ferromanganese concretions occur in quantity.

H. Couche H

Couche H (10cm) is a sediment very similar to that of couche G but with a lower proportion of sand and less quartz gravel.[{a75072 b752900 b752902}] Ferromanganese concretions are present and massive.

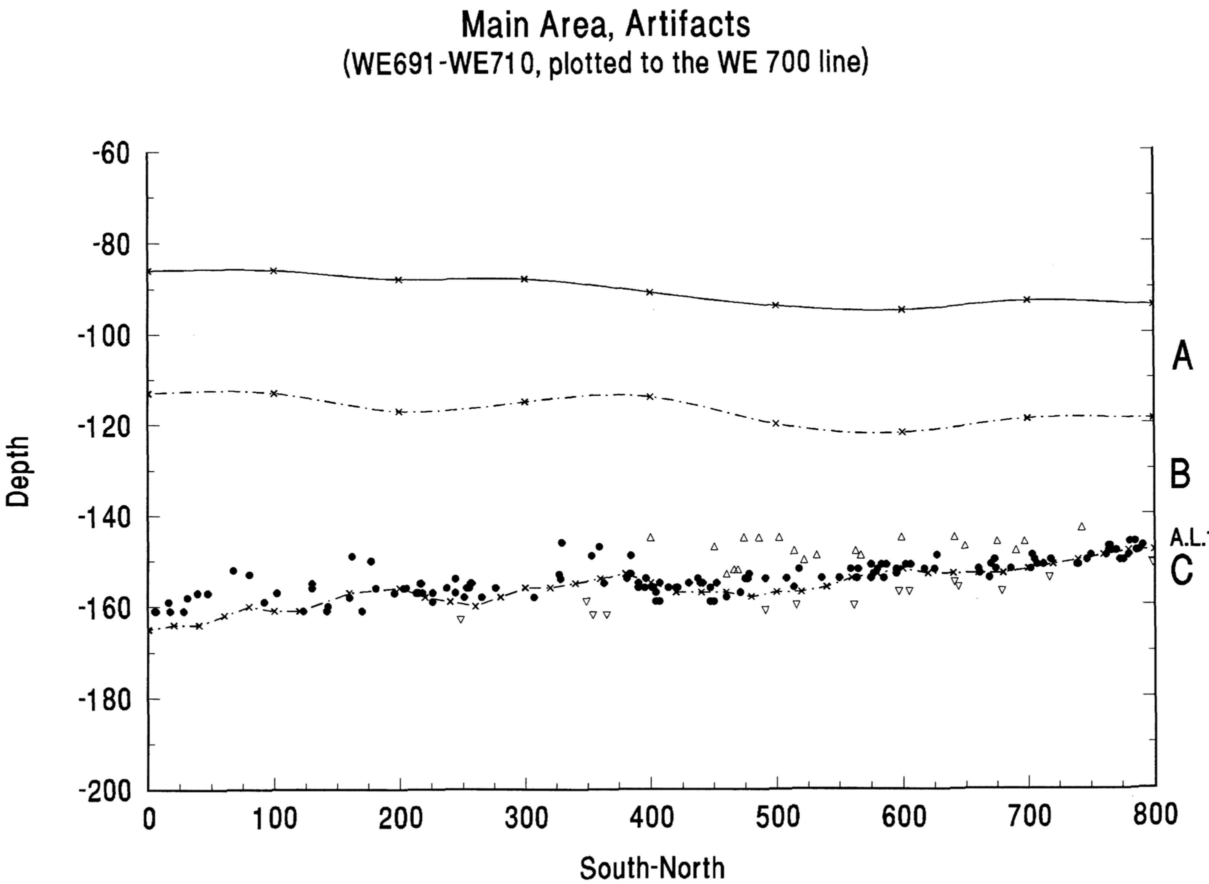


Figure 1-8. Section through the middle (WE 700cm line) of Trench V in the Main Area, showing the surveyed boundaries of stratigraphic units and the locations of artifacts within 10cm of that line as projected to it. Upward-pointing triangles = artifacts in couche B (Basal); solid circles = artifacts in Archaeological Level 1; downward-pointing triangles = artifacts in couche C.

I. Couche I

Couche I (10cm) is another silty-sandy clay.{a75072 b752902 b752904} The matrix is very similar to that of couche H, but couche I contains fewer and more diffuse ferromanganese concretions and more quartz gravel.

J. Couche J

Couche J (5cm) is a silty-sandy clay with less quartz gravel than in couche I.{a75072 b752902 b752904}

K. Couche K

Couche K (5cm) has the same silty-sandy clay matrix of overlying levels, but quartz gravel is common here.{a75072 b752904}

L. Couche L

Couche L (5cm) contains very numerous cobbles and abundant quartz gravel.{a75072 b752904} It is described (Laville et al. 1985: 1137, 1138) as a solifluction nappe (French: "*épandage de galets soliflués*" and "*coulée de solifluxion*"). Ferromanganese concretions occur in high frequency in a sandy-silty clay matrix.

M. Couche M

Couche M (>5cm; base not reached) is a silty-sandy hydromorphized clay almost completely lacking in both quartz gravel and ferromanganese concretions.{a75072 b752904}

N. Ditch Fill

A large post-Palaeolithic ditch or gully was found during the 1975 excavations in approximately the eastern half of Squares VI-B and VI-C and the western half of VII-B (Figure 1-9). This feature, trending roughly north-south, had been dug or was eroded into the upper zone of couche C, and thus it had removed Archaeological Level 1. Four linear meters of the ditch were uncovered in the Main Area, and what appears to be the same feature was seen in the cleaned section of the roadcut on the northern side of the road that separates Area 3 from Area 2, ca. 8m south of the excavated portion (Figure 1-10).{b754036 b754038} The bottom of the ditch slopes gently to the south, approximately conformably with the modern land surface. Only at the base of the feature, where it cut into couche C, were the ditch walls visible in section, and only there could they be followed in excavation.{b752108 b752216} There was absolutely no visible difference between the upper part of the ditch fill and the *in situ* couche B to the east and west of the fill.{b752104} Infrared photographs of the south wall of Square VI-B taken by Alexander Marshack during the excavations in 1975{a75144} show a vague difference between the ditch fill and the couche B sediments, identifying what is probably the western wall of the ditch. The infrared photographs might be

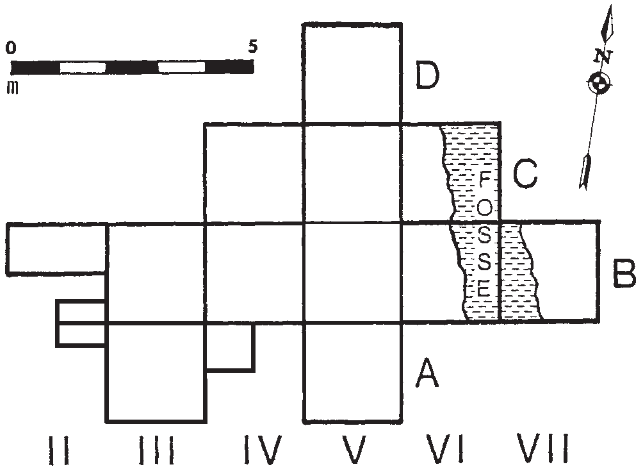


Figure 1-9. Sketch map showing the location of the post-Palaeolithic ditch or gully ("FOSSE" on the map) encountered during the 1975 excavations and its relationship to the other parts of the Main Area.

interpreted as showing a very irregular, partially undercut, partially slumped western wall of the ditch, but this is far from certain.

Because the exact location and slope of the walls of the ditch within couche B could not be known with certainty, only those artifacts found within the limits of the stratigraphically visible trace of the bottom of the ditch were assigned to a "ditch fill" series. This series includes essentially the same sort of material recovered from couche A[{a75056 b751530}]—a mechanical mixture of lithic and ceramic objects that probably range in age from the Châtelperronian to at least the late Middle Ages.

III. TEST EXCAVATIONS IN AREA 3

A. Test Pit Beta

Test Pit Beta, a 2m by 2m pit, was excavated in July and August 1975 (see Figure 1-6). It was located between 26m and 28m east of Trench VII in the Main Area; its northern boundary was an eastward extension of the line between the A and B squares.[{b750836}] This position is more than 100m distant from the southeastern corner of Area 3 as defined by surface indications, but it is within a few meters of the eastern limit of the zone within which the Châtelperronian archaeological level is still *in situ*. Farther east, the archaeological level crops out at the modern surface, and in the entire southeastern corner of Area 3 it has been removed by later erosion. The stratigraphic sequence recorded in Test Pit Beta is the following:[{a75094}]

Couche A (ca. 40cm): the plough zone.

Couche B (8–20cm): this is the lowest part of the clayey silt (loess) described as couche B in the Main Area. Its basal 5–10cm contain a sparse scatter of artifacts recognized as *Archaeological Level 1* (Châtelperronian).[{a75040}] In some places, the top of this artifact scatter is just a few centimeters beneath the bottom of the plough zone. The bottom of the artifact scatter rests directly upon the underlying couche C.

Couche C (ca. 40cm): a silty-sandy clay containing numerous ferromanganese concretions, as described from the Main Area. Scattered and very rare archaeological material in the top of this level is probably mechanically derived from the immediately overlying archaeological level.

Couche D (greater than 5cm; base not reached in excavation): a plastic silty-sandy clay, as described for the Main Area.

Although it was originally planned to remove samples for sedimentological and palynological analyses from Test Pit Beta, the essential identity between its sediments and those of the Main Area prompted the abandonment of these plans. Materials from the archaeological level in Test Pit Beta were included in the studied sample of Archaeological Level 1 from Area 3.

Figure 1-10. Section of the bottom of a post-Palaeolithic ditch or gully—lighter colored fill lying disconformably on concretion-rich sediment (equivalent to couche C in the Main Area)—exposed in the northern face of the roadcut immediately south of Trenches VI and VII of the Main Area.

B. Test Pit 3W1

Test Pit 3W1, excavated in July and August 1980, was the closest to the Main Area of the four test pits located in the southwest portion of Area 3 (Figure 1-11). It was a 2m (WE) by 1m (NS) pit, located between 11m and 13m west of Trench II in the Main Area.{a80036} The northern boundary of Test Pit 3W1 was a projection of the line between the A and B squares in the Main Area.

The stratigraphic sequence recorded in Test Pit 3W1, essentially identical to that of the Main Area, is:

Couche A (ca. 35cm): plough zone, containing a few chipped flint objects, some with recent damage.

Couche B (ca. 20cm): a silty-clayey sediment like that described as couche B in the Main Area. The sediment is predominantly silty at its top, becoming more clay-rich with depth. The increase in clay content is probably gradual, but it become clearly noticeable ca. 15cm below the top of couche B. A few chipped flint artifacts and cracked cobbles, widely dispersed both vertically and horizontally, occur in the upper and middle part of couche B. At the base of the level is a vertically concentrated and much richer artifact scatter recognized as *Archaeological Level 1* (Châtelperronian). The artifact scatter, which is 4cm to 5cm thick, rests directly upon the underlying level, couche C (Figure 1-12a).{a80058 a80061 b801118} Rusty, reddish-brown and black ferromanganese concretions occur widely dispersed throughout couche B.

Couche C (greater than 5cm; base not reached in excavation): a silty clay containing very numerous ferromanganese concretions. The upper boundary is abrupt and clearly distinguished on the basis of color (a darker reddish-brown than couche B), texture (a clay, not a silt), and the frequency of ferromanganese concretions (much greater than in couche B).

The artifacts of Archaeological Level 1 in Test Pit 3W1 are indistinguishable from those found in the Main Area, with which they were combined for purposes of analysis as part of the Area 3 Archaeological Level 1 sample.

C. Test Pit 3W3

Test Pit 3W3, a 2m by 1m pit located between 18m and 20m west of Trench II,{a80037} was excavated in July 1980 (see Figure 1-11). Its northern boundary was a projection of the line between the A and B squares in the Main Area. The stratigraphic sequence observed is the following:

Couche A (ca. 35cm): plough zone.

Couche B (ca. 40cm): a compact silty-clayey sediment that is, in its upper 20cm, like that described as Couche B in the Main Area except that the frequency of ferromanganese concretions in greater here, especially in the eastern end of the test pit. Between ca. 20cm and 30cm below the surface of couche B, there is a gradual but noticeable increase in clay content. There is no clear boundary that can be followed in excavation; it is, rather, a question of a gradual transition to a more clay-rich silt. Infrequent archaeological materials (chipped flints and cracked cobbles) occur very widely dispersed within most of couche B. The basal 4cm to 6cm contain a vertically concentrated and moderately dense artifact scatter recognized as *Archaeological Level 1* (Châtelperronian). The artifact scatter rests directly upon the surface of the underlying couche C (Figure 1-12b).{a80049 b800605}

Couche C (greater than 5cm; base not reached in excavation): a silty clay containing very numerous ferromanganese concretions. The upper boundary is abrupt and undulating.

The Archaeological Level 1 artifacts from Test Pit 3W3 were included for purposes of analysis in the combined Archaeological Level 1 sample from Area 3.

D. Test Pit 3W5

Test Pit 3W5, a third 2m x 1m pit located in the same line as Test Pits 3W3 and 3W1 but 27m to 29m west of Trench II (see Figure 1-11), was excavated in July and August 1980. The stratigraphic sequence observed here is similar in general outline to that present in Test Pits 3W3 and 3W1 and in the Main Area, but it differs in detail. The sequence is:

Couche A (ca 40cm): plough zone.

Couche B (40–45cm): a very compact silty-clayey sediment that appears to be very homogeneous throughout its thickness. (The apparent increase in clay content with depth recorded for Test Pits 3W3 and 3W1 was not noticed here. Rather, the whole thickness appeared to be rather clay-rich, probably as much so as the base of couche B farther east.) Ferromanganese concretions, while present throughout, are much less frequent here than in Test Pit 3W3. Archaeological material, extremely rare in the top 20cm of couche B, increases in frequency with depth. At a depth within the level of between 30cm and 35cm, the top of the main artifact scatter begins to be encountered. However, the vertical concentration of this artifact scatter, recognized as *Archaeological Level 1* (Châtelperronian), is less than in excavations further east, and it was not possible to recognize the top of the archaeological level as a well defined surface during the excavation. Archaeological Level 1 is 7–10cm thick in Test Pit 3W5 (Figure 1-13). Unlike the situation farther east in Area 3, Archaeological Level 1 does not rest directly upon the surface of a darker, concretion-rich couche C. Rather, a basal zone of couche B, varying in thickness from 3cm to 5cm and virtually devoid of archaeological material, separates the artifact scatter of Archaeological Level 1 from the surface of couche C (Figure 1-12c).{a80077 b801303}

Couche C (greater than 5cm; base not reached in excavation): a silty clay containing very numerous ferromanganese concretions. The upper boundary of this level is absolutely sharp and markedly undulating.

Because of the difficulty in recognizing the top of the main artifact scatter during excavation, assignment of artifacts to Archaeological Level 1 was made on the basis of vertical backplotting. Pieces so assigned were included for purposes of analysis in the combined Archaeological Level 1 sample from Area 3.

E. The Alpha Complex

The so-called Alpha Complex was excavated in June, July, and August of 1975 to explore the stratigraphic and

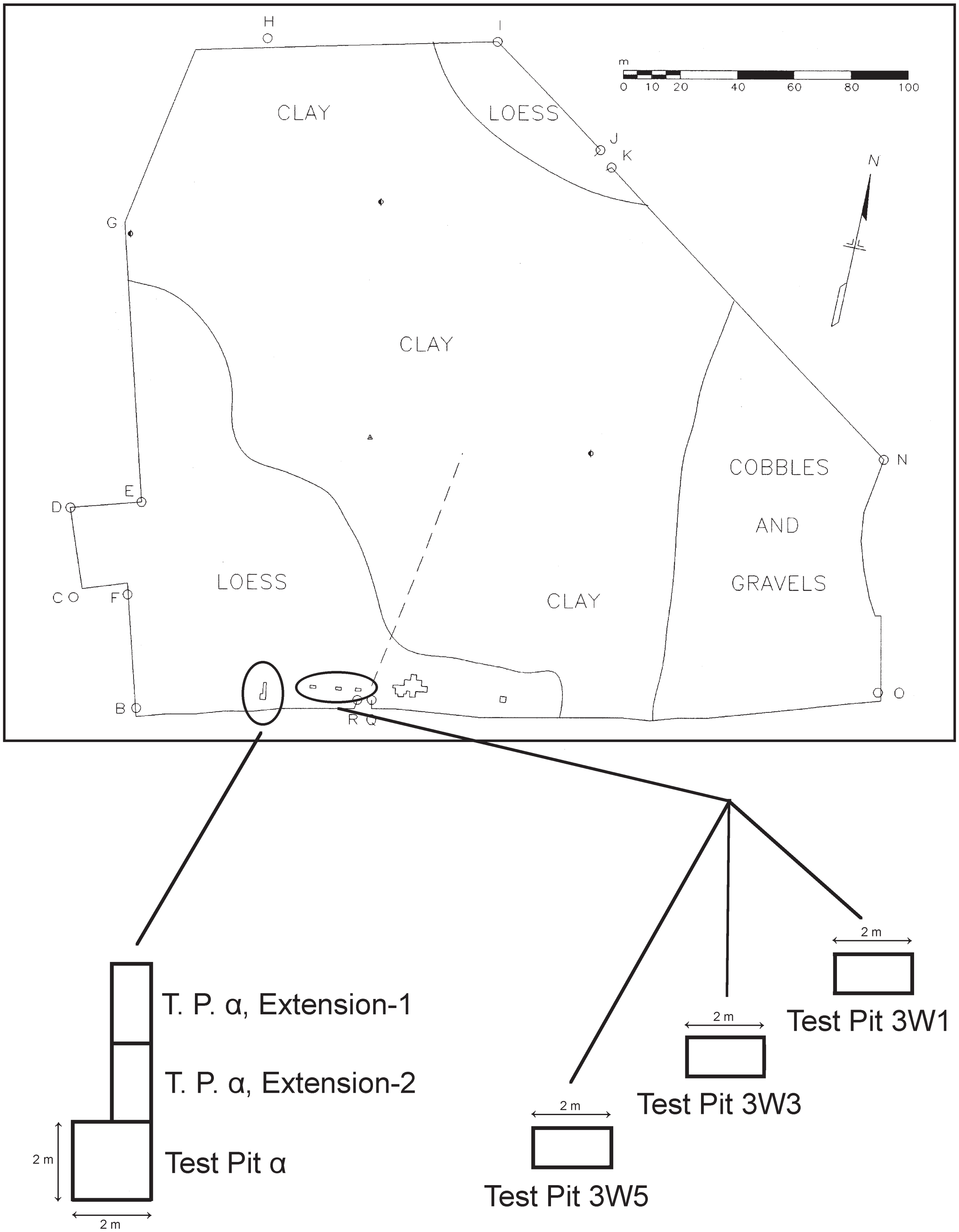


Figure 1-11. Base map shown in Figure 1-5, detailing locations of the Alpha Complex and Test Pits 3W1, 3W3, and 3W5.

paleoenvironmental context of the Châtelperronian archaeological horizon near the southwest corner of Area 3 (see Figure 1-11). A 2m x 2m pit (Test Pit Alpha),[a75005 b751022] which was excavated first, showed that there were some differences between this western zone and the Main Area to the east, and the test pit was extended northward for 4m but at a west-east width of only 1m (Test Pit Alpha, Extension-1 and Test Pit Alpha, Extension-2).[a75062] In its final configuration, the Alpha Complex exposed 8m^2 of the archaeological level. It was located between 44.5m and 46.5m west of the western edge of Trench II in the Main Area. Its northern boundary (the northern limit of Test Pit Alpha,

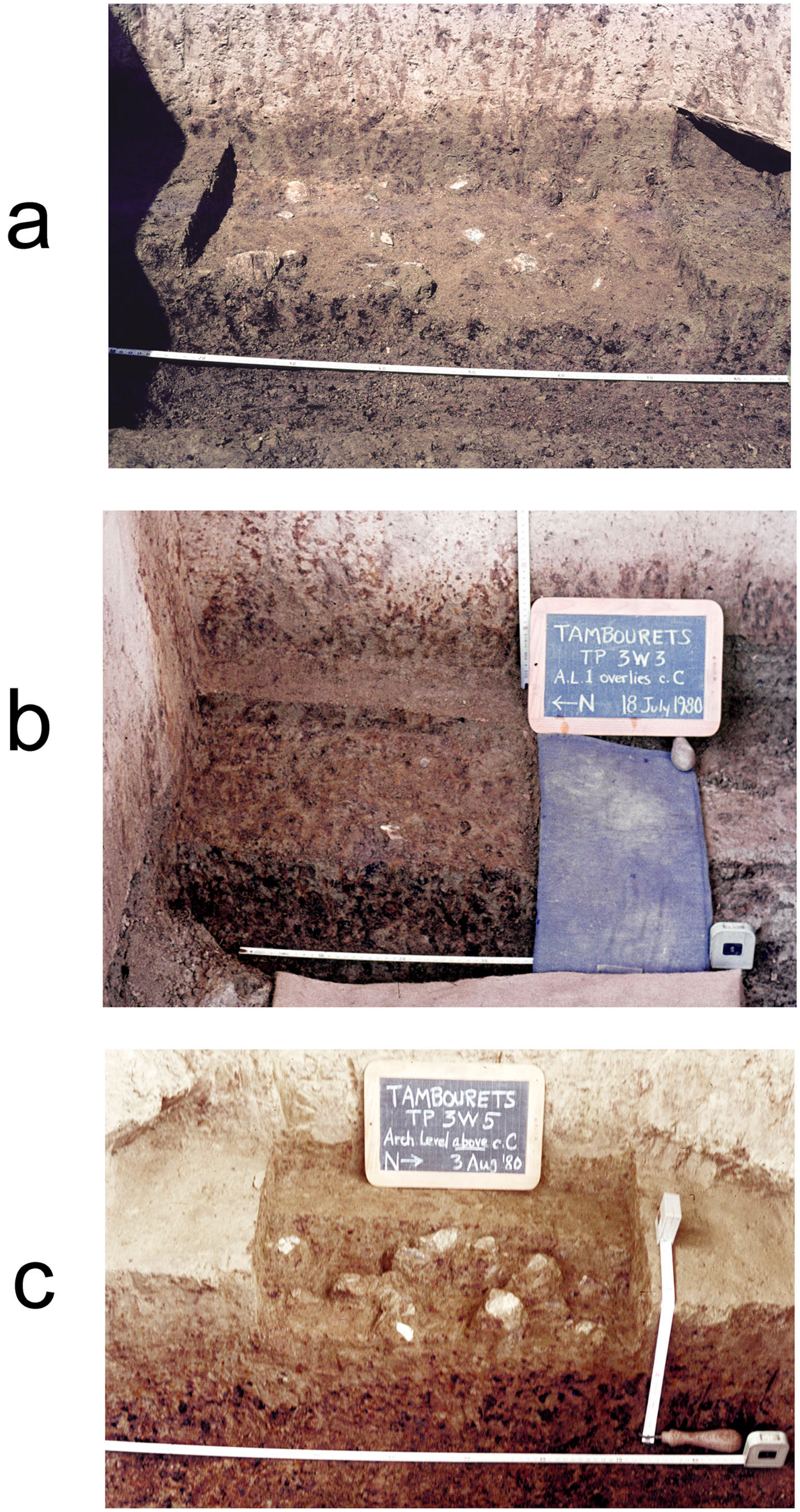


Figure 1-12. Stratigraphic relationship between Archaeological Level 1, within the couche B loess body, and the underlying couche C in the Area 3 test pits between the Main Area and the Alpha Complex. a: Test Pit 3W1; b: Test Pit 3W3; c: Test Pit 3W5.

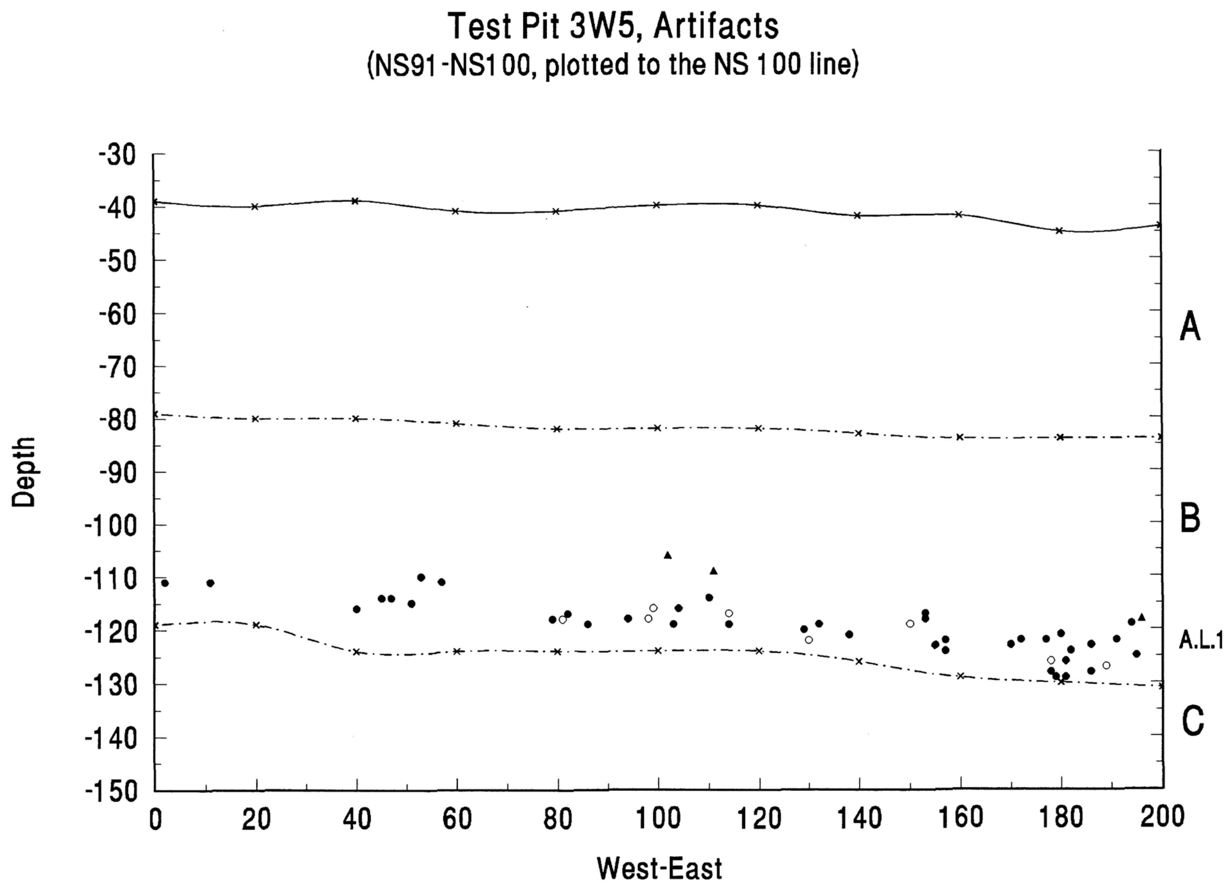


Figure 1-13. Section along the southern boundary (NS 100cm line) of Test Pit 3W5, showing the surveyed boundaries of stratigraphic units and the locations of artifacts within 10cm of that line as projected to it. Triangles = artifacts in couche B (Basal); solid circles = flat-lying artifacts in Archaeological Level 1; open circles = artifacts in Archaeological Level 1 lying at a high angle.

Extension-2) was a projection of the line between the A and B squares.

Both the sedimentary context and the stratigraphic sequence of the Alpha Complex are similar to conditions in Test Pit 3W5 but different from conditions in the Main Area. Because the test excavations between the Alpha Complex and the Main Area were carried out only in 1980, the data they supplied about the transitional nature of change from east to west were not available for interpreting the Alpha Complex in 1975. In recognition of the differences with the Main Area and in order to avoid erroneous correlations, the excavators followed the suggestion of H. Laville in using a provisional terminology for stratigraphic levels below the plough zone and their enclosed industries; this terminology was different from that used in the Main Area. Both the provisional terms and their most likely equivalents as indicated by later research are used in the descriptions that follow. The descriptions are based primarily on the field observations and laboratory analyses of H. Laville (Section V of this chapter).[a75083 b752506 b752610 b752906 b753238]

Couche A (25–40cm): the plough zone.[b753010]

Sedimentary Ensemble I (ca. 65cm): a sandy, silty, clayey sediment, hard when dry and of crumbly texture, containing some ferromanganese concretions.[b753012] Manifestations of hydromorphy appear in the lower part of Ensemble I, ca. 10cm above its base, and they become more common with depth (down to the lower limit of excavation, in Sedimentary Ensemble V). Here in the basal part of Ensemble I, the evidence of hydromorphy takes the form of grayish-green mottles varying in diameter from a few millimeters to a few centimeters. When moist, this basal zone (and all of the underlying Sedimentary Ensemble II) had the apparent characteristics of a slightly sticky, very plastic clay.[5] Sedimentary Ensemble I is obviously very similar to that part of couche B in Test Pit 3W5 that lies above Archaeological Level 1. Although no sedimentological data are available for Test Pit 3W5 to document such a comparison, it seems quite likely that the sediments of the Alpha Complex are even richer in clay. Within Ensemble I itself, the composition of the fine fraction is shown by H. Laville's analysis (see Section V, below) to be essentially unchanged from top to bottom, despite the very real difference in the "workability" of the sediment noted by the excavators. The top 25cm or so of Ensemble I contains rare and widely scattered archaeological materials ("Very High Scatter" in the provisional terminology) that appear to be a mechanical mixture of Châtelperronian chipped flints and objects of historic age (ceramics); this mixture would correspond to the contents of couche B(Upper) farther east. The basal 10–12cm contain more numerous but still dispersed chipped

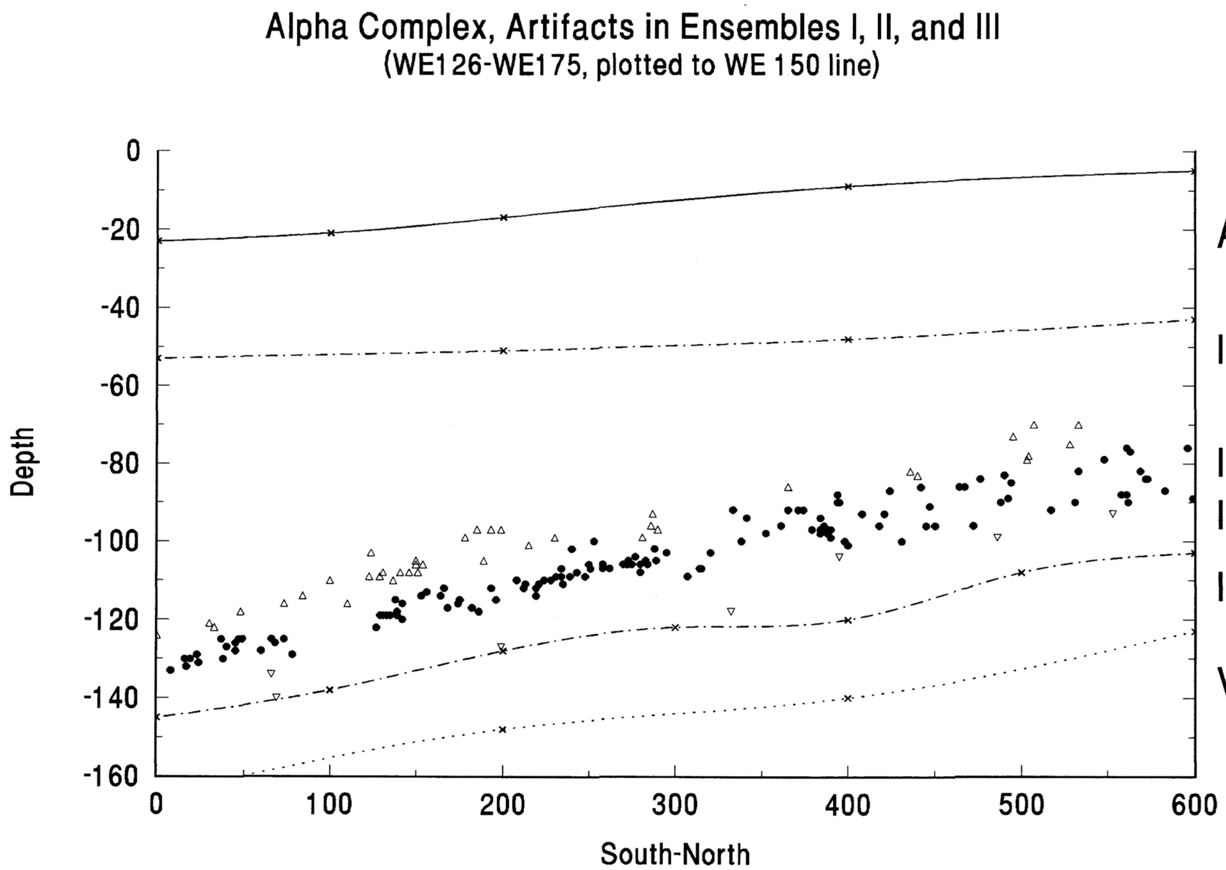


Figure 1-14. Section along the WE 150cm line of the Alpha Complex, showing the boundaries of stratigraphic units and the locations of artifacts in Sedimentary Ensembles I, II, and III within 25cm of that line as projected to it. Upward-pointing triangles = artifacts in the High Scatter; solid circles = artifacts in the Main Scatter; downward-pointing triangles = artifacts in the Low Scatter. (The boundary between IV and V is estimated, not surveyed.)

flints (excavated as "High Scatter") that become more frequent with depth (Figure 1-14); all of this material appears to be Châtelperronian, and it corresponds to the content of couche B(Basal) to the east. These dispersed objects directly overlie the concentrated archaeological horizon (in Sedimentary Ensemble II), from which they are probably mechanically derived.[a75044]

Sedimentary Ensemble II (ca. 15cm): a sediment of identical matrix to Ensemble I except that it contains, in addition, some quartz gravel.[b753014] It was given separate status in the provisional terminology because it contains the very rich principal archaeological zone (see Figure 1-14) of the Alpha Complex (the "*Main Scatter*" of the provisional terminology).[a75057 b751706] The archaeological materials are Châtelperronian, qualitatively identical to those of Archaeological Level 1 farther east.

Sedimentary Ensemble III (6–12cm): a sediment of the same kind as Ensemble II, separated because it lies between the base of the archaeological zone and the top of the visibly very different Ensemble IV.[b753014] The thickness of Ensemble III varies considerably; it is thickest where it fills depressions in the uneven surface of the underlying Ensemble IV. Except for its greater thickness and its probably higher clay content, this ensemble seems quite similar to that part of couche B underlying Archaeological Level 1 in Test Pit 3W5. The very rare artifacts found in Ensemble III (designated the "Low Scatter" or "Below Main Scatter") are probably derived mechanically from the overlying Châtelperronian level (see Figure 1-14).

Sedimentary Ensemble IV (ca. 20cm): a sediment having the same matrix as those above it but more indurated and containing very numerous ferromanganese concretions.[b753014] The top of this ensemble, which is almost certainly to be correlated with couche C farther east, is very sharply defined and undulating, even more irregular than the surface of couche C in Test Pit 3W5. In some places, the unevenness of the surface may result from gullying (Figure 1-15),[b753126 b753128] which may be easily understood in light of the pronounced slope of the surface (an average north-to-south slope of just over 4cm per linear meter, a total of ca. 25cm from the northern to the southern boundary of the Alpha Complex). Except in the area of the sedimentology-palynology sample column, this ensemble was not excavated; in the sample-column excavations, it was almost sterile.

Sedimentary Ensemble V (greater than 25cm; base not reached in excavation): a sediment of the same kind, but containing somewhat fewer ferromanganese concretions.[b753014] Sterile (but excavated only in the area of the sample column).

Although the "Main Scatter" in the Alpha Complex is,

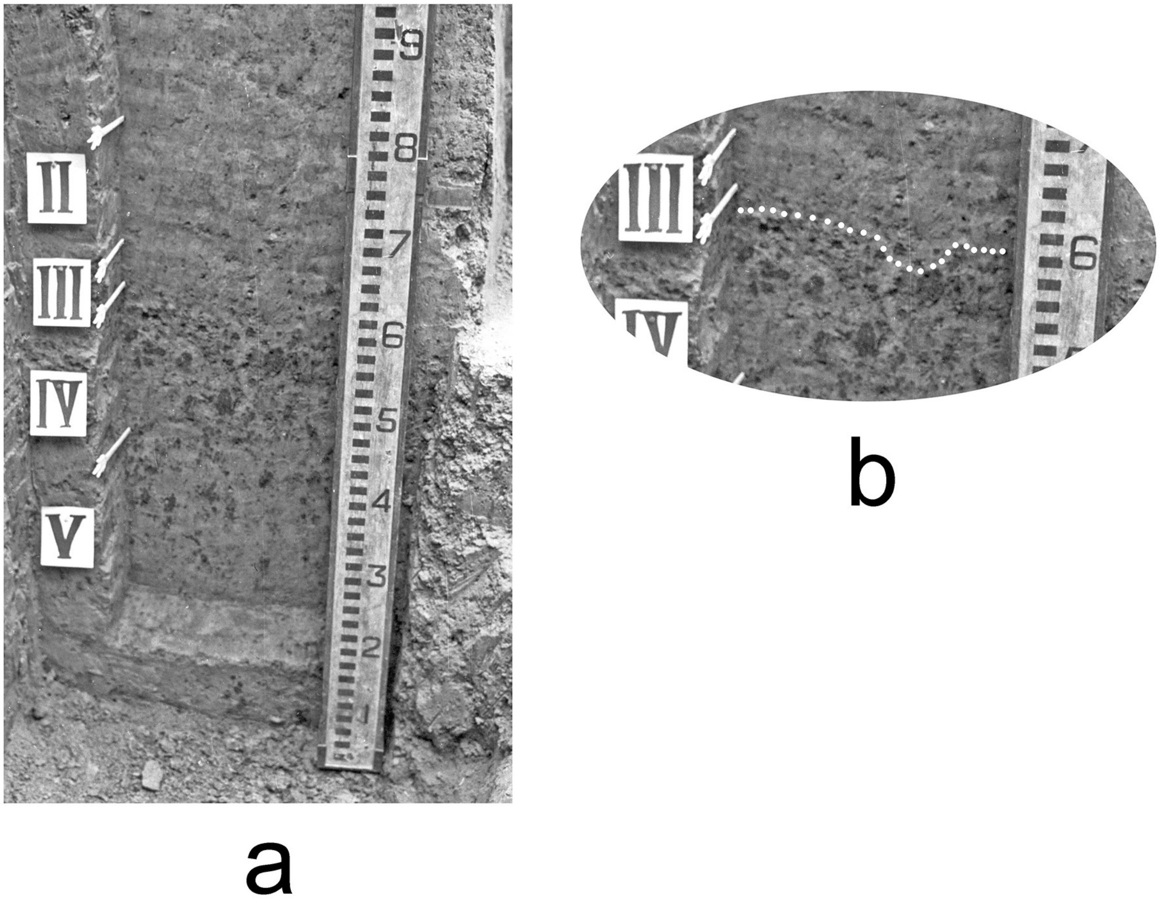


Figure 1-15. Evidence of gullying erosion in the surface of Sedimentary Ensemble IV of the Alpha Complex as seen in Laville's sample column in Test Pit Alpha.

beyond any doubt, part of the same palimpsest of Châtelperronian occupational debris represented by Archaeological Level 1 elsewhere in Area 3, the Alpha Complex materials were not included in the fully analyzed Archaeological Level 1 sample. The decision to exclude them was based not on stratigraphic reservations, but on time constraints and the already large sample from the other excavation units.

IV. TEST EXCAVATION IN AREA 2

Test Pit 2E1, excavated in July and August of 1980, was located on the extreme eastern edge of Area 2, just a few meters back from the edge of the low bluff defining the eastern border of both the +30m terrace of the Volp and the commune de Couladère.{b731407} Its location is shown by the small single "x" in Area 2 in Figure 1-4. This location is ca. 140m east of the eastern edge of the Main Area as measured along the Gensac road and then, proceeding at a right angle to such a line, ca. 68m south of the road. This means that Test Pit 2E1 is ca. 156m southeast of the Main Area. Excavation of the test pit was one part of a plan (in the event, the only part of the plan to be implemented) to determine more fully the extent of *in situ* Châtelperronian materials by testing near the known limits of the site as it had been defined on the basis of surface scatter. The location of Test Pit 2E1 was chosen on the basis of several factors: a) it is directly on the edge of a terrace landform overlooking the lower Volp terraces and floodplain; b) without itself being on steeply sloping ground, it is very close to the unnamed Volp tributary that separates the site of Les Tambourets from the site of Rachat; c) it is close to one extreme (the southeast corner) of the site as it is known from surface scatter; and, d) it was not in active cultivation in 1980.

Because of the slope of the modern land surface southward from the middle of Area 3 down to an unnamed tributary of the Volp in southern Area 2 (see Figure 1-1), the ground surface of the location of Test Pit 2E1 is approximately six meters lower than the modern surface of the field in the Main Area of excavation in southern Area 3. According to M Pierre Portet, the landowner of most of Area 2 during the 1970's and 1980's, the eastern edge of the area was used as a vineyard during the early 20th century. The vineyard was abandoned in about 1950, and the area had not been ploughed between then and 1980. At the time of the excavation of the test pit, the ground cover consisted of young acacia trees, a few abandoned grape vines, ivy, grasses, etc.

Test Pit 2E1 was begun as a 1m x 1m excavation, but it was later enlarged southward to a 1m x 2m size. The following stratigraphic sequence was observed:

Stratum I (ca. 10cm): plough zone (inactive), containing very many pebbles and small cobbles.

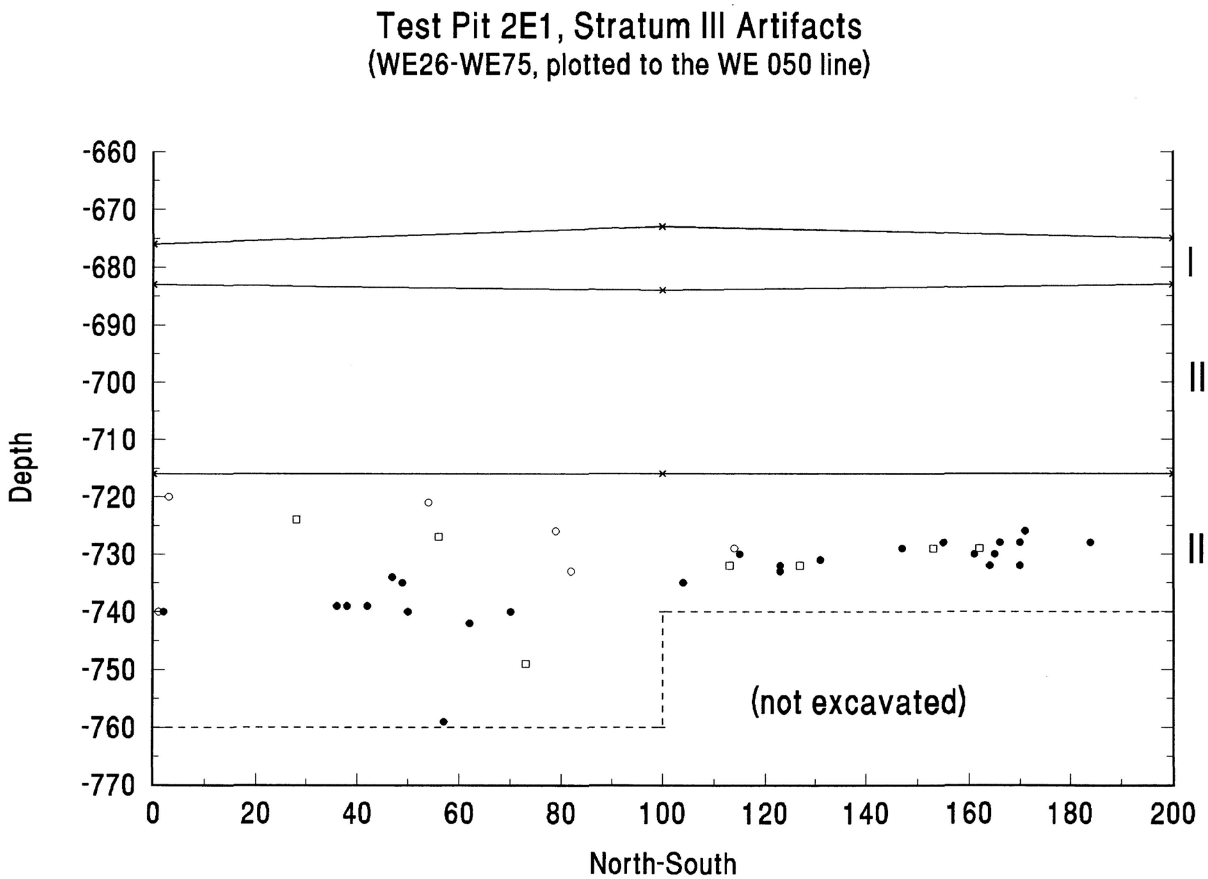


Figure 1-16. Section through the middle (WE 50cm line) of Test Pit 2E1, showing the surveyed boundaries of stratigraphic units and the locations of artifacts in Stratum III within 25cm of that line as projected to it. Solid circles = flat-lying artifacts in Archaeological Level P; open circles = artifacts in Archaeological Level P lying at a high angle; open squares = other artifacts in Archaeological Level P, attitude indeterminate.

Stratum II (ca. 30cm): a light brown sediment containing very numerous pebbles and small cobbles in a fine, predominantly silty matrix. The lower limit of the stratum is clean and abrupt. The stratum contains rare and scattered archaeological materials including chipped flint objects, potsherds, and fragments of tile or brick. Very small decomposed fragments of pottery appear throughout the entire thickness of the stratum.

Stratum III (greater than 50cm; base not reached in excavation): a light brown or yellowish-brown silty sediment, containing rare and very widely dispersed ferromanganese concretions.[a80052] Stones (pebbles, cobbles, etc.) are virtually absent. Between ca. 15cm and 20cm below the top of the stratum, there is a concentrated scatter of flint artifacts designated *Archaeological Level P* (Figure 1-16). Some very widely dispersed flint objects exist elsewhere in the stratum, both below and above the archaeological level.

The distinction between Stratum I and Stratum II is an artificial one based on the more recent disturbance by cultivation of the upper 10cm of the same body of sediment. The cultural debris found in Stratum II is a mixture of pottery, probably of historic age, and chipped flint objects, none demonstrably distinctive but probably primarily of Châtelperronian context.[6] The sediment itself is best seen as a slope-wash accumulation of recent centuries, which has included within it cultural debris of very different ages that has been transported from upslope surfaces.

The great importance of slope wash as an agent of sediment transport in Area 2 at Les Tambourets is suggested by the results of some nonarchaeological excavation carried out at the extreme southern edge of the area during the 1960s. A summary account of these circumstances was given by †Méroc and Bricker (1984: 53), but the unpublished records of Méroc merit closer examination. These records indicate:

- major and rapid infilling during historic times of the bed of the small unnamed stream that forms the southern boundary of Area 2, and
- deep burial of a concentrated scatter of Châtelperronian flint artifacts at the very foot of the slope, on the northern bank of the unnamed stream.

The rate of infilling of the stream bed itself is demonstrated by the presence of a metal object, at a depth of 7m below the modern surface of the alluvial load, in a shaft dug in 1965 by Pierre Portet in order to arrange a water source for his residence. Specifically, Portet found an iron chain, brick fragments, and chipped flint artifacts all mixed together at the very bottom of the seven-meter-deep hole.[7] Méroc concluded that because the earliest possible dating for the iron chain would be Gallo-Roman, this provided a *terminus post quem* for the 7m of alluvial infilling.

The presence of a deeply buried concentrated tool scatter is indicated by a sketch map and note[8] in Méroc's handwriting stored with 54 chipped flint objects in a box that was in the Dépôt de Fouilles in Toulouse in 1978. The note states that the flints constitute a separate lot (termed "*la série prise d'eau*" by †Méroc and Bricker 1984: 53) that were found "in place" by Portet at a depth of 2.3m on the edge of the unnamed stream while he was installing his water system. The location of the excavation is shown on the map to be immediately south of the Portet house, which would be approximately 75m to 100m southwest of Test Pit 2E1. The notation by Méroc that the flints were found "in place" would suggest, if taken literally, the accumulation of more than 2m of sediment at or near the foot of the slope since the time of the Châtelperronian occupation. This would be about twice as thick as the thickest measured sediments overlying the Châtelperronian level in Area 3 (ca. 1.1m, on the southern edge of Test Pit Alpha), a circumstance that seems quite possible.

Whatever may be the situation at the foot of the slope, the archaeological horizon encountered in Test Pit 2E1, Archaeological Level P, occurs in a context similar to that of Archaeological Level 1 in Area 3. As discussed in Chapter 3, the small assemblage sample appears to be homogeneous, quite representative in a qualitative sense of the Méroc surface collection from Area 2. It includes one very characteristic Châtelperron point, and it lacks ceramics or other objects that would argue for a post-Châtelperronian age. The clearly defined artifact scatter is 6cm to 8cm thick (see Figure 1-16). The majority of the objects in Stratum III (n=44, 68.75%) were found flat-lying or only slightly inclined; those found lying at a higher angle (n=10, 15.63%) occurred, with only two or three exceptions, either above or below the clearly defined scatter. The top of the scatter occurs at a depth of ca. 730–735cm below site zero, which is ca. 15–20cm below the top of Stratum III and 50cm to 60cm below the modern surface of the ground. The depth below site zero of the surface of Archaeological Level P (-730cm to -735cm) places it about 5.7m lower than the surface of Archaeological Level 1 along the southern (downslope) margin of the Main Area in Area 3 (ca. -160cm in Trench V, Square A). The limited information available suggests that, unlike the situation at the foot of the Area 2 slope discussed above, the slope of the Late Pleistocene land surface on the +30m terrace at the place where Test Pit 2E1 is located was very similar to the slope in Area 3 around the Main Area. The modern surface of Test Pit 2E1 is ca. 5.8m lower than the modern surface along the southern edge of Trench V, Square A, a difference nearly identical to the difference in elevation of the surfaces of the archaeological levels in the two areas, ca. 5.7m.

In light of the evidence available, can Archaeological Level P be regarded as a Châtelperronian archaeological level in essentially primary context (as close to primary context as Archaeological Level 1 in Area 3)? Because of the minuscule area excavated (2m^2) and because the base of Stratum III was not reached by excavation, this question cannot be answered with any certainty. It is probable, however, that Archaeological Levels 1 and P are the same kinds of archaeological phenomena. The fact that most of the artifacts of Archaeological Level P are flat-lying and in "fresh" (as opposed to "rolled") condition argues against the importance of sheet-wash, solifluction, or other processes of mass-wasting as agents of deposition. The predominantly silty and virtually stone-free Stratum III, within which the archaeological horizon occurs, could very well be the same loess body that is designated "couche B" in Area 3, but this has not been demonstrated through detailed analysis. The relationship of Archaeological Level P to a weathered sediment similar to couche C is likewise unknown. It is probable that the data from Test Pit 2E1 extend the area of remaining *in situ* Châtelperronian archaeological materials to the southeast corner of the site. There is, however, no evidence bearing on the relative ages of Archaeological Levels P and 1 (beyond their common assignment to the Châtelperronian tool-making tradition).

V. PALEOENVIRONMENTAL DATA

The paleoenvironmental context of the Châtelperronian of Les Tambourets was investigated by both sedimentology and palynology resulting from the analysis of sediment samples collected by the co-director of the project, Henri Laville, in 1973 and 1975. The sedimentological analyses were done by Laville, and the palynological analyses were done by Marie-Madeleine Paquereau. Informal preliminary reports of the results were submitted by both scientists, and these results were referred to in several publications during the 1970s and 1980s (as specified below). However, the time demands of other projects, retirement (Paquereau), and sudden death (Laville) had as their combined effect the absence of formal final reports.

Statements about the paleoenvironment of Les Tambourets made in this chapter and elsewhere in this monograph are based on both the published and unpublished reports. The former include Bricker and Laville (1977), Paquereau (1978), and—most importantly—Laville et al. (1985). The unpublished reports, included here as documents in PDF format, include reports by Laville on his analyses of the sediment samples collected in 1973 and 1975 (TDoc21, TDoc22, and TDoc23)[9] and a report by Paquereau on the pollen in the 1973 samples (TDoc24). Her analysis of the 1975 samples is dealt with in the published paper by Laville et al. (1985). English translations of TDoc23 (Laville) and TDoc24 (Paquereau) were appended to Bricker's 1977 report to the National Science Foundation, and they appear here as parts of TDoc11.

Descriptive data and conclusions based on them appear in earlier sections of this chapter, in Section VI, below, and in Chapter 2. Despite the lack of final reports that would include the traditional diagrams and data tables, the analytic results of Laville and Paquereau, which have been for the most part available in published form for more than a quarter century, are very detailed and very informative. The paleoenvironment of Les Tambourets is well documented.

VI. DISCUSSION AND SUMMARY

Consideration of the stratigraphic, sedimentological, and palynological data, taken in conjunction with the archaeological data presented more fully elsewhere in this monograph, leads to several broad conclusions about Les Tambourets. Those conclusions are discussed in this section by way of summarizing the stratigraphic and paleoenvironmental contexts of the Châtelperronian occupation of the site.

A. Characteristics of Archaeological Level 1

Along the southern edge of Area 3, investigated by excavation between 1973 and 1980 and, before that, by Méroc's study of the roadcut section exposed (along line BRQO in Figure 1-5), there is only one Châtelperronian archaeological level, Archaeological Level 1 in the Main Area and its obvious equivalent in the Alpha Complex. It is almost certainly a palimpsest of two or more occupational episodes, but there is only one definable stratigraphic unit. This archaeological level lies at or near the base of a loessic deposit, couche B, that is well represented in the southwestern corner of Area 3. Based on a survey and surface examination of the field in the summer of 1975, when it was not obscured by dense vegetation cover, the approximate location of the line along which the archaeological level crops out at the modern surface was plotted on the basis of dense artifact scatter (along the southeastern portion of the line shown in Figure 1-5) and/or changes in sediment type (the central and northwestern portions of the plotted line). The present thickness of the loess body increases to the west, from zero just east of Test Pit Beta to nearly one meter in the Alpha Complex; the loess body continues to be present west of Les Tambourets, where it is cut through by the road (D.8) running from Couladère to Le Plan (see Figure 1-1).

A small portion of the loess body containing the archaeological level at its base is present at the north-central limit of the field shown in Figure 1-5. The roadcut section, along line IJKN of the figure, exposes at its summit a very thin capping (20–30cm maximum) of the loess, and artifacts are visible at its base near point K of the figure. This patch of loess thins toward the southwest, disappearing along the line shown in Figure 1-5; the archaeological level crops out along this same line. This occurrence of the loess and the archaeological level is primarily in what Méroc called Area F (*ferme*). The loess cannot be identified with confidence in the north face of the roadcut, and it seems probable that construction of the new road in the 1960s removed all but the southern fringe of the *in situ* archaeological level in Area F.

The superficial deposits in the large field shown in Figure 1-5 may now be characterized in terms of the sedimentary sequence revealed in the geological column in Trench V of the Main Area. Ignoring the ubiquitous presence of the plough zone, couche B is at the surface in the southwest, south-central, and north-central portions of the field. This corresponds to Méroc's level 1 in his sketch section of the +30m terrace of the Volp (see Figure 1-3). In much of the center of the field, the soil now under cultivation is essentially clay, with localized areas of gravel and larger stones. This corresponds to couche C of the sedimentological study plus an unknown number of underlying sedimentary units and to level 2 of the Méroc sketch section. From this entire area, the loess and any archaeological level it may have contained have been removed by later erosion. In the easternmost portion of the field, truncated by the eastern edge of the +30m terrace landform (along the line NO of Figure 1-5), what is at the surface is a cobble-rich level that represents the basal unconsolidated deposits of the terrace, level 3 of the Méroc section. Based primarily on what he observed in the north face of the Gensac roadcut section, Méroc (e.g., 1969: 25, 27) described these coarse sediments as alluvium, the waterlaid deposits of the Volp when it stood at a higher level, and he reported the occasional presence in them of "rolled" flint artifacts typologically characteristic of the Acheulian. The bedrock substrate of the terrace (level 4 of the Méroc section), which is part of the mid-Tertiary "*molasse*", is visible at the base of the north face of the 1960s roadcut (along line IJKN of Figure 1-5).

The *in situ* Châtelperronian archaeological materials in southern Area 3 are not uniformly distributed (Figure 1-17). In most parts of the Main Area, Archaeological Level 1 contains 80 to 100 artifacts per square meter, but this particular zone of occupational debris appears to fade out eastward, with only 21 artifacts/m^2 in Test Pit Beta. Artifact densities diminish to the west of the Main Area as well (ca. 45 to 70 artifacts/m^2) except in Test Pit 3W5, where the highest recorded density (234 artifacts/m^2) appears in what may be a localized concentration. The variation in artifact density per unit of area is not related in any obvious way to matters of depositional context. For example, an elevated artifact density combined with an elevated proportion of artifacts found lying at a high angle might indicate the concentration of archaeological materials in secondary context by running water, solifluction, soil creep, etc. Figure 1-18 shows for each excavation unit the percentage of flint artifacts in the principal archaeological level that were essentially flat-lying when excavated. A comparison of this map with that for artifact density (see Figure 1-17) shows no patterned relationship.[10]

It is not known exactly how far to the west and southwest the zone of uninterrupted Châtelperronian archaeological occurrence continues. Although the extant loess body that is correlative with couche B continues at least 200m southwest of the Alpha Complex, Méroc placed the formal western limit of Les Tambourets at the western edge of Area 3. Support for this demarcation is provided by Méroc's study of the loess section exposed in the east face of the D.8 roadcut at the junction of this road with the old Gensac road that forms the southern boundary of Area 3 (see Figure 1-1). At this location, which Méroc called "La Côte de Couladère,"[11] he found Neolithic artifacts at the top of the loess body, but he did not report Châtelperronian artifacts. Such artifacts do, however, occur within the loess ca. 100m south-southwest of La Côte de Couladère in what may be regarded as the separate site of Terrier Ferrage

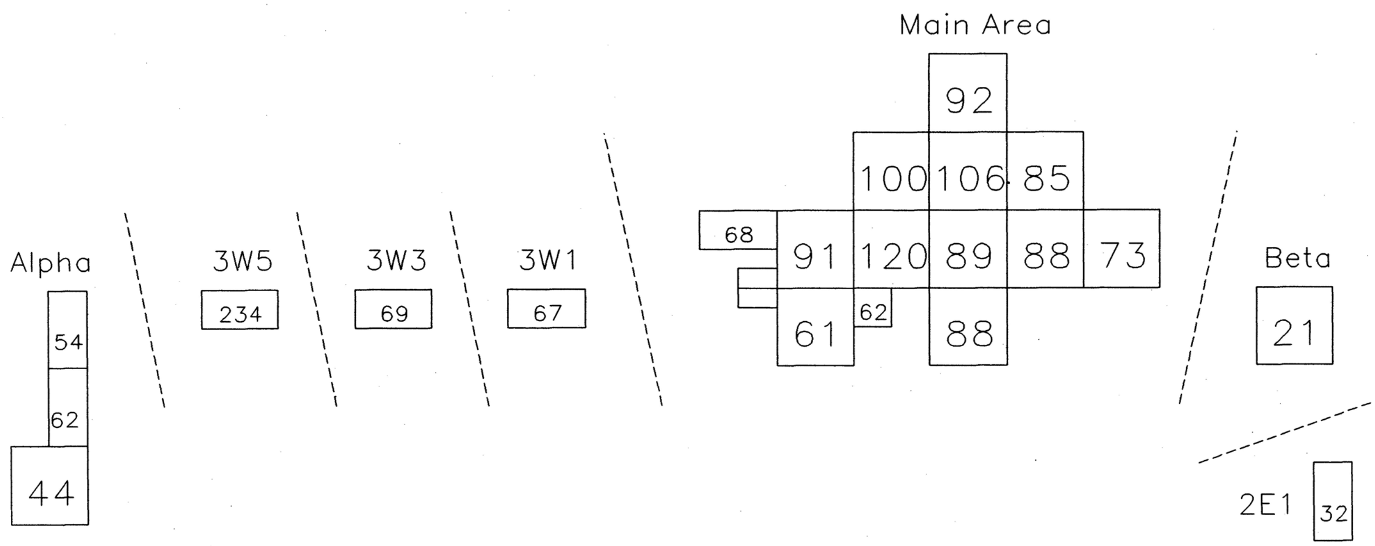


Figure 1-17. Artifact density per square meter in the principal archaeological level of various excavation units at Les Tambourets.

(Méroc 1963b: 200–201), discussed further in Appendix A. Terrier Ferrage, which like the western part of Les Tambourets is located on the +30m terrace, is ca. 200m southwest of the Alpha Complex in Area 3. The third Châtelperronian site in the immediate vicinity is Rachat (Appendix A), located on the +30m terrace, ca. 300m south-southeast of Area 2 at Les Tambourets and ca. 500m southeast of Terrier Ferrage. There is no evidence of Châtelperronian occupation between Rachat and the other two sites.

A final summary observation about Archaeological Level 1 concerns the volume of loessic sediment that forms its matrix. West of the Main Area in Area 3, the thickness of Archaeological Level 1 (and its Alpha Complex equivalent) increases markedly—from 4–5cm in Test Pit 3W1, to 4–6cm in 3W3, to 7–10cm in 3W5, to ca. 15cm in the Alpha Complex. Because this directional change is not matched by the values for artifact density per unit of area (see Figure 1-17), the suggestion is that the rate of *net* accumulation of sediment on the land surface was greater toward the west than toward the east during the time the Châtelperronian cultural debris was accumulating. To the extent that the sediment in question is loessic and that its original mode of deposition was aeolian, it is certainly various processes that *redistributed* the loess unequally following primary deposition that are responsible for the difference in net rate of accumulation in such a small area. Additional evidence of such processes is provided by the directional change in the thickness of the predominantly silty sediment that lies between the base of the archaeological level and the surface of couche C. From zero thickness in the Main Area, 3W1, and 3W3 (where the archaeological horizon rests directly upon couche C), the sediment increases in thickness westward to 3–5cm in 3W5 and 6–12cm in the Alpha Complex.

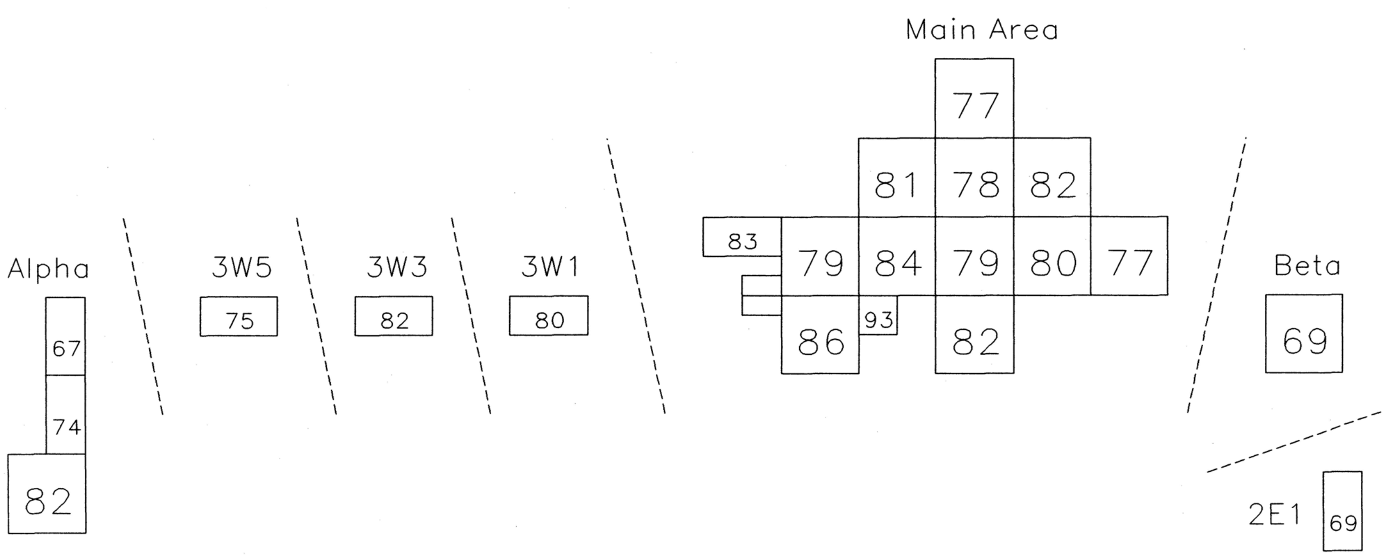


Figure 1-18. Percentage of flint artifacts that were flat-lying when excavated from the principal archaeological level of various excavation units at Les Tambourets.

B. Characteristics of Couche C

As a result of the stratigraphic, sedimentological, and palynological investigations, it is possible to confirm that couche C is a real stratigraphic unit and that its surface corresponds closely to the ancient land surface upon which loess started to accumulate shortly before the earliest episode of Châtelperronian occupation. Although the most visually obvious characteristics of couche C, the ferromanganese concretions and other evidences of hydromorphy, are the results of processes of alteration that took place after the deposition of the sediments they affect, there is now sufficient evidence that the principal time of weathering, pedogenesis, and erosion occurred before the deposition of couche B. In the Main Area, where its surface is sharp but topographically irregular, the stratigraphic integrity of couche C is demonstrated by palynology (Section V of this chapter). West of the Main Area, the surface of couche C is even sharper, especially where some essentially sterile silty sediment lies between it and the base of the archaeological level. The erosion and gullying of the surface of couche C that occurred after the main episode of pedogenetic alteration is seen best in the Alpha Complex. These observations are relevant to the geochronology of Les Tambourets, discussed in Chapter 2.

C. Paleoenvironmental Summary

The upper part of couche C was deposited during a mild and humid climate, as indicated by the pollen spectrum. In the three samples analyzed, arboreal pollen had a mean frequency of 28%, and the trees represented were primarily birch, willow, and Norway pine, with rather frequent hazel. There was some alder and elm and rare oak. It is unclear what the original nature of the sediment of these layers was. They were seriously altered by weathering subsequent to deposition, producing a clay-rich sediment containing abundant ferromanganese concretions.

After the deposition of upper couche C (and Stratum IV in Test Pit Alpha) but before the start of the Châtelperronian occupation, the mild and humid climatic conditions intensified to produce sheetwash erosion, gullying (see Figure 1-15), and incipient pedogenesis—hydromorphy and formation of ferromanganese concretions.

Following this somewhat more temperate interval, the climate changed to one characterized on the basis of the pollen content as cold and increasingly dry. In these lowest levels of couche B, arboreal pollen frequencies were only 12%–13%, and the trees were mostly Norway pine, with a few pollen of birch and willow. Sedges were present at first, but they disappeared as the climate became drier. One result of the onset of this harsher climate was the start of the eolian deposition in the area of a periglacial loess, a silty-clayey sediment that at first was probably somewhat redistributed by sheetwash (accounting for a higher clay-to-silt ratio in this partially colluvial loess at the base of couche B). Soon after the beginning of loess accumulation, the Châtelperronian occupations of this part of the +30m terrace of the Volp began, and the resulting occupational debris became incorporated in and eventually buried by the accumulating loess, forming Archaeological Level 1.

The trend toward increasingly colder and drier climate was interrupted by a minor and probably brief episode of milder conditions, somewhat less cold and more humid. This temporary change is recorded in the middle of couche B, after the Châtelperronian archaeological record had ended.

ENDNOTES

1. In an alternative terminology, the earlier part of the Tertiary Period is known as the Paleogene Period.
2. In an alternative terminology, the Oligocene Epoch ends the Paleogene Period, and the Miocene Epoch begins the Neogene Period.
3. The grayish-yellow loess of Méroc's sketch section is what is described below as couche B, which has Archaeological Level 1 at its base. Méroc's zone of concentrated ferruginous concretions corresponds, at least in part, to couche C of the excavations. No *in situ* Neolithic level in the upper part of couche B was ever discovered by the excavations, and the basal cobbles, in which Méroc reported Acheulian artifacts, were not sampled by excavation.
4. The topographic irregularity of the base of Archaeological Level 1 (=the surface of couche C), especially in V-B, was noted at the time of the 1973 *sondage*,[a73074] but attempts to interpret this phenomenon, from the very small surface exposed, as the result of frost deformation or even an ancient tree-fall (Bricker and Laville 1977: 513) must be regarded as ill-informed. The undulations reported then may now be seen, in the light of more extensive later excavation, as part of widespread evidence for the erosion and gullying of the surface of couche C before the first deposition of the couche B loessic sediment.
5. The stickiness and plasticity of basal Ensemble I and Ensemble II required a change in excavation tools. The *crochets* used elsewhere at Les Tambourets were replaced by sharpened trowels and knives, and the sediment was excavated by shaving and slicing rather than by disaggregation. The magnitude of the sedimentary difference is reflected by the fact that such a change of excavation implements and technique was required nowhere else at the site.
6. Three ceramic objects from Stratum II were large enough to catalogue: two small fragments of brick or tile and one sherd of grit-tempered redware. Thirteen chipped lithic objects were recovered: one fragment of an inverse scraper on a flake, two miscellaneous retouched pieces, and ten unretouched *débitage* products. The only artifact recovered from Stratum I was an unretouched *débitage* flake.
7. Among the professional notebooks (*carnets de fouille*) of Louis Méroc, which I examined at the Direction des Antiquités Préhistoriques de Midi-Pyrénées in Toulouse in September and October of 1978, there was a small loose-leaf notebook that was not part of the numbered series. On page 17 of that notebook, was the following entry:
   lundi 1 novembre 1965
   Le maçon M^{r} Portet qui habite en haut de la côte de Luquet sur le gisement même des Tambourets, me remet, pour le 2ème fois, un lot de silex qu'il a ramassés à mon intention en travaillant son jardin et les champs voisins. Certains proviennent du fond du puits qu'il a creusé jusqu'à 7^{m} de profondeur dans le thalweg du ruisseau qui coule au bas de la pente, devant chez lui. Ils voisinaient avec briques et une chaine en fer !! au fond tout à fait. Donc, remblaiement depuis l'epoque galloromaine au maximum.
8. The text of the note is:
   Les Tambourets
   Lot de silex trouvés en place à 2^{m} 30 de profondeur par M^{r} Portet, entrepreneur de maçonnerie, en établissant sa prise d'eau, au bord du ruisseau.
   Although the document is undated, it seems likely that the excavation referred to was part of the same water-system installation project mentioned by Méroc in his 1965 notebook.
9. These and other "TDoc" references are to be found in the separate "Tambourets Documents" section of this report.
10. r=0.102, df=19, p>0.10.
11. The source of this information about La Côte de Couladère is a pencilled sketch-map and notes by Louis Méroc, document 100 of the Méroc dossier on Les Tambourets, reproduced here as Figure A-2 of Appendix A.

CHAPTER 2
THE AGE OF ARCHAEOLOGICAL LEVEL 1

I.THE PROBLEM

There is at present no chronometric dating of the Châtelperronian of Les Tambourets. Because the relative position of the Châtelperronian in the Palaeolithic sequence of southwestern France is known within broad limits—at the end of or immediately following the Mousterian—its age at Les Tambourets must be somewhere within Oxygen Isotope Stage 3 (OIS3),[1] extending from ca. 59,000 to ca. 28,000 calendar years before the present (Genty et al. 2010: 2800). Placing it more precisely within that broad temporal range must depend on: a) comparative consideration of other sites in the region that are reliably dated; and, b) geochronological and paleoenvironmental data from Archaeological Level 1 itself and its enclosing sediments.

Archaeological Level 1 is contained within the basal centimeters of a body of periglacial loess, portions of which are preserved today on the +30m terrace on the left side of the lowermost reaches of the Volp Valley. The relevant geological maps (Carte Géologique 1970, 1977) show this loess as the surface formation on a portion of the archaeological site. Similar loess bodies are known from elsewhere in the valleys of the Garonne and its tributaries, and some of them contain molluscan fauna that has permitted their assignment to (in a former terminology) the late Würm Glacial, by which we would now understand OIS3 or OIS2 (Cavaillé 1970: 1; Cosson and Cavaillé 1977: 26–27). The conclusion stated (Cosson and Cavaillé 1977: 27) was that the loess was emplaced, primarily by wind action, during "...a dry, cold, and windy climatic episode..." (*un épisode climatique sec, froid et venteux*).

The conditions under which the sediment of periglacial loess (as opposed to desert loess) is derived and deposited are generally understood to be the most severe parts of glacial phases (Butzer 1971: 199; Flint 1957: 409; Muhs et al. 2003: 1947). Major sources of the silt-sized sediment are unvegetated glacial outwash bodies during seasonal thaws. What is probably relevant to the loess of Les Tambourets is so-called valley-train outwash from the mountain glaciation in the Pyrenees. Research in North America has shown such outwash bodies to be important sources of periglacial loess; furthermore, the valleys themselves provide effective guidance for silt-carrying winds coming off the glaciers (Bettis et al. 2003: 1938). Whatever may have been the exact sources of the Pleistocene-age periglacial loess of the lower Volp Valley, it is to be expected that the processes of deposition of this loess are to be sited temporally in a cold extreme of the fluctuating climate of the OIS3.

Laville's sedimentological analysis of the couche B loess[2] enclosing Archaeological Level 1 is completely consistent with the expectations about climate raised by the presence of a loess body. Even more indicative of an extreme climate are the results of the basal couche B sediments (see TDoc24). Arboreal pollen (AP)—mostly Norway pine with only a few birch and willow—have frequencies of only 12%–13%, contrasting with the AP frequencies of ca. 28% in the immediately underlying couche C, including not only Norway pine, birch, and willow, but also rather abundant hazel, with some alder and elm and rare oak. The pollen data are registering the sharp climatic change that followed upon the sheetwash erosion (Laville et al. 1985 [=TDoc06]: 1139), gullying, and incipient pedogenesis (see TDoc22) that took place immediately before the start of the deposition of the couche B loess. The pollen indicate that this harsher climate, following an extended period of variable but usually warmer and moister conditions, started out as cold and dry, then got progressively drier (see TDoc24). The low AP frequency for basal couche B is indicative of the relative severity of the climate; equally low frequencies (9%–13%) are found at Les Tambourets only in a solifluction nappe, couche L, ca. 1.7m below basal couche B. In short, Archaeological Level 1 accumulated at the start of a major episode of severe cold. In an earlier report (Bricker and Laville 1977 [=TDoc16]: 517), this episode of cold was attributed to the very beginning of the Würm III (*aux premiers moments du troisième stade würmien*). In terms of current terminology, the Châtelperronian of Les Tambourets dates to the beginning of some very cold episode in OIS3.

II. THE CLIMATIC RECORD OF OIS3 AND ITS CHRONOLOGY

Among the best records of climatic fluctuations during OIS3 are those determined from oxygen isotope variations in Greenland ice cores dated by annual layer counting (Svensson et al. 2008 provide a summary based on several different cores). The most severe cold-climate episodes during OIS3 are several so-called Heinrich Events, related apparently to rapid and massive discharges into the North Atlantic of Arctic ice (Cacho et al. 1999: 701–702). Three such events are relevant here (d'Errico and Sánchez Goñi 2003: 778, Figure 2; Svensson et al. 2008):

- HE3 ca. 31,000 to 29,100 calendar years before the present
- HE4 ca. 40,000 to 38,400 cal yr BP
- HE5 ca. 46,600 to 45,200 cal yr BP

The Heinrich Events, extreme examples of Greenland glacial episodes (Greenland Stadials, GS), are bounded by Greenland Interstadial episodes (GIS), as follows: HE5 occurs between GIS 13 and GIS12; HE4 is between GIS 9 and GIS 8; and HE3 is bounded by GIS 5 and GIS 4.

Other records of climatic variation during OIS3 are known from places closer to Les Tambourets than Greenland. Measurement of Pleistocene sea-surface temperatures from analyses of marine cores off the coasts of the Iberian peninsula, in both the Mediterranean (Cacho et al. 1999) and the Atlantic (Roucoux et al. 2001), have permitted the recognition of the same general climatic fluctuations during OIS3 that are seen in the Greenland ice-core records. Specifically, Heinrich Events 5, 4, and 3 are among the temperature minima recognized in both oceans, reinforcing the general conclusion that the Greenland ice record is a valid proxy for the late Pleistocene climatic sequence of southwestern Europe. In the Mediterranean (Alboran Sea core MD95-2043), the sea-surface temperatures during HE4 were somewhat colder than those of the other OIS3 Heinrich Events, and the pace of cooling was the most abrupt of the whole sequence (Cacho et al. 1999: 702).

The marine cores discussed above have the additional value of containing pollen, blown or washed into the surrounding seas from the Iberian mainland. Although very indirect, this pollen evidence gives some information about the flora of extreme southwestern Europe during Heinrich Events and other OIS3 climatic fluctuations. For example, in core MD95-2039, from the Atlantic Ocean off the coast of Portugal (Roucoux et al. 2001: 129):

> "The arboreal pollen (AP) signal shows the same millennial-scale variability as the planktonic $\delta^{18}O$ values throughout. Heinrich events are associated with periods of low AP values and every interval of heavy planktonic $\delta^{18}O$ values, concomitant with a D-O stadial event [a Dansgaard-Oeschger cold episode], is associated with an equally significant drop in AP values."

The general significance of this is that the pollen data from southwestern Europe are linked, through the temperature data from marine cores, to the climatic record of the Greenland ice and can therefore be proxies for global climatic fluctuation during OIS3. These relationships have been examined in detail by María Sánchez Goñi and her colleagues. Although there are some different patterns in marine and terrestrial developments during Heinrich Events (Sánchez Goñi et al. 2000: 399-401), the general situation is (Sánchez Goñi et al. 2002: 104):

> "Pollen records show an alternation between dry and cold conditions during the D-O stadials and humid and mild conditions during the D-O interstadials. HEs were associated with the dryest...and coldest...intervals...."

What is of note here is that Heinrich Events are manifested in southwestern Europe not only by great cold, but also by great dryness.

Additional relevant information on OIS3 climate has come from the growth rate and stable isotope content of stalagmites in the Villars Cave (Dordogne, SW France), a site on the fringes of the Massif Central ca. 225km NNW of Les Tambourets (Genty et al. 2010). As in the marine cores discussed above, the Villars Cave stalagmites record a series of alternating warm/humid and cold/dry episodes during much of OIS3. At ca. 40,000 BP, as determined by Uranium-Thorium dating, the climate got "much dryer and colder" than in the previous millennia, and this marked change in climate is considered to be "...synchronous with the Heinrich 4 cold event..." (2010: 2811, 2818). This information is helpful because it relates OIS3 terrestrial conditions in southwestern France to global climate patterns.

In order to understand the chronological placement of Les Tambourets in a comparative perspective, it is necessary to examine how other relevant archaeological sites in southwestern Europe—latest Middle Palaeolithic and earliest Upper Palaeolithic—fit into the OIS3 climatic sequence. It is now increasingly apparent that the relevant time for this region centers on ca. 40,000 years ago in real calendrical years (for example, Blockley et al. 2008; Hoffecker 2009). The most widely used dating method for this time period is ^{14}C dating, but until recently its use in this time range has been problematic. It is close to the practical limits of ^{14}C dating, which is about 50,000 years, and very special sample pretreatment is necessary to eliminate contamination by recent carbon that would produce erroneously young dates. In many, if not most cases, however, what is called ultrafiltration of collagen in samples of ancient bone has been shown to be effective (Higham et al. 2006).

Another problem with ^{14}C dating in the ca. 40,000 BP time range has been thought to be the so-called Laschamp Excursion, a time between ca. 41,000 and 40,000 when a weakening of Earth's magnetic field permitted more cosmic radiation to produce more ^{14}C in the upper atmosphere (Singer et al. 2009). Samples from organisms that were alive during the Laschamp Excursion would, therefore, be radioactively "hotter" than usual, and their ^{14}C dates would be correspondingly too young. Erroneously young errors between 4,000 and 10,000 years were reported (Blockley et al. 2008: 767; Giaccio et al. 2006: 357–358), but re-examination of some of these data suggested errors that are generally much smaller (Talamo et al. 2012: 2465–2466). In any case, the problems of the Laschamp Excursion and other fluctuations in the production of ^{14}C are now regarded as having been solved by the development of the INTCAL09 radiocarbon age calibration curve, extending back to 50,000 BP (Reimer et al. 2009). In the view of the developers of the calibration curve, fluctuations in ^{14}C production "...do not invalidate radiocarbon dating at all, because the calibration procedure is designed to account for these anomalies" (Talamo et al. 2012: 2466).

III. LATE MOUSTERIAN OF ACHEULIAN TRADITION (MTA) SITES

It has long been understood that the Châtelperronian, as an archaeological entity, developed from a southwest European Mousterian of Acheulian Tradition (MTA), specifically the Mousterian of Acheulian Tradition, Type B (MTA-B). In their recent synthetic summary of various characteristics of the Middle-to-Upper Palaeolithic transition in Western Europe, Mellars and French (2011: 625 and SOM—text and Table S1) gave various estimates for the *latest* MTA-B in southwestern France based primarily on available thermoluminescence (TL) and electron spin resonance (ESR) dates. These estimates vary from an early extreme of ca. 47,000 cal yrs BP to a late extreme of ca. 43,000 BP, with an intermediate date (2011: Table S1) of 44,400 BP. Two of the sites included in the Mellars and French study—Le Moustier and Pech de l'Azé I—and one that was not—Camiac—merit further comment.

The lower shelter at **Le Moustier** (Dordogne) supplies relevant information for specifying the age of the MTA-B in southwestern France. A thick sequence of MTA-B levels collectively designated Layer H has been dated by both thermoluminescence on samples of burnt flints (Valladas et al. 1986), and electron spin resonance on samples of animal teeth (Mellars and Grün 1991). The mean value of the ESR dates, using the linear uptake (LU) method chosen as appropriate by the analysts, is 41,000±2600 cal yrs BP (1991: 270, Figure 1), whereas the mean value of the TL dates on samples from the upper subdivisions of Level H is 42,500±2000 cal yrs BP (Valladas et al. 1986: 453, Table 2). These dates overlap extensively within the one-sigma error limits and are, therefore, essentially the same. If the true age of these levels is close to the central tendencies of the means, it would fall somewhere between 43,000 and 41,000 BP.

The study of the sediments and contained pollen of Level H, summarized by Laville et al. (1980: 201), determined that the lower part of Level H accumulated during a time of "cold but humid climate," whereas the upper part was assigned to a time of "cold and dry conditions." Combining the paleoenvironmental information with the likely dating suggests a colder episode in the Greenland ice-core record not very long before Heinrich Event 4. Younger Mousterian levels, I (Denticulate Mousterian) and J (Typical Mousterian) overlie the MTA-B at Le Moustier, followed by another level, K, usually attributed to the Châtelperronian. Level K will be discussed briefly in a later paragraph, below.

Another relevantly dated occurrence of the MTA-B in southwestern France is at **Pech de l'Azé I** (Dordogne), Level 6, at the base of which Neanderthal skeletal material was recovered (Soressi et al. 2007). A cervid tooth from basal Level 6 produced a coupled ESR/Uranium-series date of 43,000+8000/-6000 cal yrs BP. Two unburnt bones from the top of Level 6 were used as samples for AMS ^{14}C dating, producing two dates (GrA-25632 and GrA-25633) (Soressi et al. 2007: 464) that, when calibrated with IntCal09 (Reimer et al. 2009), specifies a range of ca. 43,300 to 41,500 BP. Considering the results of both dating techniques, it is probable that the age of Level 6 at Pech de l'Azé I centers on ca. 43,000 to 42,000 BP.[3] According to the climatic sequence documented in the Greenland ice cores, this millennium was, for the most part, the time of Greenland Interstadial 11 (d'Errico and Sánchez Goñi 2003: 778, Figure 2; Svensson et al. 2008: 50, Table 1). It might be expected, therefore, that Level 6 would have accumulated during a relatively mild climatic episode.

The expectation of a relatively mild climate for Level 6 is supported by the few faunal data available (Soressi et al. 2008: 106, Tableau 1 and Tableau 2). The dominant forms are red deer and bovines, with some roe deer, horse, and boar. Reindeer is very rare or absent. A mild climate is indicated as well by the study of the Level 6 sediments (Laville 1975; Laville et al. 1980). Level 6, a time of mild, humid climate with significant chemical weathering, followed a time of very cold, very dry climate and was followed, in turn, by a sequence of cold-dry and milder-more humid episodes. What the dating of Level 6 at Pech de l'Azé I (and of Le Moustier Level H) seems to indicate is that the MTA-B was still present in southwestern France *after* Heinrich Event 5. Therefore, the cold, dry extreme associated with the Châtelperronian at Les Tambourets is very unlikely to be HE5. A later cold extreme must be the relevant one.

Level 6 at Pech de l'Azé I is overlain by Level 7, a thick rockfall containing dispersed MTA-B artifacts. A total of 13 ESR dates and 1 coupled ESR/U-series date run on animal teeth have been reported (Soressi et al. 2007: 463, Table 5), but they are so heterogeneous that they cannot be used to determine the age of these materials with any confidence. All that can be said is that, based on stratigraphic superposition, they are younger than Level 6. Laville's study of the sediments (1976: 62–65) suggests that at the time following the deposition of the level with the Neanderthal child (Level 6), the climate was generally severe but with at least one milder episode before the final collapse of the shelter.

The Level 7 artifacts themselves, representing the debris from brief occupations that took place not long before the final collapse of the roof, are of some interest. François Bordes (1955: 18) termed the Level 7 materials a "final" MTA, and he noted that, in an early publication, Denis Peyrony (1949: 21) classified them as Châtelperronian ("Périgordien I"). Wherever one draws the line through the developmental continuum from MTA-B to Châtelperronian, the latest materials from Pech de l'Azé I are near that line. As Bordes (1955: 18) expressed it: "*Avec cette couche nous ne sommes pas loin, en effet, du Paléolithique supérieur, tant chronologiquement que typologiquement.*" If our interpretation of the age of Level 6 is correct, the latest MTA-B and the earliest Châtelperronian would date, at least in southwestern France, to the time of alternating colder and less severe climatic intervals between ca. 42,000 and 40,000 BP—that is, between the time of Greenland Interstadial 11 and Heinrich Event 4.

One more terminal Mousterian site is relevant to the discussion of the age of the Châtelperronian at Les Tambourets. This is the site of **Camiac** (Gironde), where rescue archaeology carried out by Michel Lenoir in the 1970s produced very useful archaeological and paleoenvironmental information before the destruction of the site by quarrying operations (Guadelli et al. 1988; Guadelli and Laville 1990; Lenoir 2000; Rigaud 1976b). The artifacts recovered from Level D were described originally as "...*une industrie très pauvre intermédiaire entre le Paléolithique moyen et le Paléolithique supérieur ancien*" (Rigaud 1976b: 539) and later as "...*un Moustérien tardif à caractères évolués*..." (Guadelli et al. 1988: 61). It has not been called MTA-B, but it does contain one Châtelperron point (1988: 66, Figure 1-7), and the assemblage as illustrated (1988: 66-69, Figs. 1 to 4) appears to be very close typologically to a flake-rich Châtelperronian.

Camiac is dated chronometrically only by a conventional ^{14}C date run in the 1970s:

- Ly1104 35,100+2000/-1500 ^{14}C yrs BP.

Applying the IntCal09 curves (Reimer et al. 2009) to the central value of this date produces an age of ca. 40,300 cal yrs BP, *but* because the date is a conventional date (not AMS) run long ago on bone, it is probable that the 40,300 BP estimated age is at least somewhat too young. The value of Camiac for our purposes derives not primarily from its ^{14}C date, but rather from the dating suggested by the study of the pollen contained in its sediments and the explicit chronological correlation between Camiac and Les Tambourets published by scientists who studied both sites.

Faunal remains were present in Level D, but they were fragmentary, much altered by hyena gnawing (a hyena den was located on one side of the occupation area), and probably not strictly contemporaneous with the artifacts (Guadelli et al. 1988: 61; Lenoir 2000: 61). This archaeofauna, a mixture of species indicating a rigorous climate and others indicating more temperate conditions, does not lead to a clear diagnosis of the climate. There were, however, coprolites associated with the faunal remains, and the analysis of pollen contained within them indicated a cool, humid climate where most of the arboreal pollen were of Norway pine (Guadelli and Laville 1990: 46). The pollen in the zone of Level D sediment containing the artifacts, generally above the coprolite-bearing zone, reflected a considerably more temperate climate, with an arboreal pollen frequency of 58%. This floral community included stands of oak and hazelnut, indicators of warmth, while sedges and other water-loving forms indicated continuing humidity. Pollen from sediments above Level D indicated that the humid, temperate conditions continued for some time, changing gradually to a cooler and markedly humid climate (Guadelli et al. 1988: 63; Guadelli and Laville 1990: 46).

The conclusion reached by the studies of Camiac was that the archaeological level—transitional between Mousterian and Châtelperronian—dates to the latter part of what was called at the time the Würm interstadial, *l'interstade würmien* (for example, Guadelli and Laville 1990: 47, Tableau 1). Specific cross-ties based on palynology are proposed between the sequence at Camiac and that at Les Tambourets (Guadelli and Laville 1990: 46; Guadelli et al. 1988: 63). Using the terminology published earlier by Laville et al. (1985; see TDoc06), the base of Level D at Camiac probably represents the end of pollen zone IV at Les Tambourets, the humid but cool middle or second phase of the Würm interstadial, between the so-called Tambourets warming (*amélioration des Tambourets*), phase 1, and the Cottés warming (*amélioration des Cottés*), phase 3. Most of Level D at Camiac, containing the archaeological level, represents at least the beginning of the Cottés warming, identified as pollen zone V (=couche F) at Les Tambourets. To the extent that these correspondences are accurate, they give a general idea of the stratigraphic/temporal distance between the transitional industry of Camiac and the Châtelperronian of Les Tambourets, the latter having been assigned to pollen zone VIII (=couche B) (1985: 1138).

IV. INITIAL UPPER PALAEOLITHIC SITES

The earliest archaeological entity of the Upper Palaeolithic in southwestern Europe that is generally considered to be allochthonous rather than a development from the regional Mousterian is the Aurignacian (*sensu lato*). A brief consideration of the dating of the Aurignacian in this region is of indirect relevance to the Châtelperronian of Les Tambourets in that it provides a broader context for that occupation. And, of course, the question of the relative ages of the Châtelperronian and Aurignacian in southwestern France is at the heart of recent controversy about the nature of the culture of the latest Neanderthals.

Although there are several very helpful compilations of chronometric dates for Aurignacian occupations in southwestern Europe (for example, Arrizabalaga et al. 2009: 261, Table 14.1; Jöris and Street 2008: 789, 792, Figs. 4 and 9; Mellars 2000: 35, Table 5.1; Rigaud 2001: 64, Tableau 1), they are almost without exception ^{14}C dates, both conventional and AMS. In very general terms, there are two kinds or stages of the Aurignacian that are relevant here. The older has been called, variously, Archaic Aurignacian, Proto-Aurignacian, and Fumanian (as discussed by Mellars 2006). Although it is older farther east, calibrated ^{14}C dates for sites in northern Spain and southwestern France are generally between ca. 42,000 and 41,000 cal yrs BP (Mellars 2006: 178, Figure 7). Recently published dates from Les Cottés in Vienne suggest that it may have lasted later to the north of the classic southwestern area (as discussed below). A later kind of Aurignacian, sometimes stratigraphically superposed at the same site (for example, Szmidt et al. 2010), begins the "Classic Aurignacian" sequence of southwestern France with what has been called Early Aurignacian (*Aurignacien ancien*). There is much variation, but ^{14}C for the earliest "Early Aurignacian" occupations in southwestern France cluster, when calibrated, between a few centuries before 40,000 and 39,000 cal yrs BP (Higham, Jacobi, et al. 2011: 561; Mellars 2006: 168; Rigaud 2001: 64, Tableau 1).

The environmental context of the Aurignacian in northernmost Spain and southwestern France is known in very broad outline based on recent studies at widely scattered sites in these regions. As summarized by Arrizabalaga et al. (2009: 280):

> "In general terms, it appears that the end of the Mousterian and the beginning of the Upper Palaeolithic (Chatelperronian) coincide with the final moments of the so-called Würmian Interstadial, under benign climatic conditions..., a situation which becomes a climate dominated by adverse conditions during the oldest periods of the Aurignacian. ...at the end of this technocomplex, the environmental conditions tended to improve, worsening again throughout the Early Aurignacian."

Farther north in France, in the "classic" region of the Périgord, the Archaic Aurignacian or Proto-Aurignacian or Fumanian is very poorly represented (Bon 2002: 166; Mellars 2006: 169–170), but the Early Aurignacian or *Aurignacien ancien* is well known from many sites. Furthermore, it has been clear for decades (Laville et al. 1980) that the earliest Early Aurignacian in the Périgord dates to the onset of what was formerly called the Würm III cold.

Beyond these general conclusions about the chronology and environment of the earliest Upper Palaeolithic, it is useful, in trying to determine the broader context of the Châtelperronian of Les Tambourets, to look more specifically at the data from several relevant Aurignacian and/or Châtelperronian sites in northern Spain and southwestern France. The sites were chosen because there is useful paleoenvironmental information and, in some cases, recently determined chronometric dating.

The site of **Cueva Morín** (Villanueva de Villaescusa, Provincia de Cantabria, Spain), located at the western end of the area under consideration here, contains a long sequence of Palaeolithic occupations, including Châtelperronian (Level 10), so-called Archaic Aurignacian (Levels 9 and 8), and Early Aurignacian (Levels 7 and 6) (Arrizabalaga et al. 2009; González Echegaray and Freeman 1971). AMS ^{14}C dating of a sample of charcoal from Level 8, the upper of two Archaic Aurignacian levels, produced the following result (2009: 261, Table 14.1):

- GifA-96263 36,590±770 ^{14}C yrs BP.

The central value of this date would be about 41,600 cal yrs BP as calibrated by IntCal09 (Reimer et al. 2009). No modern AMS dating of the Level 10 Châtelperronian exists, but the early palynological study of Arlette Leroi-Gourhan (1971) is of interest in view of the new dating of Level 8. According to Leroi-Gourhan, the climate at the time of the Châtelperronian was quite temperate, whereas that of the Archaic Aurignacian (Levels 9 and 8) registered clear alternations of warmer and cooler episodes. The pollen of Level 7, the earliest Early Aurignacian, indicate a brusque change to extremely cold, dry conditions. The ^{14}C dating of Level 8 provides an anchor point for the early Upper Palaeolithic sequence at Cueva Morín, placing the Archaic Aurignacian (and presumably the underlying Châtelperronian) in the rapidly alternating warmer and colder episodes registered in the Greenland ice cores in the millennia prior to Heinrich Event 4 (d'Errico and Sánchez Goñi 2003; Svensson et al. 2008). There is little doubt that the marked change registered in Level 7 reflects the effects of Heinrich Event 4.

Farther to the east than Cueva Morín, the cave site of **Labeko Koba**, at Arrasate (Provincia de Guipúzcoa, País Vasco, Spain), contained Châtelperronian, Proto-Aurignacian, and Early Aurignacian archaeological levels (Arrizabalaga et al. 2003; Arrizabalaga et al. 2009). The very sparse Châtelperronian materials came from Level IX (Lower). Two AMS ^{14}C dates on bone from this level have been published (2009: 261, Table 14.1):

- Ua-3034 26,575±505 ^{14}C yrs BP
- Ua-3324 34,215±1265 ^{14}C yrs BP

Ua-3034 is obviously too young, and that may be the case for Ua-3324 as well, which would have a range from ca. 40,700 to 37,400 cal yrs BP when calibrated with IntCal09. The authors warn that all the AMS dates from the site must be viewed with caution because"...problems of collagen preservation are present" (Arrizabalaga et al. 2003: 418). More useful information comes from the study of the site's sediments, pollen, and fauna. The Châtelperronian of Level IX (Lower) accumulated under "...humid, relatively temperate conditions compatible with the Würm Interstadial..." (2003: 419). After that, throughout the time of the Proto-Aurignacian (Level VII), a not totally consistent set of paleoenvironmental indicators seems to represent short-lived alternations of warmer and cooler climatic phases, with cooling early in the Early Aurignacian (Level V). This sequence is recognizably similar to that described above for Cueva Morín.

Located nearly due east of Labeko Koba, but on the north slope of the Pyrénées in the French Basque country, la Grotte **Gatzarria** (Pyrénées-Atlantiques) is of interest here because it contains levels of Châtelperronian, Proto-Aurignacian, and Early Aurignacian in clear stratigraphic superposition (Laplace 1966a). Chronometric dates for Gatzarria are not available, but geochronological information has been published (Lévêque and Miskovsky 1996) based on a study of the sediments. The occupations of the Châtelperronian, Level Cjn3, and the Proto-Aurignacian, Levels Cjn2 and Cjn1, were referred to a long period of decalcification, chemical weathering, and alteration. The upper zone of these sediments, the Proto-Aurignacian levels, probably represents a cool and humid climate; the climate of the lower zone, with the Châtelperronian level, is consistent with the end of an interstadial, identified by the authors as probably the "Cottés" Interstadial (1996a: 53–54). The sediments containing the Early Aurignacian, Levels Cbci-Cbf, are characterized by cryoclastic debris. The granulometry and other indicators signal a severely cold climate, the beginning of what was formerly called the Würm III. This is, once again, a familiar climatic sequence.

The very large cave of **Isturitz** (Saint-Martin-d'Arberou and Isturitz, Pyrénées-Atlantiques, France), with a long history of excavation (Esparza San Juan and Mujka Alustiza 1996), is located in the Pyrenean piedmont about 25km northwest of Gatzarria. Archaeological remains of both the Middle and Upper Palaeolithic have been found at various loci in the cave system. The presence of a Châtelperronian occupation at Isturitz, although it has been claimed, is very uncertain, based solely on the (unprovenienced) presence of three Châtelperron points (1996: 77–78). What is of interest here is a recently excavated sequence of Aurignacian levels in the Salle Saint-Martin (Arrizabalaga et al. 2009: 271–274; Szmidt et al. 2010). The sequence extends from Proto-Aurignacian at the bottom to a kind of Early Aurignacian at the top. In between is a level, C4c4, with an industry described as "intermediate" between the Proto-Aurignacian and the Early Aurignacian (Szmidt et al. 2010: 762). Six samples of cut-marked bone from this level were dated at the NSF-Arizona lab using AMS ^{14}C dating. The weighted mean of the six dates is reported as 37,180±420 ^{14}C yrs BP (Szmidt et al. 2010: 764, Table 3); the calibrated range using IntCal09 is between 42,625 and 41,355 cal yrs BP (Szmidt et al. 2010: 765, Table 4). The Greenland ice-core record leads to the expectation that this age range falls in a time of relatively rapidly alternating warmer and cooler episodes prior to Heinrich Event 4, which began ca. 40,000 BP. We seem not yet to have much published information on the paleoenvironment of the recently excavated levels. There is some hint from the faunal remains that the earliest Proto-Aurignacian level (C4d1, four stratigraphic levels below the dated C4c4) represents a rather temperate climate, getting less temperate in the "intermediate" levels, and getting colder, with reindeer dominant, in the Early Aurignacian (2010: 762). This does not conflict with the results of a palynological study done half a century ago on samples from the Salle Saint-Martin (Ar. Leroi-Gourhan 1959), which showed that the Early Aurignacian (*Aurignacien typique*) took place during the establishment of a cold episode, "le refroidissement du paléolithique supérieur" (1959: 620). Despite the paucity of environmental information, the new AMS dates from Isturitz are invaluable in showing that the Proto-Aurignacian was established in extreme southwestern France a millennium or more before Heinrich Event 4.

Brassempouy (Landes, France), located about 60km northeast of Isturitz, is a site with several rockshelters and karstic solution cavities. Upper Palaeolithic materials at the site include representatives of Early Aurignacian and Châtelperronian industries. Paleoenvironmental information is complicated by the fact that the faunal samples, abundant at some site loci, are often poorly preserved and, in some cases, are the result of accumulation by carnivores, not human activities (Patou-Mathis and Boukhima 1996). The best information about the chronological placement of these levels comes from AMS ^{14}C dates on charcoal samples, replacing earlier series of conventional ^{14}C dates that were manifestly too young. Two of the new dates are particularly informative (Arrizabalaga et al. 2009: 261, Table 14.1):

- Early Aurignacian of Level 2F/2DE of the Grotte des Hyènes: GifA-101094 34,810±540 ^{14}C yrs BP.

The IntCal09 calibration curves (Reimer et al. 2009) suggest that this may be ca. 39,250 cal yrs BP.

- Châtelperronian of Level Ebc2 of the Abri Dubalen: GifA-101045: 36,130±690 ^{14}C yrs BP.

The IntCal 09 equivalent is ca. 41,300 cal yrs BP. When these calibrated ages are compared with the Greenland ice-core chronology (d'Errico and Sánchez Goñi 2003; Svensson et al. 2008), the Early Aurignacian at Brassempouy is seen to fall within the span of Heinrich Event 4, and the Châtelperronian would have occurred in the period of variable climate preceding HE4. The latter assignment is consistent with the conclusion of Patou-Mathis and Boukhima (1996: 472) that the Châtelperronian of the Grotte du Pape at Brassempouy occurred during the Cottés Interstadial. It is consistent, as well, with the presumed temporal placement of the Early Aurignacian at the sites of Isturitz, Gatzarria, and other sites discussed above.

Another Châtelperronian site that needs to be considered in the present discussion is located well to the north of the Pyrenean foothills, in the drainage of the Charente River, about 50km from the present Atlantic coast. The rockshelter site of La Roche à Pierrot at **Saint-Césaire** (Charente-Maritime, France) is well known because the upper of two Châtelperronian archaeological levels contained a fragmentary Neanderthal skull and associated postcranial remains (Lévêque et al. 1993). The archaeological sequence at the site includes Mousterian, Châtelperronian, and Aurignacian. Châtelperronian material is found in two levels: Ejop-inf or Level 9 and the overlying Ejop-sup or Level 8. The Neanderthal remains were found in Level 8, and six samples of burnt flint from this level were dated by TL dating (Mercier et al. 1991). The published mean of the six determinations is 36,300±2700 BP (1991: 738, Figure 1). A subsequent reconsideration of this date using Bayesian analysis revised it to 37,200±2600 yrs BP, and the 95% credibility (two-sigma) range for Level 8 as a whole was calculated to be 41,900 BP to 33,900 BP (Millard 2006: 367).

Directly above the Level 8 Châtelperronian is an archaeologically sterile level (Ejo-inf or Level 7), overlain by a series of Aurignacian levels. Level Ejo-sup or Level 6 is described as "Proto-Aurignacian" (but it is not clear if this means the same thing here as at sites farther south). TL dates for Level 6 (Mercier et al. 1991: 738, Table 1; 1993: 18, Table 3.1) are:

- sample 96 30,800±3300 BP
- sample 60 34,000±3900 BP.

The Bayesian analysis of these dates by Millard (2006: 366, Figure 2) put the 95% credibility levels for these two dates at ca. 26,200 to 37,400 BP and ca. 28,000 to 38,500 BP, respectively. Level Ejf or Level 5 is Early Aurignacian; and Levels Ejm and Ejj, or Levels 4 and 3, are Evolved Aurignacian (Miskovsky and Lévêque 1993: 9-12). These levels have no published TL dates.

Combining the sedimentological data with the information on pollen (Leroyer and Ar. Leroi-Gourhan 1993) and fauna (Lavaud-Girard 1993), Miskovsky and Lévêque (1993: 9–12) summarize the paleoenvironmental context as follows: Level 9, containing the earlier Châtelperronian occupation, represents the resumption of deposition after a period of erosion; it has "...quite clearly the characteristics of an interstadial phase..." (1993: 12–13). Level 8, with the Neanderthal skeletal remains, has both floral and faunal indications of a transition from the more temperate levels below to the colder Aurignacian levels above. The sediments suggest "...an initial cold snap associated with relatively high humidity" (1993: 14). The pollen data suggest that cooling continued in Level 6, the "Proto-Aurignacian" level. The climate of Level 5, with a "...classic industry of the early Aurignacian (Aurignacian I)..." (1993: 9), was much more severe than that of the underlying levels. Evidence for this is the frost weathering of the sediments, a fauna dominated by reindeer and including mammoth and woolly rhinoceros, and a pollen assemblage indicating a cold grassy steppe with an arboreal pollen frequency of less than 20% (1993: 9).

The climatic sequence just described for Saint-Césaire is one seen at other French and Spanish sites containing initial Upper Palaeolithic occupations, namely, the Châtelperronian during more temperate, "interstadial" conditions, the classic Early Aurignacian in a very severe cold climate (probably Heinrich Event 4), and an earlier Proto-Aurignacian (or Archaic Aurignacian or Fumanian) between these extremes in a climate general cool and often humid. However, the TL dates for the Châtelperronian and Aurignacian levels, with or without Bayesian revision, are very problematic, seemingly at odds with the known chronology for the earlier Upper Palaeolithic of France. If the TL dates were to be accepted, this would mean that the same cultural sequence occurred in Charente-Maritime as it did 200–300 km farther south, but each stage thereof happened several millennia later, an unlikely scenario. The best chronometric dating for the Châtelperronian of Saint-Césaire is provided by a newly published ^{14}C date on a sample of the tibia of the Neanderthal skeleton itself, which comes from Level 8 (Hublin et al. 2012: 18745, Table 1):

- OxA-18099 36,200±750 ^{14}C yrs BP.

The central value of this date when calibrated by INTCAL09 is ca. 41,400 cal yrs BP, more than a millennium before the extreme cold of Heinrich Event 4, which is probably associated with the Early Aurignacian of Level 4 at Saint-Césaire. As Hublin et al. remark (2012: 18745), the one-sigma range of this date, between 41,950 and 40,660 cal yrs BP, "...corresponds to the transition from CP [Châtelperronian] to later CP at the Grotte du Renne...". In other words, the Level 8 Neanderthal of Saint-Césaire is considered to predate Level VIII at the Grotte du Renne and Level D at the Grotte du Bison (as discussed below).

In attempting to understand the wider chronological context of the Châtelperronian at Les Tambourets, one of the most important other sites to consider is la Grande Roche de la Plématrie at **Quinçay** (Vienne, France), some 100km to the northeast of Saint-Césaire (Lévêque 1993; Lévêque and Miskovsky 1983; Roussel 2012; Roussel and Soressi 2010). There is at Quinçay a long sequence of Châtelperronian occupations overlying a level of Mousterian of Acheulian Tradition, Type B (Roussel and Soressi 2010: 207–208), and although there is no chronometric dating, rich paleoenvironmental data permit its placement within OIS3 to be specified with considerable confidence (Leroyer 1990; Lévêque and Miskovsky 1983). A *lower series*, ca. 90cm thick, contained the Mousterian (Level Egc) and the earlier Châtelperronian archaeological levels (Levels Egf and En). It was composed for the most part of fine-grained sediments that had accumulated and weathered in place during times of warmer temperate conditions. There was greater humidity at the start and again at the end of the series. The overall characteristics of the sediments and their internal variation permitted their temporal assignment to the "Würm II/III interstadial" (Lévêque and Miskovsky 1983: 375). The analysis of the pollen produced a similar conclusion—rather temperate conditions suggesting the "oscillation of Les Cottés" (Leroyer 1990: 51). Leroyer pointed out that there were some clear similarities between this part of the sequence at Quinçay and the part of the climatic sequence at Les Tambourets in levels *below* the archaeological level, but she could not suggest a detailed correlation (1990: 51–52). The *upper series* contained several later Châtelperronian horizons, including two in which were found perforated animal teeth (Granger and Lévêque 1997; Roussel 2011: 19–20). This series started with an episode of major sheetwash (*ruissellement*) in Level Emj, followed immediately in Level Emf by a very cold, dry climate, with abundant evidence of frost weathering (frost-riven plaquettes, etc.). At the top of Level Em, there was a brief temperate and humid episode (Level Emo), followed by a return of the very cold, dry conditions (Level Ej). The sediments of this upper series are considered to represent the "Würm IIIa", the first major cold of the Würm III (Lévêque and Miskovsky 1983: 376).

The climatic sequence associated with the initial Upper Palaeolithic at Quinçay is a familiar one—variable but generally temperate ("interstadial") conditions are succeeded by a rigorously cold, dry climate. At several other sites considered, the archaeological succession proceeded from Châtelperronian (temperate), to Proto-Aurignacian (variable), to Early Aurignacian (cold, dry). At Quinçay, however, the Châtelperronian is the only representative of the Upper Palaeolithic that is found throughout these significant changes in climate. In a study of sites of this time period in the region of Poitou-Charentes, Lévêque (1993: 282) emphasized this difference. He pointed out that there are four sites in the region where the first real cold of the "Würm III" is represented by cryoclastic *éboulis* layers. At three of these sites—Saint-Césaire, La Quina, and Les Cottés—it is the Early Aurignacian (*Aurignacien ancien*) that is found in these *éboulis*, but at Quinçay, it is still the Châtelperronian. This, then, is a major difference, and the upper series at Quinçay contains materials from *late* Châtelperronian occupations, which lasted into the extreme climate of what is almost certainly Heinrich Event 4.

About 40km ENE of Quinçay, in the valley of the Gartempe River, is the site of **Les Cottés** (Saint-Pierre-de-Maillé, Vienne), which has become of increasing importance in contributing to our understanding of the Châtelperronian. Discovered in the late 19th century, the site became well known because of Louis Pradel's excavations in the mid-20th century (Pradel 1961, 1967). Pradel reported a sequence of Mousterian, an "evolved" Châtelperronian that he called Perigordian II, and several varieties of Aurignacian. Both faunal analysis and palynology were associated with Pradel's work. The macrofauna of the Châtelperronian level was characterized by Bouchud (1961: 268–269) as indicating the onset of a cooler, drier, steppic climate following an earlier temperate and humid one. The pollen analysis by Bastin identified a pronounced temperate interval, which he designated the Cottés Interstadial, just beneath the Châtelperronian level, during which a less temperate climate became established (Bastin et al. 1976).[4]

A new phase of research at Les Cottés began in 2006 under the general direction of Marie Soressi (Soressi et al. 2010; Talamo et al. 2012). The stratigraphic sequence reported included the following archaeological levels:

- Unit 02 Final Early Aurignacian
- Unit 04-Upper Early Aurignacian
- Unit 04-Lower Protoaurignacian
- Unit 06 Châtelperronian
- Unit 08 Mousterian

A series of new AMS radiocarbon dates included four non-outlier dates for the Châtelperronian of Unit 06 (Talamo et al. 2012: 179, Table 4):

- MAMS-10803: 38,540±270 ^{14}C yrs BP
- EVA-11/OxA-V-2381-53: 36,230±210 ^{14}C yrs BP
- EVA-12/OxA-V-2382-45/MAMS-10823: 37,360±610 ^{14}C yrs BP
- EVA-13/OxA-V-2382-46/MAMS-10824: 38,100±210 ^{14}C yrs BP

Calibrating these dates using a Baysian model and both OxCal 4.1 (Bronk Ramsey 2009) and INTCAL09 (Reimer et al. 2009) produces ages for the Châtelperronian of Les Cottés between ca. 43,000 and 42,000 cal yrs BP. This time span, well before the start of the Heinrich Event 4 cold, shows that despite the previously used description of "evolved" Châtelperronian, Unit 06 at Les Cottés is not a late or recent Châtelperronian. Indeed, the new dating framework shows that it is both the Protoaurignacian of Unit 04-Lower and the Early Aurignacian of Unit 04-Upper that belong in the HE4 cold. It will be remembered that sometime during the more than a millennium of HE4, the site of Quinçay, less than 50km distant from Les Cottés, was still occupied by people making Châtelperronian artifacts.

Just over 200km northeast of Les Cottés lies another Châtelperronian site that is well known not only for its artifacts, but also for some fragmentary Neanderthal skeletal remains. The latest Châtelperronian level at the **Grotte du Renne** (Arcy-sur-Cure), Level VIII, may be another example of a late Châtelperronian occupation lasting into the time of a major cold, of about the same age as Early Aurignacian occupations elsewhere in France. The geochronological placement of Level VIII was suggested first by the palynological analyses of Arlette Leroi-Gourhan (1964). Following a more temperate interval in the latest Mousterian, the Châtelperronian occupations of Levels X and IX occurred during times of fluctuating but generally cold climate, reaching the most extreme cold in Level VIII (1964: 11). The extreme cold of Level VIII was detected as well in the sedimentological analysis of Miskovsky (Lévêque and Miskovsky 1983: 384). It was well understood in some of this early literature that the severe cold of the latest Châtelperronian at the Grotte du Renne was the same cold in which the Early Aurignacian was found at most other sites in France, the exception being the latest Châtelperronian occupations at Quinçay (Leroyer 1988: 104; Leroyer and Ar. Leroi-Gourhan 1983: 43; Lévêque and Miskovsky 1983: 384, 389). Some of the interpretations of the pollen sequence at the Grotte du Renne have been contested (d'Errico and Sanchez Goñi 2003: 772–773), but what has been questioned is the identification of temperate "interstadials." The reality of the extreme cold during the final Châtelperronian of Level VIII has not been challenged.

Because the importance of the Grotte du Renne was recognized from the earliest days of radiocarbon dating, numerous ^{14}C dates have been produced by several laboratories during the past half-century. It is unfortunately the case, however, that a clear and agreed-upon chronology for the site still does not exist. The first dates produced were run on aggregate samples of burnt bone (F. David et al. 2001: 226), producing generally inconsistent results. AMS dates run during the 1980s and 1990s did not remove the chronological uncertainties (F. David et al. 2001: 227–228). Recently a series of 31 new AMS dates were produced from samples of humanly modified bone, tooth, and ivory by the Oxford lab and interpreted using Baysian modeling (Higham et al. 2010). As a result of this project, the Oxford researchers concluded that "...material from several different contexts has moved both up and down the stratigraphic sequence into the Châtelperronian levels (2010: 20239), implying that none of the organic objects used as samples for ^{14}C dating can be assumed to have a securely known stratigraphic context. The conclusions of the Oxford study and, in particular, the methodologies used to produce them were challenged and vigorously rejected by a group of scholars from France and Spain (Caron et al. 2011; Zilhâo et al. 2011) and just as firmly restated and retained by Higham and others in the United Kingdom (Higham, Brock, et al. 2011a, 2011b).

Yet another series of dates was produced even more recently at the Max Planck Institute for Evolutionary Anthropology in Leipzig. A series of 31 newly chosen samples of unworked and unmodified bone (faunal refuse) from Châtelperronian levels was used to produce AMS dates after sample preparation that included ultrafiltration (Hublin et al. 2012: 18744). The resulting dates were calibrated with INTCAL09 and interpreted with a Baysian model (but a different one from that used by Higham et al. [2010]). These results were a further challenge to the 2010 Oxford study. The Leipzig study concluded that significant mixture within the Châtelperronian levels or between them and the overlying Protoaurignacian was "unlikely". Hublin et al. suggested instead that the humanly modified organic samples used for the OxA dates "...may at times have biased the sampling toward poorly preserved bones" (2012: 18747).

What is of particular relevance to the present attempt to determine the more general context of the Châtelperronian at Les Tambourets is the chronometric dating, if any, of Level VIII at the Grotte du Renne. Two radiocarbon dates that were part of the original, pre-1960 attempt to develop a chronology for the Grotte du Renne are of interest here:

- GrN-1736: 33,720±412 ^{14}C yrs BP[5]; and,
- GrN-1742: 33,860±250 ^{14}C yrs BP (Vogel and Waterbolk 1963: 164; Higham et al. 2010, Figure S1).

When the INTCAL09 calibration (Reimer et al. 2009) is applied, these dates are approximately 38,690 cal BP and 38,740 cal BP, respectively. The calibrated dates fall well within the temporal span of the Heinrich Event 4, in agreement with the signals of severe cold reported from both the pollen and the sediments. However, the recent Oxford study (Higham et al. 2010) produced new AMS dates for Level VIII. As interpreted using both INTCAL09 and Baysian modeling, the three dates in question (OxA-21,573, OxA-21,683, and OxA-X-2279-14) place Level VIII between ca. 40,000 and 43,000 cal yrs BP, clearly before Heinrich Event 4 (2010: 20238, Figure 2, and Figure S2). The Leipzig dates on Level VIII (EVA-52, -53, -54, -55, and -56) fall in the same general time span as the OxA dates—ca. 41,600 to 40,600 cal yrs BP for the 1-sigma range and ca. 41,800 to 40,000 for the 2-sigma range (Dateset S1 in the on-line Supporting Information accompanying Hublin et al. 2012). The Oxford and Leipzig dates, produced using ultrafiltration of the samples, ought to be more nearly accurate than the dates run in the mid-20th century, but they would appear to fit poorly with what is known of the paleoenvironmental conditions.[6]

The context of the Châtelperronian at Arcy-sur-Cure is at least partially clarified by results of the recent work at the **Grotte du Bison** (F. David et al. 2006; F. David et al. 2009; Enloe and F. David 2010), which is directly adjacent to the Grotte du Renne. A late Châtelperronian level, Level D, contains materials from the same series of occupations as Level VIII at the Grotte du Renne. Indeed, for part of the time span in question, the sediments of Level D (Bison) and Level VIII (Renne) were physically continuous from the one cavity to the other through openings in the thin rock wall between them (F. David et al. 2006: 15, Figure 8). Sedimentological analyses of Level D by Miskovsky (in F. David et al. 2006: 16–19) showed that Level D accumulated during a time of cold, dry climate following a more temperate interval. The pollen of Level D, analyzed by Girard (in F. David et al. 2006: 19–23), indicate a cold, dry, steppic vegetation community.

Two radiocarbon dates have been published for Level D at the Grotte du Bison (F. David et al. 2006: 28; Enloe and F. David 2010):

- Beta-180086: 33,670±450 ^{14}C yrs BP
- OxA-8091/Lyon-742: 34,050±750 ^{14}C yrs BP.

These dates are identical within the error ranges, and their central values are equivalent to between ca. 38,650 and 38,850 cal yrs BP when calibrated by INTCAL09. This dating falls directly within the time span of Heinrich Event 4, an age consistent with the cold, dry climate indicated by both the sediments and the pollen. This consistency is particularly important because of the undoubted contemporaneity of Level D with Level VIII at the Grotte du Renne, which accumulated during a time of extreme cold. The context of a late Châtelperronian at Arcy-sur-Cure is very helpfully clarified by the recent work at the Grotte du Bison.

The eponymous site for the Châtelperronian is the **Grotte des Fées at Châtelperron** (Allier, France) (Delporte 1957), located on the northern flank of the Massif Central about 150km to the south of the Grotte du Renne. The collapsed cave or rockshelter was first excavated in the mid-19th century (summarized by Delporte 1957: 452–456; Zilhão et al. 2008: 4–7), and Delporte's mid-20th-century excavations encountered, to some extent, the backdirt from these early excavations. Questions about the location and extent of such backdirt in relation to the stratigraphic succession reported by Delporte are at the root of an extensive and exceptionally acerbic published controversy (*in order of publication:* Gravina et al. 2005; Zilhão et al. 2006; Mellars et al. 2007; Zilhão et al. 2007; Zilhão et al. 2008; Mellars and Gravina 2008). The only elements of the controversy to be discussed here concern the dating of the initial Upper Palaeolithic at the site.

Delporte (1957: 456–457) reported five main levels (*niveaux principaux*) of Châtelperronian, B5 at the bottom through B1 at the top, overlying poorly differentiated Mousterian levels (C3-C1). A small number of characteristically Early Aurignacian (cf. Aurignacian I) tools made on a different and allochthonous lithic material occurred in the Châtelperronian levels, mostly in Level 4 and its basal component, Level 4a (1957: 472; Zilhão et al. 2006: 12646, Table 4). It is agreed by both sides in the dispute that Level B5, the main and earliest Châtelperronian level recognized by Delporte, was—at least in some areas—*in situ* when he excavated it. Consequently, three AMS ^{14}C dates run recently on museum-curated faunal fragments excavated by Delporte are generally accepted as providing good estimates of the age of the earliest Châtelperronian at the site (Gravina et al. 2005). As calibrated by the Oxford lab producing the dates, this age would be between 43,000 and 42,000 cal yrs BP (2005: 54 and 55, Figure 5), well before Heinrich Event 4 and quite in line with other Châtelperronian sites discussed above. However, the IntCal09 calibration, which is what has been used in this chapter, would make the age range about 1000 years earlier, with a central value of ca. 44,500 cal yrs BP. Such an age seems anomalously early for the Châtelperronian, as discussed below in Section V of this chapter.

The disagreement between the two interpretations of the Grotte des Fées concerns Levels 4, 3, 2, and 1. Two AMS ^{14}C dates exist on bones from Level 4. One date (OxA-14319; Gravina et al. 2005: 54, Table 1) would have a range of ca. 44,000 to 43,600 cal yrs BP as calibrated by IntCal09, just in the range of the Level 5 dates. The other Level 4 date (OxA-14318; Gravina et al. 2005: 54, Table 1) is, however, much younger, calibrating by IntCal09 to a range of ca. 41,000 to 40,500 cal yrs BP. This is well within the range of seven dates from bones with a combined (undifferentiated) "Levels B1-B3" attribution. Mellars and his co-authors (Gravina et al. 2005: 54; Mellars and Gravina 2008: 58) see the time span between these two Level B4 dates as a time when people (modern humans) making Early Aurignacian artifacts paid one or several sporadic and brief visits to the site, presumably while the Châtelperronian artificers were absent. After this, Châtelperronian occupation of the site continued, resulting in the archaeological materials in Levels B3 to B1. Zilhão and his colleagues (Zilhão et al. 2008) believe: a) that Delporte's Levels B1 to B3 are, in their entirety, backdirt from the 19th-century excavations; b) that this is true, at least in part, for Level B4; c) that the Aurignacian artifacts were deposited originally on a surface destroyed by the 19th-century excavations and, unrecognized by the early excavator, were incorporated in the backdirt of those excavations; and, d) that they were re-excavated by Delporte, who was digging, unwittingly, in backdirt.

Both sides in the dispute have advanced detailed chains of argument in support of their position, but it is unlikely that *definitive* answers to the questions about the stratigraphy of the site can be obtained at this late date, particularly in the absence of modern paleoenvironmental data. A possible problem for the "*in situ*" interpretation is that the postulated interstratification at a bit older than 40,000 BP involves the Early Aurignacian rather than the chronologically more probable Proto-Aurignacian. However, this is not impossible; as shown by the data of Zilhão et al. (2008: 24, Figure 20), there are some "Aurignacian I" occupations in southwestern France whose ^{14}C dates may be located in this time range (depending on how they are calibrated). In addition, the Early Aurignacian ("Aurignacian I") sequence at the abri Pataud (Les Eyzies, Dordogne) is now known to have begun "...during the millennium prior to 40,000 cal BP" (Higham, Jacobi, et al. 2011: 561). Interstratification of Châtelperronian and Early Aurignacian at the Grotte des

Fées is chronologically possible *if* the Châtelperronian artifacts in Levels B1-B3 are *in situ*. A major problem for the "backdirt" interpretation is the fact that all seven of the bones from B1-B3 producing finite dates have ages in the range of or younger than the younger sample from Level B4, and none reflect the greater ages of the lower Châtelperronian levels that would have contributed in some measure to the postulated backdirt. Such pronounced sampling error is not impossible, but invoking it weakens the argument.

What can be said with certainty about the Grotte des Fées is that the principal Châtelperronian occupation, in Level B5, took place well before Heinrich Event 4. What happened later at the site cannot be known with certainty. There was, without doubt, a brief Early Aurignacian presence at the site, but its relationship to the Châtelperronian, which was somewhat unclear to Delporte in the 1950s, remains unclear today. If the new ^{14}C dates from bones in Levels B1-B3 date *in situ* Châtelperronian occupations, this is a late Châtelperronian, at least partially contemporaneous with that of Quinçay.

The site of **Roc de Combe** (Nadaillac, Lot, France), in the classic region of Périgord, may have a Châtelperronian occupation dated by AMS ^{14}C. The stratigraphic sequence originally reported for this site (Bordes and Labrot 1967) has been significantly reinterpreted by later analysis of the materials recovered (J.-G. Bordes 2002, 2006). As a result, the Oxford AMS dates on Level 10 (OxA-1264 and OxA-1443), putatively the earliest Châtelperronian level, must be disregarded because "...levels 9 and 10 were defined through a post-excavation selection of objects coming from a disturbed part of the site: they are not valid analytical units..." (J.-G. Bordes 2006: 151). The assumption here is that the bone samples dated *might* have come from a Châtelperronian occupation, or they might be of either Mousterian or Aurignacian provenience. New samples were chosen from Level 8, regarded as undoubtedly Châtelperronian, and these samples came from the rear of the shelter, where problems of mixture of materials from overlying or underlying levels were considered to be minimal (but *not* absent). Three dates have been published, GifA-101264, -101265, and -101266 (J.-G. Bordes 2002: 95). The central value of the oldest of the three (GifA-101265) is ca. 48,500 BP when calibrated by IntCal09, and the possibility has been raised (2002: 96) that this sample represents contamination from the underlying Mousterian. The other two dates, very similar to one another, have calibrated central values of ca. 44,000 BP. These are anomalously early dates for the Châtelperronian, as noted by J.-G. Bordes (2002: 96), similar only to those from Level 5 at the Grotte des Fées. It must be remembered that all three samples providing the recently run dates come from a level, Level 8, reported to contain some Mousterian artifacts considered to be evidence of mixture (2002: 94).

Another site in the Périgord is **Grotte XVI** (Cénac-et-Saint-Julien, Dordogne, France). The older of two finite dates for Level B, the Châtelperronian level at the site, is:

- AA2997 38,100±1670 ^{14}C yrs BP (Lucas et al. 2003: 291).

The central value of this date, calibrated by IntCal, is ca. 42,550 cal yrs BP. The implication of these dates is that the Châtelperronian would be well before Heinrich Event 4, well before the Early Aurignacian (*Aurignacien ancien*) occupations as known from sites in the Périgord.

And finally, as noted above in the discussion of the late Mousterian of **Le Moustier** (Dordogne, France), Level K in the lower shelter has sometimes been designated as Châtelperronian. However, the artifacts attributed to this level are so heterogeneous typologically and so damaged by post-depositional alternation (Harrold 1978: 220–221; de Sonneville-Bordes 1960: 163–164; Valladas et al. 1986: 452–453) that it is by no means clear what is being dated by the TL dates on three burnt flints from that level. The weighted mean age of these determinations is 42,600±3200 yrs BP (1986: 453, Table 2). Although this is a possible age for a Châtelperronian occupation, it cannot prudently be accepted as such in light of the strong doubts about the archaeological integrity of Level K, and it is not considered further here. (The program of ESR dating at Le Moustier [Mellars and Grün 1991] did not produce dates for Level K.)

V. SUMMARY OF CHRONOLOGY

With the brief review of some relevant OIS3 sites in southwestern Europe having been done, the broad context of the Châtelperronian at Les Tambourets can be summarized as follows:

- Late Mousterian (MTA-B) occupations in the region took place during a time of fluctuating climatic phases. Temperature varied from cold to temperate, usually humid, but with occasional cooler, drier episodes. These latest Mousterian occupations can be dated very broadly to no later than between ca. 43,000 and 41,000 calendar years BP (it is probable that all chronometric dates so far available for MTA-B are at least somewhat too young).
- Almost all Châtelperronian occupations at the sites surveyed here took place during humid warm or temperate climates, most often described by the analysts as "interstadial." Exceptions to this situation occur: a) for Level 8 at Saint-Césaire, which represents the transition to a colder, very humid environment; b) for the upper series at Quinçay, which represents an extended period of very cold, very dry climate briefly interrupted by a more temperate and humid interval; and, c) for Level VIII at the Grotte du Renne and the contemporaneous Level D at the Grotte du Bison, which together represent a very cold, dry climate. Chronometric dates for the Châtelperronian fall generally in a 6000-year span from ca. 44,500 to 38,500 cal yrs BP. This is almost certainly too long. The first two millennia of this span, from ca. 44,500 to ca. 42,500 BP, are represented primarily from the calibrated ^{14}C dates from the Grotte des Fées and Roc de Combe. These dates were characterized above as "anomalous,"

primarily because such an age would seem to create an awkward overlap with the latest Mousterian of Acheulian Tradition. The true duration of the Châtelperronian is probably much closer to the ca. 4150 years estimated by Mellars and French (2011: 624, Figure 2B).

- The environment of the Proto-Aurignacian (Archaic Aurignacian, Fumanian) occupations in the region under consideration is generally described as fluctuating warmer and cooler, or progressively cooling. Only two sites in our sample have chronometric dates; a 1000-year range between ca. 42,000 and 41,000 BP seems to be indicated, but this is probably the center of a somewhat longer span. As noted earlier, recent dating of what has been called Protoaurignacian at Les Cottés places it between ca. 40,000 and 39,000 cal yrs BP, within Heinrich Event 4 and just slightly older than the Early Aurignacian at the same site (Talamo et al. 2012: 182, Figure 5). If this is the same archaeological phenomenon as what has been called Protoaurignacian farther south and east, it is anomalously late here in the north.
- Early Aurignacian (Aurignacian I) occupations throughout the region are associated with the rapid onset of extremely cold, dry conditions, which are certainly the climatic expression of Heinrich Event 4, the start of which is firmly dated in the Greenland ice-core chronology to ca. 40,000 BP. Although not included in our sample, a number of sites in the region have calibrated AMS ^{14}C dates that confirm this age for the earliest Early Aurignacian—for example, recently published dates for Level 14 at the abri Pataud (Les Eyzies, Dordogne), the beginning of the long Aurignacian sequence at that site. As summarized by Higham and his colleagues (Higham, Jacobi, et al. 2011: 561), "...occupation at the Abri Pataud began during the millennium prior to 40,000 cal BP" and continued through the Heinrich Event 4.
- The specification of chronometric age ranges in the four paragraphs above, shows what appear to be overlaps or contemporaneities between and among the tool-making traditions discussed. To some extent, this results from the fact that chronometric dates are stated only probabilistically as a temporal range within which the true age of the sample is considered to lie. As a result, the range of two samples, archaeological levels, or groups whose actual ages are in fact different may well overlap. This is part of the explanation for the apparent overlap between latest Mousterian (MTA-B) and early Châtelperronian. Another reason for this particular overlap may have to do with sample designation when a line is drawn, more or less arbitrarily, through a developmental continuum. It is more meaningful to think of the MTA-B-to-early-Châtelperronian continuum as occurring between ca. 44,000 and 41,000 BP.
- The partial contemporaneity of the Châtelperronian and the Proto-Aurignacian requires a different kind of explanation. There is here no developmental continuum; the Proto-Aurignacian did not develop from the Châtelperronian (Roussel 2013). Both the chronometric dates and the paleoenvironmental data suggest that the earliest Proto-Aurignacian occupations in northwestern Spain and southwestern France occurred at a time when the earliest Châtelperronian, or perhaps the latest MTA-B, was already present in the area (although Proto-Aurignacian/Fumanian occupations are earlier farther east). Thereafter, for at least a millennium, the two tool-making traditions were truly contemporaneous—but, on present evidence, *without* interstratification at any one site.
- The temporal overlap between the late Châtelperronian and the early Early Aurignacian is demonstrated by paleoenvironmental information from Quinçay and the two sites at Arcy-sur-Cure. There is no reason to doubt the assignment of Quinçay's upper series to Heinrich Event 4, and the chronometric dating of Level D at the Grotte du Bison is supporting evidence. As noted above, the frost-weathered sediments of the upper series at Quinçay are interrupted by a thin level, Level Emo, representing a brief temperate, humid episode. This is of interest because both the GISP2 (d'Errico and Sánchez Goñi 2003: 778, Figure 2) and NorthGRIP (Svensson et al. 2008: 49, Figure 3) versions of the Greenland ice-core climatic record show a minor and short-lived "blip" of less severe cold within HE4. The same "blip" within HE4 is found in the pollen record of marine cores in both the Atlantic off Portugal and the Mediterranean off Spain, where they show up as short-lived episodes of greater humidity (d'Errico and Sánchez Goñi 2003: 778, Figure 2). Whether or not Level Emo at Quinçay registers the HE4 "blip," the broad contemporaneity of Châtelperronian and Early Aurignacian at the beginning of HE4 is clear.
- Although the Châtelperronian overlaps temporally with both the Proto-Aurignacian and the Early Aurignacian, there is only one possible (and sharply disputed) example of within-site interstratification currently known—the troublesome case of the Grotte des Fées. Furthermore, there is no between-site interstratification either—no cases, for example, where at one site Proto-Aurignacian overlies Châtelperronian, whereas at another site this stratigraphic order is reversed. Zilhão et al. (2008: 39) discuss the general question in terms of "...the ebb and flow of the frontier between Neandertals and moderns." While assuming that encounters must have occurred, they conclude "...that such situations of territory interdigitation would have been much shorter than required for the geological re-

cord of caves and rock shelters to have preserved them as distinct interstratifications...". It is also the case that "contemporaneity" must not be understood too literally. Neither geochronology nor chronometric dating can provide more than very broad-brush temporal resolution.

- Although a typological/technological comparison of the Châtelperronian of Les Tambourets with assemblage samples from other Châtelperronian sites was not part of this present study or that of Scandiuzzi (2008), the results of a primarily technological comparison were reported by Guilbaud (1993). Guilbaud studied materials from Level 8 (EjopSup) at Saint-Césaire, Level En at Quinçay, and material from Area 3 at Les Tambourets. He found (1993: 49) that what he called the "Mousterioid" theme of blank production, which is prominent at Saint-Césaire, is "rare or less characteristic" at both Les Tambourets and Quinçay. His general conclusion (1993: 55, note 12) was that "...the Castelperronian assemblages of Les Tambourets and Quinçay (EN) are technologically more specialized in the direction of the Upper Palaeolithic than the Castelperronian of Saint-Césaire." He expressed agreement with the previously stated conclusion of †Méroc and Bricker (1984: 71) that Les Tambourets has an "evolved" Châtelperronian clearly differentiated from the Mousterian.
- The review of relevant Mousterian, Châtelperronian, and Aurignacian sites in the preceding pages emphasizes the fact that cultural chronology in the Palaeolithic cannot be based on chronometric dating (^{14}C, TL, ESR, etc.) alone; it must be considered in conjunction with geochronology (sedimentology, palynology, paleontology) if the results are to be useful.

VI. AGE OF THE CHÂTELPERRONIAN AT LES TAMBOURETS

At the beginning of this chapter, it was stated that the geochronological study of Les Tambourets, carried out several decades ago, concluded that the Châtelperronian archaeological level dated to the first real cold of the Würm III. The terminology of this statement is no longer in use, but we can now recognize "the first real cold of the Würm III" as Heinrich Event 4 in OIS3. **The lower centimeters of the couche B loess body at Les Tambourets, containing Archaeological Level 1, accumulated early in HE4, at or shortly after 40,000 calendar years ago.** Within couche B, but above Archaeological Level 1, there is a thin, more clay-rich sediment zone that represents a brief time of milder, more humid climate preceding the resumption of severely cold, dry conditions. This brief climatic amelioration, reminiscent of Level Emo at Quinçay, may well register the "blip" within HE4 discussed above.

In a wider regional context, **Les Tambourets is a late Châtelperronian site**, postdating by about two millennia the earliest Proto-Aurignacian occupations in southwestern Europe and postdating by even longer the earliest Châtelperronian sites. The only other Châtelperronian occupations that are now known to be as late as Les Tambourets are those of the upper series at Quinçay, which probably lasted even a bit later, Level D at the Grotte du Bison, and very probably Level VIII at the Grotte du Renne. **The Châtelperronian of Archaeological Level 1 at Les Tambourets is approximately contemporaneous with some classic Early Aurignacian (Aurignacian I) sites elsewhere in southwestern France.**[7]

ENDNOTES

1. Some authors prefer an alternative but equivalent terminology, Marine Isotope Stage 3 (MIS3).
2. Laville's reports do not contain the loan-word from the German, loess, employing instead the phrase "a silty deposit of aeolian origin" (*un dépôt limoneux d'origine éolienne*) (Laville et al. 1985 [=TDoc06]: 1137).
3. Recently published dates for Pech de l'Azé IV (McPherron et al. 2012) indicate that the latest MTA occupation in that part of the Pech de l'Azé locality ended somewhat earlier, at ca. 45,000 cal yrs BP.
4. Bastin's identification of an "interstadial" was disputed by d'Errico and Sánchez Goñi (2003: 772), who agreed that there had been a major warm phase, but they attributed it to an "interglacial," probably in OIS 5 more than 70,000 years ago. The new radiocarbon dating of the Mousterian level *preceding* the putative interstadial (Talamo et al. 2012: 182, Figure 5)—dating between ca. 43,000 and 46,000 cal yrs BP—is not consistent with this suggestion.
5. Radiocarbon date GrN-1736 appears in both Figure S1 and Table S1 of the on-line "Supporting Information" accompanying Higham et al. (2010). A footnote to Table S1 explains that this lab number was never assigned by the Groningen lab, and the type of sample for this date is listed in Table S1 as "not known". The answer to this apparent mystery can be found by consulting Movius (1960) and Vogel and Waterbolk (1963). Both this date and the one for GrN-1742 consisted of "charcoal and ash from hearth in Level VIII" (Movius 1960: 366). Both were reported in advance of formal publication as "GRO" dates before Groningen corrected its previously run dates for the Suess effect. Both dates were run between October 1958 and April 1959. The appropriate correction for dates run during these months produces a GrN date, as follows (Vogel and Waterbolk 1963: 164): Grn-1736 33,720±412 ^{14}C yrs BP. The other date, GrN-1742, was published *with* the correction.
6. This is a conflict that needs to be explained rather than just ignored. Where is the major cold episode that is the local manifestation of Heinrich Event 4 in the Grotte du Renne sequence? Do the Level VIII samples used by Oxford and Leipzig come from low enough in that level to have preceded the maximum cold? These are questions not answered in the existing literature.
7. Les Tambourets provides an example of a situation anticipated a decade ago by d'Errico and Sánchez Goñi (2003: 781), who wrote: "If a short overlap between the two technocomplexes [Châtelperronian and Aurignacian] did occur, which is difficult to affirm on the basis of available evidence, it probably took place just before or within the first part of the H4 event."

CHAPTER 3
OVERVIEW OF ASSEMBLAGE SAMPLES

The following chapters of this monograph examine in detail the technological and typological characteristics of the individual categories of stone tools found at Les Tambourets (scrapers, burins, etc.) and the by-products of their manufacture. This chapter presents, by way of introduction, a broad overview of *all* the archaeological materials recovered during the excavations of 1973, 1975, and 1980. In addition, the inventory of retouched tools in the principal archaeological horizon, Archaeological Level 1, is compared with the inventories of the four largest components of the Méroc surface collection from Les Tambourets, previously reported in detail by †Méroc and Bricker (1984). The overview consists of a series of tables and comments on them.

Most of the objects recovered in all stratigraphic units are objects of flint or some similar cryptocrystalline rock (Table 3-1). These are the artifacts dealt with in Chapters 4 through 11 of this report. There are also a few undoubted tools made of stone other than flint; those in Archaeological Level 1 are discussed in Chapter 13. Because the refuse from the Châtelperronian occupations is enclosed within a loess body, with an aeolian mode of primary deposition, cobble-sized inclusions are most plausibly regarded as manuports. Some of these are freshly broken cobble fragments ("cracked cobbles"), the fracturing of which may have resulted from human action (for example, heating in a fire). Whatever may be the explanation for the high frequency of cracked cobbles in couche B(Upper), which may be intrusive from Holocene disturbances, any human activity involved occurred well after the Châtelperronian occupations.

No faunal remains were found in any excavated unit (see Table 3-1), the weakly acidic nature of the enclosing loess having precluded the preservation of such material.[1] A few ceramic fragments were found within Archaeological Level 1 or immediately below it in couche C. Their presence results doubtless from the tunneling activities of moles (observed frequently during the excavation seasons) or other burrowing animals. The great majority of the ceramics recovered in excavation were in couche B(Upper), where they result from Holocene disturbance (like many of the cracked cobbles), and the Ditch Fill unit. All were either small eroded potsherds or fragments of brick or tile. Very similar material in the Méroc surface collections was identified in 1978 with the help of MM Michel Vidal and André Muller, specialists in the archaeology of the region, as being of four kinds (†Méroc and Bricker 1984: 66-67):

- tile and brick from the period of Roman occupation of the region, the first century BC to the fifth century AD;
- various sherds of Medieval pottery, from the 11th to the 15th centuries AD;
- clay pipe fragments, from the 17th or 18th centuries; and,
- glass bottle fragments, probably from the 20th century.

Between 20% and 30% of all flint artifacts in the stratigraphic units of the Main Area and adjacent test pits (excluding the Alpha Complex) are retouched tools (Table 3-2a). Except for miscellaneously retouched pieces, dis-

Table 3-1. Inventory of objects recovered by excavation in the stratigraphic units below the plough zone in Areas 3 and 2 at Les Tambourets.

	AREA 3										AREA 2	
	Main Area + TPs					*Alpha Complex Scatters*					*TP 2E1*	
	A.L.1	C.B (Up)	C.B (Bas)	C.C	Ditch Fill	Very High	High	Main	Below Main	C.C	Str. II	Str. III
Flint objects	4258	345	404	160	118	70	106	366	19	1	13	64
Nonflint stone tools	32	7	-	-	5	-	-	-	-	-	-	-
Manuports	157	69	18	8	39	-	8	15	5	-	-	-
Cracked cobbles	164	215	20	12	65	-	5	3	5	-	1	-
Ceramic fragments	3	31	-	2	11	1	-	-	-	-	3	-
Faunal remains	-	-	-	-	-	-	-	-	-	-	-	-
Totals	4614	667	442	182	238	71	119	384	29	1	17	64

Table 3-2. Inventory of flint artifacts in the stratigraphic units below the plough zone in Area 3 (excluding the Alpha Complex) at Les Tambourets. a: All flint artifacts; b: unretouched débitage products only.

a.

	Arch.Lev.1 n	Arch.Lev.1 %	c.B(Upper) n	c.B(Upper) %	c.B(Basal) n	c.B(Basal) %	couche C n	couche C %	Ditch Fill n	Ditch Fill %
Retouched tools	851	19.99	88	25.51	85	21.04	35	21.88	33	27.97
Nuclei	238	5.59	12	3.48	6	1.49	4	2.50	5	4.24
Unret.déb. products	3169	74.42	245	71.01	313	77.48	121	75.63	80	67.80
Totals	4258	100.00	345	100.00	404	100.01	160	100.01	118	100.01

b.

	Arch.Lev.1 n	Arch.Lev.1 %	c.B(Upper) n	c.B(Upper) %	c.B(Basal) n	c.B(Basal) %	couche C n	couche C %	Ditch Fill n	Ditch Fill %
Blades & spalls	540*	17.04	31*	12.65	55	17.57	18	14.88	8*	10.00
Flakes	2037	64.28	170	69.39	213	68.05	85	70.25	52	65.00
Chunks	592	18.68	44	17.96	45	14.38	18	14.88	20	25.00
Totals	3169	100.00	245	100.00	313	100.00	121	100.01	80	100.00

* sample includes 2 spalls

cussed in Chapter 9, these are the artifacts inventoried in terms of the de Sonneville-Bordes and Perrot type list (see below).[2] Most of the flint artifacts are, as expected in a habitation site, by-products of tool manufacture, either nuclei (ca. 6% in Archaeological Level 1) or waste flakes, blades, and chunks ("unretouched *débitage* products"). The latter, which are discussed in Chapter 11, are predominantly flakes in all units (Table 3-2b). In the Alpha Complex of Area 3, there are relatively fewer retouched tools and more unretouched *débitage* products (Table 3-3). The Main Scatter has just over 11% retouched tools compared with 20% in Archaeological Level 1, a significant difference.[3] It seems possible that the Alpha Complex, on the western margin of the site, was less of a regular occupation zone than the Main Area because the contemporary land surface in Alpha was somewhat more steeply sloping (compare Figures 1-8 and 1-14 in Chapter 1). The frequency of retouched tools in Stratum III of Area 2's Test Pit 2E1 (see Table 3-3), which contains what has been called Archaeological Level P, is very similar to that of Archaeological Level 1 farther upslope, in Area 3.

An inventory of the retouched flint tools in Palaeolithic assemblages needs to be reported in terms of some standard categories. For this chapter, the categories are the 92 "types" in the list constructed by de Sonneville-Bordes and Perrot (1954, 1955, 1956a, 1956b). This list was chosen not because it is necessarily the best typological scheme, but because it has been so widely used for more than half a century. There are more comparative data on the Western European Upper Palaeolithic published using this list than any other (for example, for the Châtelperronian, the studies of Harrold [1978] and Grayson and Cole [1998]). As used here, there is only one modification of the original list: Type 30 has been subdivided into Type 30-A, burin on a broken surface, and Type 30-B, burin on an unretouched edge or end of blank. Furthermore, the dihedral burin index (IBd) of de Sonneville-Bordes and Perrot, which includes Type 30, has been supplemented with a "restricted dihedral burin index" (IBd_r), which excludes both Types 30-A and 30-B.

The retouched tools excavated from Area 3 (excluding

Table 3-3.--Inventory of flint objects in the stratigraphic units below the plough zone in Areas 3 (Alpha Complex) and 2 at Les Tambourets. a: All flint artifacts; b: unretouched débitage products only.

a.

	AREA 3									AREA 2	
	Alpha Complex Scatters									*Test Pit 2E1*	
	Very High		High		Main		Below Mn.	c.C	Strat. II	Strat.III	
	n	%	n	%	n	%	n	n	n	n	%
Retouched tools	12	17.14	12	11.32	41	11.20	5	-	3	12	18.75
Nuclei	1	1.43	-	-	4	1.09	-	-	-	-	-
Unret.déb. products	57	81.43	94	88.68	321	87.70	14	1	10	52	81.25
Totals	70	100.00	106	100.00	366	99.99	19	1	13	64	100.00

b.

	AREA 3									AREA 2	
	Alpha Complex Scatters									*Test Pit 2E1*	
	Very High		High		Main		Below Mn.	c.C	Strat. II	Strat.III	
	n	%	n	%	n	%	n	n	n	n	%
Blades & spalls	10	17.54	23	24.47	56*	17.45	4	-	2	12	23.08
Flakes	43	75.44	64	68.09	250	77.88	8	1	4	36	69.23
Chunks	4	7.02	7	7.45	15	4.67	2	-	4	4	7.69
Totals	57	100.00	94	100.01	321	100.00	14	1	10	52	100.00

* sample includes 2 spalls

the Alpha Complex) are inventoried in Table 3-4.[4] Detailed study of the tools in Archaeological Level 1, grouped into broad morphofunctional classes, is reported in Chapters 4 to 9, but some general characteristics of the Châtelperronian of Les Tambourets are evident from the data of Table 3-4. Scrapers are somewhat more frequent than burins. Within the scraper class, side-scrapers (Type 77) and discoidal scrapers (Type 8) are well-represented.[5] Châtelperron points (Types 46 and 47) are present in all units except Ditch Fill. Splintered pieces (Type 76) are very frequent, and this is a genuine characteristic of the Châtelperronian at this site. Notched pieces (Type 74) and denticulate pieces (Type 75) are even more frequent, but these frequencies are at least partially misleading. Some, perhaps many, of the undoubted notches must represent accidental damage; this matter is discussed more fully in Chapter 9.

In the Alpha Complex of Area 3 and Test Pit 2E1 of Area 2 (Table 3-5), the retouched tools recovered (including Châtelperron points) are representative of the same Châtelperronian industry more abundantly sampled in the Main Area and adjacent test pits. Because of the very small sample sizes, nothing more can be said.

Palaeolithic objects collected from the surface by Louis Méroc over several decades are more numerous than those excavated between 1973 and 1980. The Méroc collection was discussed in detail in an earlier publication (†Méroc

Table 3-4.--Typological inventory of retouched flint tools in the stratigraphic units below the plough zone in Area 3 (excluding the Alpha Complex) at Les Tambourets; type numbers are those of de Sonneville-Bordes and Perrot (1954, 1955, 1956a, 1956b).

Type Number and Name	Arch. n	Level 1 %	c.B (Up) n	c.B (Bas) n	c.C n	Ditch Fill n
1. End-scraper	29	4.03	--	--	--	--
2. Atypical end-scraper	30	4.17	1	3	2	1
3. Double end-scraper	5	0.70	--	--	--	2
4. Ogival end-scraper	5	0.70	1	--	--	--
5. End-scraper on retouched	7	0.97	--	2	--	--
7. Fan-shaped end-scraper	2	0.28	--	--	--	--
8. Discoidal scraper	40	5.56	--	4	1	--
12. Atypical carinate scraper	10	1.39	--	2	--	--
14. Flat nose-shaped or shouldered scraper	--	--	1	2	--	--
15. Nucleiform scraper	5	0.70	--	--	--	--
16. *Rabot* or plane	5	0.70	--	--	--	--
17. End-scraper + burin	3	0.42	--	--	1	--
18. End-scraper + truncated piece	1	0.14	--	--	--	--
22. Perforator + burin	1	0.14	--	--	--	--
23. Perforator	4	0.56	--	1	--	--
24. *Bec* or atypical perforator	22	3.06	2	--	1	1
25. Multiple perforator or *bec*	2	0.28	--	1	--	--
26. Microperforator	--	--	1	2	--	--
27. Symmetrical dihedral burin	3	0.42	--	--	--	--
28. Asymmetrical dihedral burin	15	2.09	--	2	--	1
29. Transverse or transverse/oblique dihedral burin	22	3.06	--	--	1	--
30-A. Burin on a broken surface	6	0.83	1	--	--	--
30-B. Burin on an unretouched edge or end of blank	11	1.53	--	1	--	--
31. Multiple burin associating Types 27 to 30	7	0.97	--	--	--	--
35. Burin on a straight, oblique retouched truncation	4	0.56	1	--	--	--
36. Burin on a concave retouched truncation	5	0.70	1	1	1	--
37. Burin on a convex retouched truncation	1	0.14	--	--	--	--
38. Transverse burin on a straight or convex lateral truncation	2	0.28	--	--	--	--
40. Multiple burin associating Types 34 to 39	2	0.28	--	--	--	--

Table 3-4--page 2

Type Number and Name	Arch. Level 1 n	%	c.B (Up) n	c.B (Bas) n	c.C n	Ditch Fill n
41. Mixed multiple burin, Types 27-30 + Types 34-39	3	0.42	1	--	--	--
43. Nucleiform burin	12	1.67	--	--	--	--
44. Flat-faced burin	1	0.14	--	--	--	--
46. Châtelperron point	22	3.06	5	2	1	--
47. Atypical Châtelperron point	6	0.83	1	1	--	--
57. Shouldered piece	2	0.28	--	--	--	--
58. Completely backed blade	9	1.25	2	--	--	--
59. Partially backed blade	10	1.39	1	2	1	--
60. Piece with straight, right-angle truncation	11	1.53	1	1	1	--
61. Piece with straight, oblique truncation	16	2.23	--	1	--	1
62. Piece with concave truncation	15	2.09	1	3	1	2
63. Piece with convex truncation	11	1.53	--	1	--	1
64. Bitruncated piece	1	0.14	--	--	--	--
65. Piece with continuous retouch on one edge	38	5.29	7	4	1	2
66. Piece with continuous retouch on both edges	4	0.56	2	--	--	--
74. Notched piece	141	19.61	23	18	9	7
75. Denticulate piece	35	4.87	7	8	1	4
76. Splintered piece	77	10.71	7	5	2	--
77. Side-scraper	32	4.45	3	--	2	--
84. Truncated bladelet	--	--	--	--	--	1
88. Denticulate bladelet	1	0.14	--	--	--	--
89. Notched bladelet	1	0.14	--	--	--	--
92. Other tools, not included in Types 1-91	22	3.06	1	3	--	--
Totals	719	100.05	71	71	26	23

Scraper index (IG)	18.50
Aurignacian scraper index (IGa)	1.39
Perforator index (IP)	3.62
Burin index (IB)	13.07
Dihedral burin index (IBd)	8.90
Restricted dihedral burin index (IBd_r)	5.56
Truncation burin index (IBt)	1.67

and Bricker 1984). The typological inventories and indices for the Méroc material from Areas 1, 2, 3, and Tambourets-Terssac are reported here and compared with the total Archaeological Level 1 inventory (Table 3-6). Two results of the comparison are apparent. First, the Archaeological Level 1 material excavated from Area 3 is not identical in terms of tool-type frequencies to those in Méroc's surface-collected sample from Area 3. Archaeological Level 1 has significantly fewer scrapers, more perforators, more dihedral burins, and fewer truncation burins than Méroc's Area 3 series.[6] There is, thus, considerable lateral variation *within* one area of the site. Second, variation *among* areas is obviously present, but this is not easy to characterize on the basis of the 92 types.

In order to facilitate inter-areal comparisons, the typological variation was collapsed from the standard 92 types

Table 3-5.--Typological inventory of retouched flint tools in the stratigraphic units below the plough zone in the Alpha Complex of Area 3 and Test Pit 2E1 of Area 2 at Les Tambourets; type numbers are those of de Sonneville-Bordes and Perrot (1954, 1955, 1956a, 1956b).

	Alpha Complex Scatters				*TP 2E1*	
Type Number and Name	Very High n	High n	Main n	Below Main n	Str. II n	Str. III n
1. End-scraper	--	1	--	--	--	--
2. Atypical end-scraper	--	1	--	1	--	1
8. Discoidal scraper	--	--	--	--	1	--
14. Flat nose-shaped or shouldered scraper	--	--	1	--	--	--
23. Perforator	--	--	1	--	--	--
24. *Bec* or atypical perforator	1	--	--	--	--	--
28. Asymmetrical dihedral burin	1	--	1	--	--	--
36. Burin on a concave retouched truncation	--	--	1	--	--	--
37. Burin on a convex retouched truncation	--	--	1	--	--	--
46. Châtelperron point	1	2	--	--	--	1
58. Completely backed blade	1	1	--	--	--	1
59. Partially backed blade	1	--	3	--	--	--
60. Piece with straight, right-angle truncation	1	--	1	--	--	--
61. Piece with straight, oblique truncation	--	--	1	1	--	1
62. Piece with concave truncation	--	--	--	--	--	2
63. Piece with convex truncation	--	--	--	1	--	--
65. Piece with continuous retouch on one edge	--	1	4	--	--	1
66. Piece with continuous retouch on both edges	--	--	1	--	--	--
74. Notched piece	3	5	9	--	--	2
76. Splintered piece	--	--	3	--	--	1
84. Truncated bladelet	--	--	1	--	--	--
92. Other tools, not included in Types 1-91	--	--	1	--	--	--
Totals	9	11	29	3	1	10

into just 9 morphofunctional classes, as follows:

1.	Scrapers-A	Types 1–15
2.	Scrapers-B	Type 77
3.	Perforators	Types 23–26
4.	Burins	Types 27–44
5.	Denticulates	Type 75
6.	Splintered pieces	Type 76
7.	Backed tools	Types 45–49, 85–87
8.	Truncated pieces	Types 60–64, 84
9.	Marginally retouched pieces	Types 65–67

The totals for each class, expressed as an index, are shown for Archaeological Level 1 and the four principal parts of the Méroc collection in Table 3-7. These data were used for a weighted-pair cluster analysis,[7] with the results graphed as Figure 3-1. The clustering shows that, despite the differences mentioned in the previous paragraph, the excavated sample from Area 3 (that is, Archaeological Level 1) is more closely related to the surface collection from that area than those from other areas. The Area 3 materials (both samples) are most closely similar to those from Area 2, where-

Table 3-6.--Typological inventory of retouched flint tools in the Méroc surface collections from Area 1, 2, 3, and Tambourets-Terssac (data from Méroc and Bricker 1984:58-60, Tabl. II) compared with the excavated tools in Archaeological Level 1 of Area 3 (data from Table 3-4); type numbers are those of de Sonneville-Bordes and Perrot (1954, 1955, 1956a, 1956b).

	Méroc 1		Méroc 2		Méroc 3		Arch. Lev. 1		Méroc T-T	
Type Number and Name	n	%	n	%	n	%	n	%	n	%
1. End-scraper	8	1.67	20	2.11	25	3.82	29	4.03	4	0.84
2. Atypical end-scraper	23	4.79	73	7.71	53	8.10	30	4.17	25	5.25
3. Double end-scraper	1	0.21	4	0.42	8	1.22	5	0.70	2	0.42
4. Ogival end-scraper	5	1.04	10	1.06	11	1.68	5	0.70	7	1.47
5. End-scraper on retouched blade or flake	5	1.04	26	2.75	16	2.45	7	0.97	8	1.68
7. Fan-shaped end-scraper	2	0.42	8	0.84	3	0.46	2	0.28	2	0.42
8. Discoidal scraper	6	1.25	34	3.59	35	5.35	40	5.56	8	1.68
10. Thumbnail scraper	4	0.83	1	0.11	3	0.46	--	--	--	--
11. Carinate scraper	--	--	--	--	1	0.15	--	--	--	--
12. Atypical carinate scraper	--	--	2	0.21	2	0.31	10	1.39	1	0.21
13. Thick nose-shaped scraper	--	--	--	--	1	0.15	--	--	--	--
14. Flat nose-shaped or shouldered scraper	1	0.21	1	0.11	4	0.61	--	--	--	--
15. Nucleiform scraper	1	0.21	4	0.42	14	2.14	5	0.70	3	0.63
16. *Rabot* or plane	1	0.21	5	0.53	3	0.46	5	0.70	--	--
17. End-scraper + burin	2	0.42	7	0.74	9	1.38	3	0.42	3	0.63
18. End-scraper + truncated piece	--	--	4	0.42	1	0.15	1	0.14	1	0.21
19. Burin + truncated piece	1	0.21	5	0.53	4	0.61	--	--	--	--
21. Perforator + end-scraper	1	0.21	2	0.21	--	--	--	--	--	--
22. Perforator + burin	--	--	--	--	1	0.15	1	0.14	--	--
23. Perforator	3	0.63	3	0.32	--	--	4	0.56	3	0.63
24. *Bec* or atypical perforator	6	1.25	10	1.06	5	0.76	22	3.06	9	1.89
25. Multiple perforator or *bec*	--	--	2	0.21	--	--	2	0.28	1	0.21
27. Symmetrical dihedral burin	--	--	2	0.21	3	0.46	3	0.42	2	0.42
28. Asymmetrical dihedral burin	3	0.63	9	0.95	6	0.92	15	2.09	5	1.05
29. Transverse or transverse/ oblique dihedral burin	3	0.63	4	0.42	3	0.46	22	3.06	1	0.21

Table 3-6--page 2

Type Number and Name	Méroc 1 n	Méroc 1 %	Méroc 2 n	Méroc 2 %	Méroc 3 n	Méroc 3 %	Arch. Lev. 1 n	Arch. Lev. 1 %	Méroc T-T n	Méroc T-T %
30-A. Burin on a broken surface	3	0.63	11	1.16	5	0.76	6	0.83	1	0.21
30-B. Burin on an unretouched edge or end of blank	--	--	5	0.53	8	1.22	11	1.53	4	0.84
31. Multiple burin associating Types 27 to 30	--	--	6	0.63	4	0.61	7	0.97	1	0.21
34. Burin on a straight, right-angle retouched truncation	--	--	2	0.21	--	--	--	--	1	0.21
35. Burin on a straight, oblique retouched truncation	--	--	3	0.32	4	0.61	4	0.56	2	0.42
36. Burin on a concave retouched truncation	5	1.04	11	1.16	12	1.83	5	0.70	5	1.05
37. Burin on a convex retouched truncation	--	--	7	0.74	3	0.46	1	0.14	2	0.42
38. Transverse burin on a straight or convex lateral truncation	--	--	2	0.21	--	--	2	0.28	--	--
39. Transverse burin on a notch	--	--	1	0.11	1	0.15	--	--	--	--
40. Multiple burin associating Types 34 to 39	--	--	4	0.42	6	0.92	2	0.28	1	0.21
41. Mixed multiple burin, Types 27-30 + Types 34-39	--	--	6	0.63	7	1.07	3	0.42	1	0.21
43. Nucleiform burin	2	0.42	10	1.06	17	2.60	12	1.67	5	1.05
44. Flat-faced burin	--	--	--	--	--	--	1	0.14	--	--
45. Abri Audi knife	--	--	--	--	--	--	--	--	2	0.42
46. Châtelperron point	39	8.13	20	2.11	13	1.99	22	3.06	27	5.67
47. Atypical Châtelperron point	20	4.17	13	1.37	12	1.83	6	0.83	14	2.94
57. Shouldered piece	3	0.63	3	0.32	--	--	2	0.28	1	0.21
58. Completely backed blade	3	0.63	7	0.74	2	0.31	9	1.25	8	1.68
59. Partially backed blade	10	2.08	9	0.95	3	0.46	10	1.39	5	1.05
60. Piece with straight, right-angle truncation	2	0.42	9	0.95	4	0.61	11	1.53	7	1.47
61. Piece with straight, oblique truncation	9	1.88	38	4.01	12	1.83	16	2.23	12	2.52
62. Piece with concave truncation	21	4.38	39	4.12	15	2.29	15	2.09	17	3.57
63. Piece with convex truncation	7	1.46	19	2.01	8	1.22	11	1.53	4	0.84

Table 3-6--page 3

Type Number and Name	Méroc 1 n	Méroc 1 %	Méroc 2 n	Méroc 2 %	Méroc 3 n	Méroc 3 %	Arch. Lev. 1 n	Arch. Lev. 1 %	Méroc T-T n	Méroc T-T %
64. Bitruncated piece	--	--	13	1.37	--	--	1	0.14	3	0.63
65. Piece with continuous retouch on one edge	44	9.17	63	6.65	31	4.74	38	5.29	39	8.19
66. Piece with continuous retouch on both edges	5	1.04	7	0.74	4	0.61	4	0.56	3	0.63
67. Aurignacian blade	--	--	--	--	1	0.15	--	--	--	--
73. *Pic*	--	--	--	--	--	--	--	--	1	0.21
74. Notched piece	142	29.58	202	21.33	121	18.50	141	19.61	137	28.78
75. Denticulate piece	37	7.71	74	7.81	37	5.66	35	4.87	23	4.83
76. Splintered piece	27	5.63	64	6.76	56	8.56	77	10.71	48	10.08
77. Side-scraper	9	1.88	45	4.75	40	6.12	32	4.45	10	2.10
84. Truncated bladelet	2	0.42	--	--	1	0.15	--	--	--	--
88. Denticulate bladelet	1	0.21	--	--	--	--	1	0.14	--	--
89. Notched bladelet	--	--	2	0.21	1	0.15	1	0.14	1	0.21
92. Other tools, not included in Types 1-91	13	2.71	16	1.69	15	2.29	22	3.06	6	1.26
Totals	480	100.08	947	100.00	654	99.95	719	100.05	476	99.97
Scraper index (IG)		11.67		19.32		26.91		18.50		12.61
Aurignacian scraper index (IGa)		0.21		0.32		1.22		1.39		0.21
Perforator index (IP)		1.88		1.58		0.76		3.62		2.73
Burin index (IB)		3.33		8.76		12.08		13.07		6.51
Dihedral burin index (IBd)		1.88		3.91		4.43		8.90		2.94
Restricted dihedral burin index (IBd_r)		1.25		1.80		2.45		5.56		1.89
Truncation burin index (IBt)		1.04		2.85		3.82		1.67		2.31

Table 3-7.--Relative frequencies of tool classes (as defined in the text) in Méroc's surface collections from Areas 1, 2, 3, and Tambourets-Terssac and in Archaeological Level 1.

	Méroc Area 1	Méroc Area 2	Méroc Area 3	Arch. Lev. 1	Méroc T-T
Scrapers-A	11.67	19.32	26.91	18.50	12.61
Scrapers-B	1.88	4.75	6.12	4.45	2.10
Perforators	1.88	1.58	0.76	3.62	2.73
Burins	3.33	8.76	12.08	13.07	6.51
Denticulates	7.71	7.81	5.66	4.87	4.83
Splintered pieces	5.63	6.76	8.56	10.71	10.08
Backed tools	12.30	3.48	3.82	3.89	9.03
Truncated pieces	8.54	12.46	6.12	7.51	9.03
Marginally retouched pieces	10.21	7.39	5.50	5.84	8.82

as the surface sample from Area 1 is most like that from Area Tambourets-Terssac. These relationships are consistent with the topographic situation. Area 2 is simply the downslope extension of Area 3, both of which are on the +30m terrace of the Volp. Areas 1 and Tambourets-Terssac, on the other hand, are on the + 15m terrace. These latter areas, on the +15m terrace, have fewer scrapers and burins and more backed and marginally retouched pieces than the areas on the +30m terrace. This probably has to do with the different areal distribution of functions on some unknown number of living floors, but the data to interpret these differences do not exist.

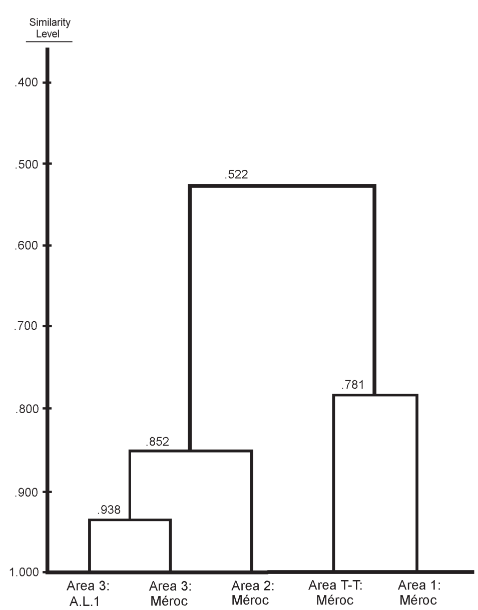


Figure 3-1. Relationships among assemblage samples at Les Tambourets as determined by weighted-pair cluster analysis of the tool-class frequencies shown in Table 3-7.

In summary, then, the 20th-century excavations at Les Tambourets recovered nearly 6,000 chipped stone artifacts, more than 4,000 of which came from the principal Châtelperronian archaeological horizon, Archaeological Level 1. This excavated assemblage sample provides a context for a large additional sample collected from the surface by Louis Méroc—over 3,700 such artifacts from Area 3 and, in part at least, for a further 20,000 flints from other areas of the site (†Méroc and Bricker 1984: 58–60, Tableau III). This grand total of over 28,000 chipped stone artifacts means that Les Tambourets is, despite the absence of faunal material, a major source of information about the Châtelperronian lithic industry—at a site lacking both Mousterian and Aurignacian occupations. Any attempt to characterize the material culture of the Châtelperronian must take Les Tambourets into account.

ENDNOTES

1. The pH as measured in several samples by Henri Laville varied but clustered closely around a pH of 6 (TDoc23).

2. The totals of the different categories of objects given in the tables in this chapter may differ slightly from those appearing in the tables of Chapters 9 to 11 and 13, which tabulate *studied* artifacts only, excluding those for which crucial attributes cannot be determined because of breakage or other problems. Other differences arise because of classificatory ambiguity—for example, a *rabot* must be counted as a tool in one context but as a nucleus in another. Inventory totals in the present chapter, which are counted directly from the master artifact catalogue for the site, record each object in one category only and do so regardless of completeness or damage.
3. Chi-squared=34.376, df=2, P<0.001.
4. Type percentages and indices are omitted where the total number of tools in a stratigraphic unit is less than 100.
5. Scrapers on thick flakes or chunks, which must here be inventoried as "atypical carinate scrapers" (Type 12), are not like characteristically Aurignacian scrapers, and they do *not* represent an Aurignacian component of the industry.
6. Chi-squared=34.806, df=3, P<0.0001.
7. Program WPCLUS of SIGSTAT (1986).

CHAPTER 4
LATERAL DISTRIBUTION PATTERNS

I. INTEGRITY OF ARCHAEOLOGICAL LEVEL 1

It is certain that Archaeological Level 1 at Les Tambourets does not represent a single undisturbed living floor. Among the catalogued objects recovered from Archaeological Level 1 in Area 3 are a few sherds of Medieval and later historic vessels. Of far more quantitative importance is the fact that during the excavation scores of ancient and now filled animal burrows were recognized at the stratigraphic boundary between the bottom of Archaeological Level 1 and the top of the underlying couche C. These small burrows, usually less than 10cm in diameter, are undoubtedly the work of moles, which today infest the plough zone (couche A) and the higher levels of couche B but do not at present penetrate more deeply. It seems clear that at various times in the past some of the archaeological materials of Archaeological Level 1 were encountered by the burrowing animals and moved from their "original" positions—up, down, or laterally. The vertical movement of objects from the archaeological level is best shown by the existence of 160 flint objects in couche C, all of them formally indistinguishable from the Archaeological Level 1 assemblage sample and many of them found lying at a high angle in the lighter-colored fill of an animal burrow. It is clear, then, that post-occupational activities of both man and animals have introduced a certain amount of "noise" into the distributional pattern of the Châtelperronian artifacts.

It is, furthermore, extremely probable that Archaeological Level 1 is composed of cultural debris from multiple occupations rather than a single one. Although the archaeological level could not be successfully subdivided during excavation, the range of thickness of the artifact scatter—generally 4cm to 8cm—suggests that the total duration during which artifact "deposition" occurred was not a brief one. Châtelperronian occupation took place at the beginning of a period of loess accumulation in OIS3 (as discussed in Chapter 2), but some Archaeological Level 1 artifacts rest directly upon the weathered and eroded surface of couche C whereas others are separated from couche C by one or several centimeters of the couche B loess. The strongest evidence in favor of multiple occupations over a long period (as opposed to a long single occupation) is provided by the lateral extent of the entire site. That surface indications of Châtelperronian occupation are found today over several hectares and that over 24,000 artifacts assignable to the Châtelperronian were collected from this surface during the 20th century (†Méroc and Bricker 1984) make it highly improbable that the entire site should have been occupied at a single moment. It is far more likely that Les Tambourets and the nearby Châtelperronian sites of Terrier Ferrage and Rachat (Méroc 1963a: 65, 67; Appendix A), represent an area occupied, temporarily but repeatedly over a period of years, by people making Châtelperronian artifacts and, that in the intensively sampled Main Area of Area 3, the part of Les Tambourets with which this chapter is concerned, Archaeological Level 1 represents a palimpsest of cultural debris from more than one Châtelperronian occupation. An attempt to interpret the lateral distribution pattern of the archaeological materials must be carried out with this probability in mind.

A frequently used technique for assessing the degree to which artifacts have been moved, either on the living surface during an occupation or in the enclosing sediments after deposition as a result of various disturbance processes, is the mapping of so-called rejoins and refits. A rejoin is the putting back together of the fragments of an artifact that broke after it was in a finished state. A refit, on the other hand, is the repositioning back onto a core—or a flake struck off earlier—of a flake or blade or chunk struck from that core. In a seriously disturbed context, the individual components of a rejoin or refit will usually be, when recovered in excavation, quite separated from one another in space, laterally and/or vertically. A drawback to the use of this approach is the difficulty in identifying rejoins and refits. It requires having a large proportion of the relevant occupational refuse available for examination at one time, and it requires many, many hours of mechanical trial-and-error manipulation.

The identification of rejoins and refits in Archaeological level 1 at Les Tambourets was based on partial samples, not an exhaustive analysis of the complete series. The archaeological materials recovered in each of the three excavation seasons were studied separately in different years. This means, for example, that if one part of a broken flake excavated in 1975 could be rejoined with another fragment of the same flake excavated in 1980, this rejoin was not discovered. Furthermore, the small series from the 1973 test excavation was not examined systematically for rejoins and refits. There are, then, no data from Trench V, Squares A and B (Figure 4-1). And, of course, there are no data concerning Archaeological Level 1 from the area of the historic-age ditch.

Although the results reported here are based on an only partial sample, the results may be broadly representative of the Main Area as a whole. In his own later study of the Archaeological Level 1 materials, René Scandiuzzi (2008) looked for refits and rejoins, and he examined the complete assemblage sample, from all three excavation seasons. It appears that he was able to add only one example, a refit of a core-tablet trimming flake back onto a prismatic nucleus (find spots not specified), to what was already known from our earlier study.[1]

The find-spots of the eight rejoins and three refits documented by the present study in Archaeological Level 1 in the Main Area are shown in Figure 4-1, with more detailed information appearing in Table 4-1.[2] The lateral separation between the two components of a rejoin/refit varies from nearly nothing to more than four meters, but the majority of the distances are less than one meter, including two pairs each within the confines of the distributional anomalies that may represent the outlines of artificial structures (see section III of this chapter, below). Vertical separation is also small, ranging from none to a maximum of five centimeters. In only one of the tabulated cases (artifacts 1295 and 2244)

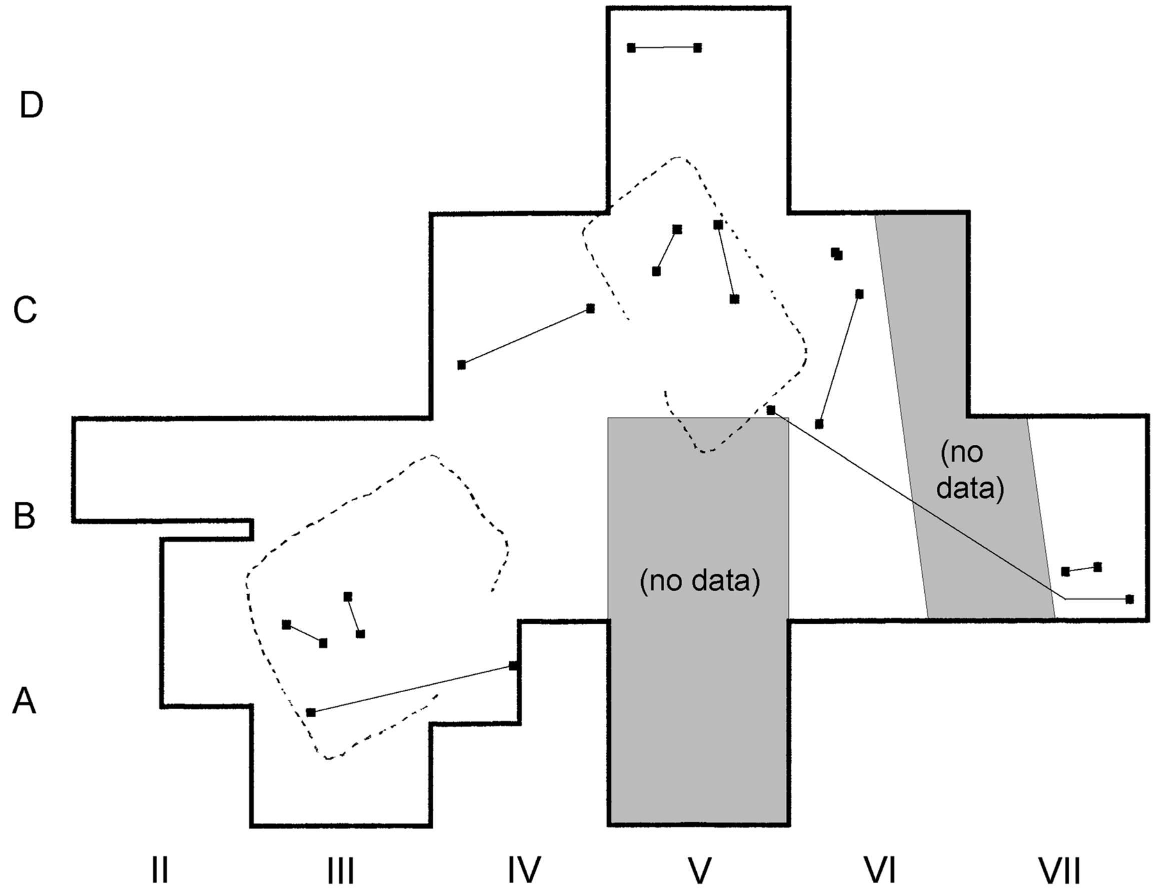


Figure 4-1. Find spots of the rejoins and refits from the Main Area of Area 3 (1975 and 1980 excavations only); detailed information is given in Table 4-1. There are no data from the 1973 excavation or the historic-age ditch. Approximate outlines of possible artificial structures (discussed in Section III of this chapter) are shown in dashed lines.

was a rejoined or refitted piece found in a stratigraphic unit other than Archaeological Level 1; in the exceptional case, a fragment of a scraper was found in couche B(Basal), three centimeters higher than the scraper itself.

Although the study of rejoins and refits was based on incomplete samples, and although it remains true that Archaeological Level 1 must be a complex palimpsest, the generally minimal separation of the components of rejoins and refits, both laterally and vertically, does not correspond to the situation expected in a seriously disturbed context. This, then, gives some reason to be optimistic that an examination of the distributional patterns of different artifact classes will be informative.

II. DISTRIBUTION OF ARTIFACT CLASSES

Although Archaeological Level 1 is certainly a palimpsest of more than one Châtelperronian occupation, and although it is quite certain that post-occupational disturbances have altered the original positions of some of the objects, an analysis of spatial patterning is nevertheless worthwhile. Some culturally meaningful "signal" may be recognizable in the data despite the presence of noise. The analysis started with the entire contents of Archaeological Level 1 as a unitary whole, because only the tool scatter as a whole has firm stratigraphic reality. Although some pieces come from near the top of the scatter and others from near the bottom, it was impossible to make consistent vertical separations during the excavation.

Several statistical techniques were employed in the attempt to elucidate lateral distribution patterns in Archaeological Level 1. Two initial tests used were the variance-mean ratio test for random patterning and a series of contingency table tests for the absence of spatial association (Dacey 1973) using 39 1.00m^2 quadrats.[3] The results indicate that the total sample of all artifacts in Archaeological Level 1 is nonrandomly distributed ($P<0.05$) and that the distribution patterns of nuclei, unretouched *débitage* products (flakes and blades, utilized and not), and artifacts found lying at a high angle are significantly spatially associated with the pattern of the general distribution of all artifacts (probabilities range from 0.04 to <0.0001). The patterns of the other artifact categories are not congruent with the general distribution (probabilities from 0.14 to 0.70). Because nuclei and *débitage* products combined account for the overwhelming majority of the total assemblage sample from Archaeological Level 1 in the Main Area—208 nuclei, 473 chunks, 1,675 flakes, and 395 blades out of a total of 3,791 catalogued objects,[4] for a combined percentage of

Table 4-1.--Rejoined and refitted pieces from the Main Area of Area 3 (1975 and 1980 excavations only). The last two columns list the straight-line horizontal distance and the vertical distance in centimeters between the find spots of each component of the rejoin or refit.

Cat. Nos.	Description	Action	Tr.	Sq.	NS	WE	DE	Strat. Unit	Hor. Dif.	Vert. Dif.
1295	scraper fragment	rejoin	VII	B	151	107	157	cB(Bas)		
2244	scraper		VII	B	146	142	160	A.L.1	35	3
1392	nucleus fragment	rejoin	VI	B	6	33	156	A.L.1		
3507	nucleus fragment		VI	C	78	79	156	A.L.1	136	0
1596	nucleus fragment	rejoin	V	C	56	53	154	A.L.1		
1614	nucleus fragment		V	C	17	73	155	A.L.1	44	1
1854	unret. flake	rejoin	V	D	38	99	149	A.L.1		
1890	unret. flake		V	D	37	25	149	A.L.1	74	0
1962	"spec. hammer"	rejoin	V	C	11	122	151	A.L.1		
2022	"spec. hammer"		V	C	82	139	155	A.L.1	73	4
2127	unret. blade	rejoin	V	C	192	180	156	A.L.1		
2272	unret. blade		VII	B	179	178	161	A.L.1	440	5
3345	cracked cobble	rejoin	IV	C	147	34	145	A.L.1		
3923	cracked cobble		IV	C	91	178	150	A.L.1	155	5
3539	chunk	refit	VI	C	42	59	155	A.L.1		
3558	unret. flake		VI	C	43	59	155	A.L.1	1	0
5372	unret. flake	refit	III	B	177	106	152	A.L.1		
6254	unret. flake		III	A	10	120	156	A.L.1	36	4
5683	misc. ret. flake	refit	III	A	90	64	157	A.L.1		
6493	notched flake		IV	A	41	93	156	A.L.1	234	1
6204	unret. flake	rejoin*	III	A	19	78	155	A.L.1		
6427	unret. flake		III	A	4	40	156	A.L.1	41	1

* Pièce gélivée; fractured by frost action

72.57%—the *general* distribution pattern is what it is largely because the excavations happened to encounter a portion of the site in which chipped-stone tool production was a major contributor to the resulting archaeological record.

An exploratory R-mode factor analysis was employed to investigate possible spatial associations between and among specific artifact categories. The sample used for factor analysis was composed of frequencies (raw counts) of 12 categories of artifacts in each of 39 1.00m^2 quadrats. The correlation matrix from which the analysis started is shown in Table 4-2. Based on the two criteria suggested by Vierra and Carlson (1981), the data summarized by the correlation matrix appear to be appropriate for factor analysis.[5] Four factors were extracted, accounting for 64.52% of the total variance.

The information derived from the factor analysis, including mapping of the factor scores back onto the quadrat grid, may be summarized as follows:

- As indicated by other techniques, much of the spatial patterning in Archaeological Level 1 has to do with the *débitage* process rather than with very specific tool-use activities.
- Nuclei and their unretouched products (*débitage* flakes and blades) behave somewhat differently in space; there are, likewise, some differences in the spatial distributions of blades and flakes. Further clarification of this finding was produced by the use of Dacey's (1973) contingency table test for the absence of spatial association between pairs of specific artifact classes. In brief, blades showing utilization damage (*possible* evidence of use as informal tools) tend to occur at site loci other than those containing nuclei, unmodified blades, and unretouched flakes (utilized or not).
- An elongated area containing artifacts representing diversified activities, including flint-knapping and several kinds of probable tool use, extends diagonally across the Main Area from southwest to northeast. This corresponds generally to the locations of the two possible artificial structures (discussed below in Section III) and the area between them.
- Another locus, on the downslope margin of the Main Area (centered on square V-A), is characterized by flint-knapping debris and tools representing what may be a less diversified range of other activities.

The kinds of analyses whose results are briefly summarized above provide much information about the random or nonrandom nature of specific distributions and the extent to which combinations of specific distributions are significantly associated in space. However, they give only very generalized information on just where in the excavated area individual artifact categories are particularly frequent and even vaguer information on the location(s) of co-occurrence of specific categories. It is desirable to supplement such analyses by defining and specifying the spatial limits of clusters of artifacts by techniques other than just visual inspection and intuitive interpretation of distribution maps. The kind of use to which Kintigh and Ammerman (1982) have put k-means cluster analysis is well suited to answer exactly this kind of need. Of particular utility here is the fact that this clustering technique uses as direct input the lateral coordinates of artifacts, measured to the nearest centimeter, rather than quadrat counts.[6] Although the k-means clustering technique is very helpful, its full potential is achieved only as a result of certain decisions made by the analyst about the relationships between alternative clustering results and the data being clustered. A full explanation of the decisions made for the analyses of the Les Tambourets material is given in an unpublished symposium paper (available here as TDoc02, pp. 8–11). In general terms, the goal was to identify for each artifact class the most salient clusters, defined as those containing the greatest number of artifacts in the smallest area (avoiding the logical but meaningless extreme of a one-artifact "cluster"). The results of the series of k-means analysis are summarized in Section IV of this chapter, following the discussion in Section III of the possible traces of artificial structures.

III. POSSIBLE ARTIFICIAL STRUCTURES

One part of the laboratory analysis of the results of the 1975 excavation season was the preparation of a lateral distribution map of all catalogued objects recovered from Archaeological Level 1 in the Main Area. The map revealed a distributional anomaly that had not been noticed in excavation—double alignments of artifacts separated by a linear empty or nearly empty space. This is best seen in Figure 4-2 in the northern part of Trench III, Square B, and the western part of IV-B. In these squares, the two alignments appear to meet at close to a right angle. It seemed possible that the anomaly represented part of the trace of an artificial structure, approximately half of which remained unexcavated. The excavation season of 1980 had as one of its goals the investigation of this anomaly. As a result of this further excavation, a putative structure was recognized and designated Structure 1 (Figure 4-3, upper). Furthermore, the less definite traces of a possible second artificial structure, Structure 2, could be recognized in Trench V, Square C, and adjacent squares (Figure 4-4, upper).

The model that shaped the hypothesis about artificial structures is what André Leroi-Gourhan (1976: 662) called the "wall effect" (*effet de paroi*) in his discussion of possible tents at the Magdalenian site of Pincevent in northern France. According to this model, the nearly empty space in the middle of the double alignments would represent the position of the walls of a structure, possible a skin tent. During the time that such walls were in place, they would have impeded the dispersion of artifacts on the living floor, both outside and inside the structure. The alignments of artifacts on both sides of the empty spaces result, in part, from the fact that the structure's walls "trapped" artifacts and thus created lateral concentrations that reflect the shape of the structure's ground-plan. Once the walls no longer existed, having been removed by the inhabitants or having decayed away during a period of site abandonment, the structure's

Table 4-2.--Correlation matrix of artifact categories.

	BU	SC	SP	BK	MR	HA	NU	CF	CB	UF	UB	CO
BU*	1.000											
SC	-0.165	1.000										
SP	0.122	0.320	1.000									
BK	0.049	-0.152	-0.234	1.000								
MR	-0.071	0.053	-0.176	0.489	1.000							
HA	-0.078	0.174	-0.077	-0.152	-0.151	1.000						
NU	0.182	0.082	0.205	0.033	0.098	-0.046	1.000					
CF	0.139	0.264	0.187	0.291	0.123	-0.216	0.235	1.000				
CB	0.448	-0.063	0.027	0.376	0.364	-0.442	0.287	0.340	1.000			
UF	-0.059	0.405	0.407	0.130	0.008	0.006	0.299	0.430	-0.208	1.000		
UB	-0.133	0.304	0.126	0.043	0.108	-0.258	-0.078	0.513	0.140	0.164	1.000	
CO	0.091	-0.108	0.255	0.189	0.073	-0.177	0.359	0.146	0.303	-0.069	-0.195	1.000

NOTE: * BU: burins; SC: scrapers; SP: splintered pieces; BK: backed tools; MR: marginally retouched pieces; HA: hammers; NU: nuclei; CF: unmodified flakes; CB: unmodified blades; UF: utilized flakes; UB: utilized blades; CO: cracked cobbles

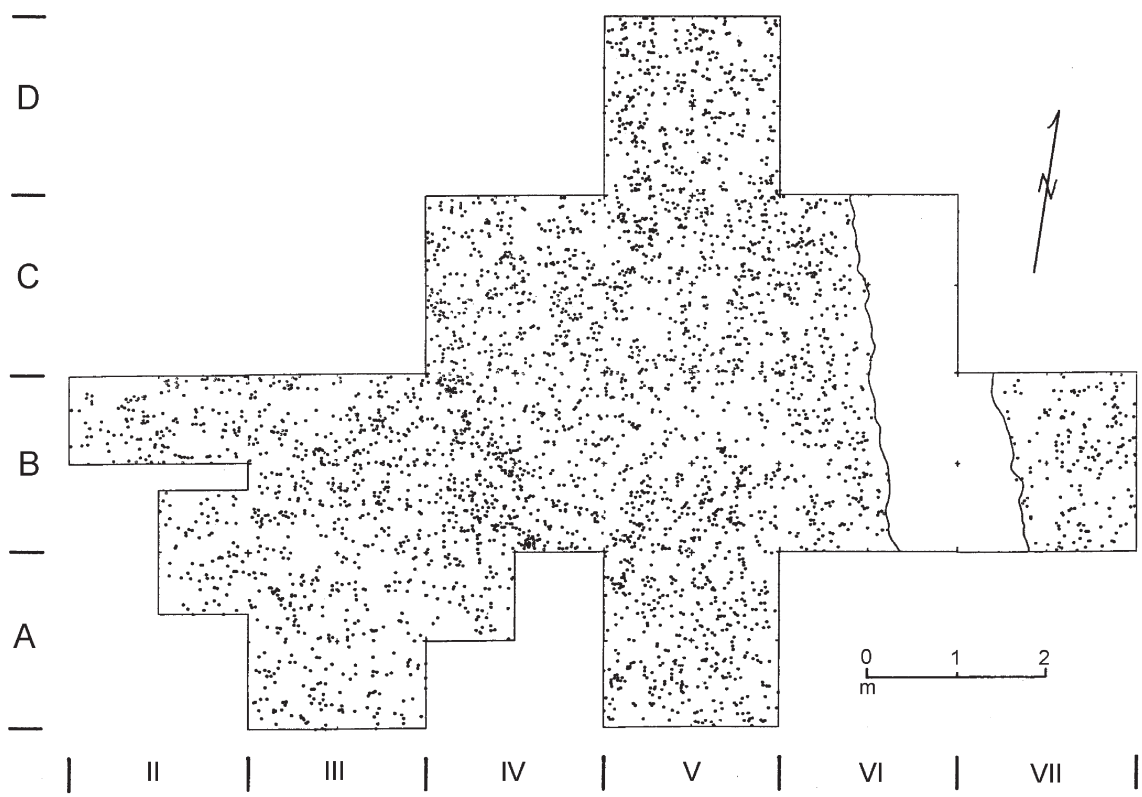


Figure 4-2. General scatterplot of all catalogued objects in Archaeological Level 1 in the Main Area. Archaeological Level 1 had been removed by a historic-age ditch in portions of Trenches VI and VII.)

outline was preserved "in negative" by a systematic pattern of the *absence* of artifacts.

The detailed description of the two distributional anomalies and their interpretation as possible artificial structures were communicated in a paper prepared for an international symposium held at the University of Cambridge in 1987. However, this paper (included here as TDoc02) was not submitted for publication in the proceedings of the symposium because of lingering uncertainty about the validity of the interpretation. Was it possible that the traces of such discrete and short-lived occupational episodes could really be preserved within a complex, multi-occupational palimpsest, or were the anomalies simply the result of unspecified natural site-formation processes?

One consideration that may help answer this question is the relationship of the anomalous distributional pattern to the topography of the substrate. The surface of couche C, which is the substrate relevant to Structure 1, slopes very gently to the southeast (Figure 4-3, lower), and what was interpreted as the entrance opens downslope. The putative side walls are in the axis of the slope, and the front and back walls are parallel to the slope. The surface of couche C was not visibly altered by the construction or use of Structure 1. Neither this surface nor the vertical limits of the artifact scatter of Archaeological Level 1 shows any sharp change in elevation from exterior to interior across any wall line; the interior floor of the structure was neither raised nor semi-subterranean. Despite careful search in that part of Structure 1 excavated in 1980, no post moulds were discovered.

The situation is different for Structure 2 (Figure 4-4, lower). A slight depression in the surface of couche C is generally congruent with the shape of Structure 2, suggesting that the microtopography of the existing ground surface was somewhat altered by the construction or use of the structure. This effect is most marked in the southern half of the shelter (see Figure 4-4, lower), where the -157cm contour defines a rectangular depression having an orientation almost identical to that of the structure's walls. The differences in elevation are, however, very slight; the greatest relief on the surface of couche C, occurring along the back wall near the southeast corner, is only 4cm in ca. 20cm laterally, from -153cm just outside the structure to -157cm just inside the wall line. In no meaningful sense, therefore, is this a semisubterranean structure. As is the case with Structure 1, the probable entrance opens downslope.

Another major consideration in judging the likelihood of the artificial-structure interpretation is the congruence, if any, between the footprints of the distributional anomalies (structures?) and the distributional patterns of different artifact classes. An overview of these relationships is best seen in the results of the k-means clustering analyses (Figures 4-5 and 4-6). Plotting the locations of the most salient clusters (the greatest number of artifacts in the smallest area) for each artifact category on maps marking the foot-

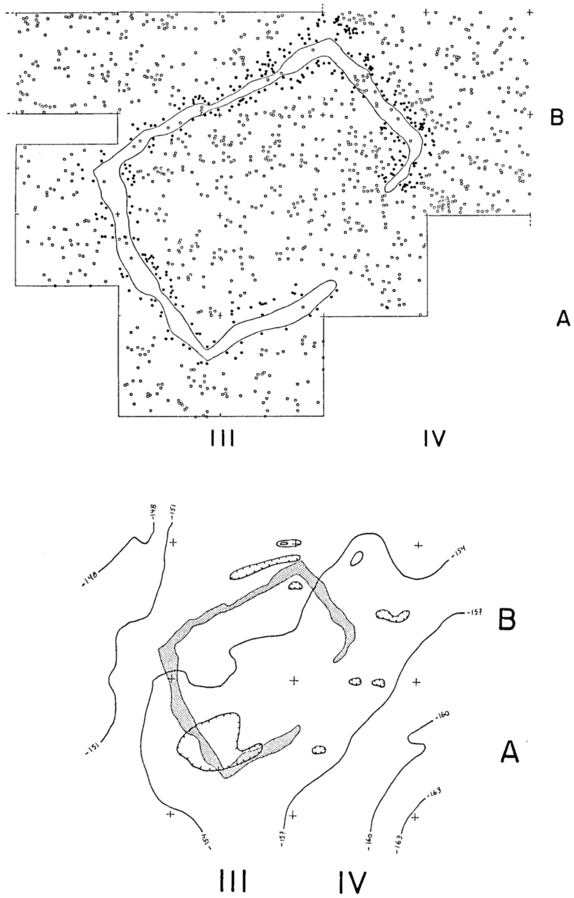


Figure 4-3. *Evidence of possibly artificial "Structure 1." Upper: traces of the wall lines superposed on a portion of Figure 4-2. Lower: outline of the structure superposed on a contour map of the surface of couche C; elevations shown are below site datum.*

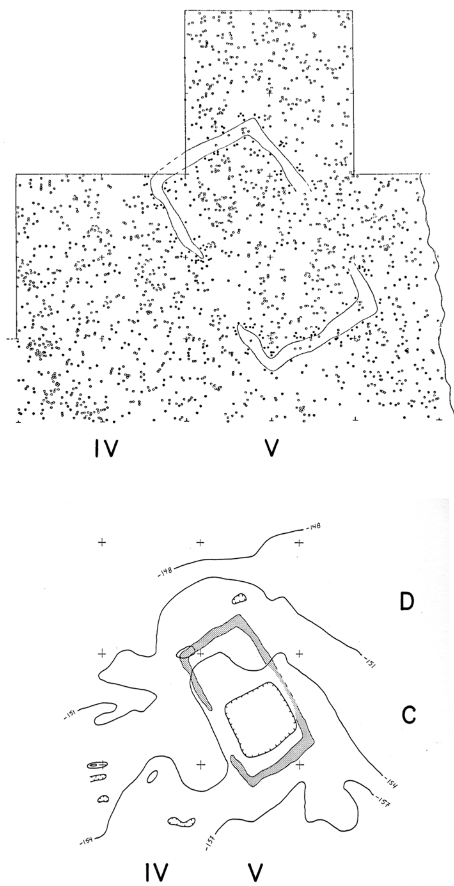


Figure 4-4. Evidence of possibly artificial "Structure 2" (graphic conventions as for Figure 4-3).

prints of the putative structures shows at once that there are real differences in lateral distribution patterns. Some categories "behave" similarly with respect to both structures—side-scraper clusters are near the entrances and immediately outside them; marginally retouched pieces are primarily within the structures to the left of the entrance; utilized blades are within the structures and between them; and burnt flints are adjacent to the structures but not in them. This is the sort of locational congruence that might be expected if the structures were real and used in very similar ways. The most salient categories of some other categories are located differently with respect to the footprints—burins and Châtelperron points are associated preferentially with Structure 2, not Structure 1, whereas the opposite is true for splintered pieces. If the structures are real, this kind of patterning would indicate functional difference. None of the other artifact categories patterns in any clear way with the putative structures.

The area south and southeast (downslope) of both structures, sampled in Trench V, Square A, has a distinctive combination of artifact clusters—one category of finished tools (burins); nuclei, unmodified blades, and unmodified flakes; flints lying at a high angle; and, cracked cobbles. J.-P. Rigaud (personal communication, May 1985) suggested to me that the southeastern zone may have been a "dump" area downslope of the zone of the structures, similar in some ways to the dump area he identified in the Upper Périgordian occupation of Level VII at Le Flageolet-1 (Rigaud 1976a). The abundance of the waste products of the *débitage* process, the concentration of cracked cobbles without strong evidence of surface hearths in that area, and the important cluster of flints lying at a high angle are all consistent with this interpretation.

The technique of k-means clustering analysis, combined with the other techniques mentioned, has provided a somewhat clearer picture of the lateral distribution patterns of the artifacts in Archaeological Level 1 than could be obtained by less formal, more impressionistic means. By basing interpretation on the most salient clusters only, it is possible to use k-means clustering as a very effective filter to remove "background noise," concentrating on the strongest part of the "signal." This is particularly useful at Les Tambourets, where multiple occupations and post-occupational disturbance combine to "smear" the patterning of any single occupational episode. However, the fact that techniques have been chosen to facilitate interpretation *in spite of* these problems does not mean that the problems have been removed. There remain two specific limitations

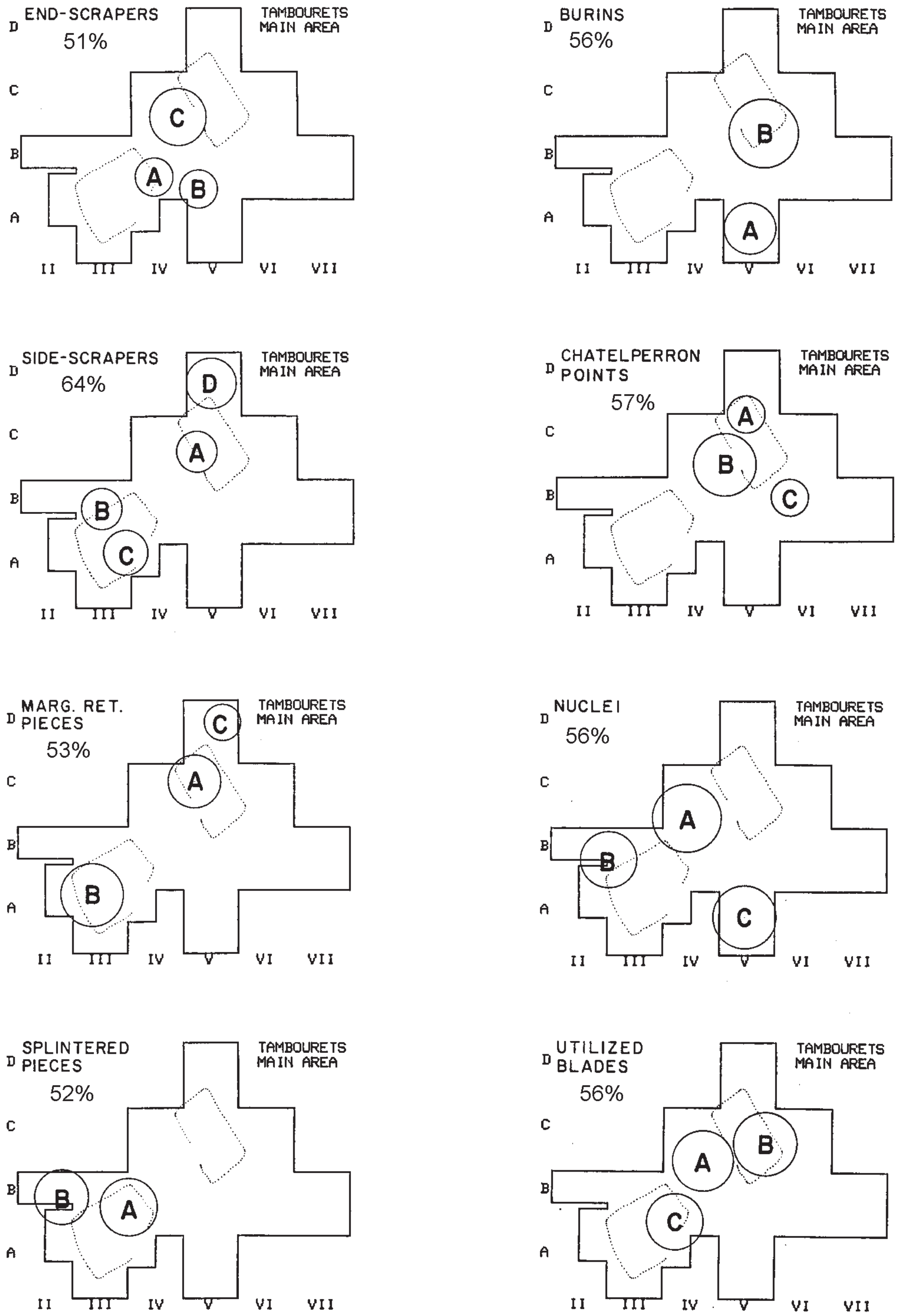


Figure 4-5. Locations of the salient k-means clusters of end-scrapers and other artifact categories superposed on the traces of the possibly artificial structures. Each salient cluster is plotted as a circle whose size is proportional to the area of the cluster.

to the validity of the interpretations of the k-means results. First, one-third to one-half of the examples of each artifact category have been ignored by the analysis, and a cluster that is not quantitatively salient in the overall patterning may have qualitative significance for some briefly or infrequently practiced activity. Second, the existence of multiple occupations has been ignored, and the different clusters of the same artifact category may result from activities that took place at quite different times. It is clear, then, that the k-means results and the rather broad-brush interpretations based on them describe for us only the most visible aspects of a complex palimpsest.[7] And, most unfortunately, none of the techniques has provided *conclusive* evidence either for or against the interpretation of the two distributional anomalies as artificial structures.

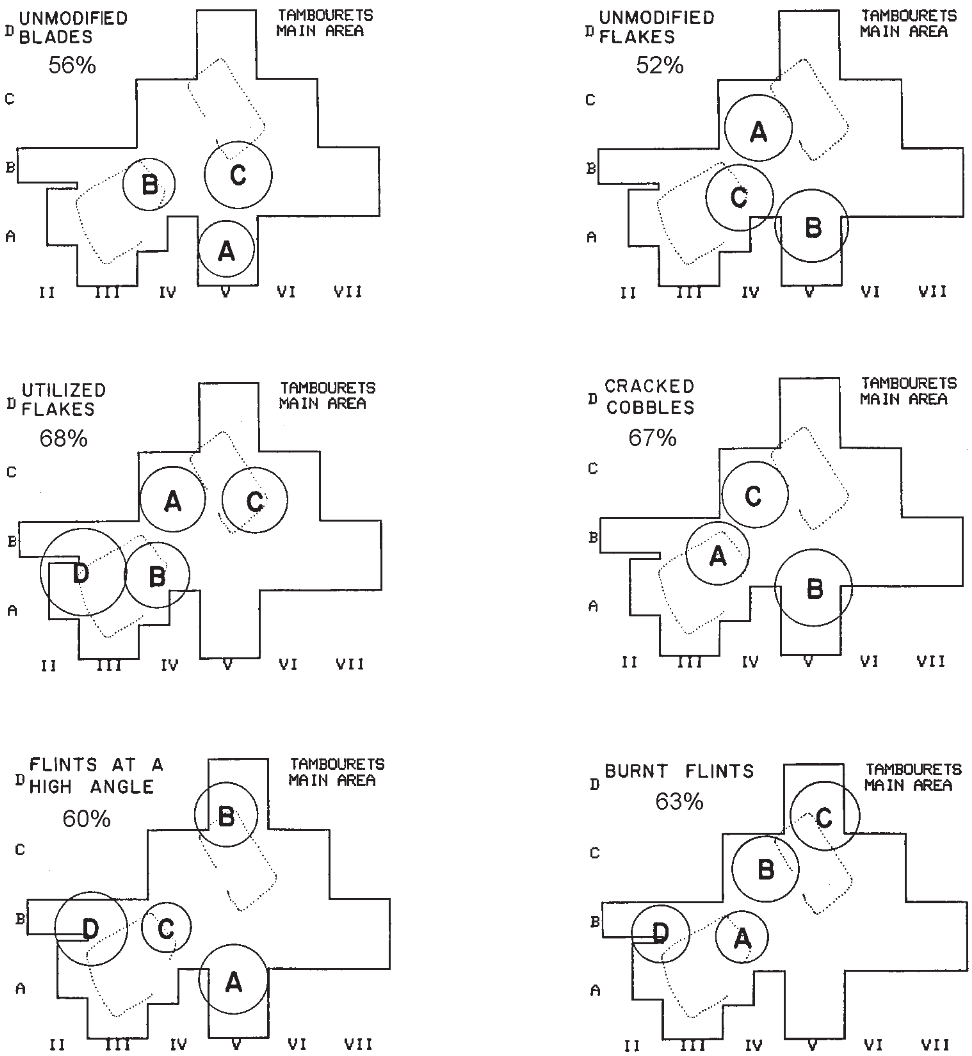


Figure 4-6. Locations of the salient k-means clusters of unmodified blades and other artifact categories (graphic conventions as for Figure 4-5).

ENDNOTES

1. Scandiuzzi (2008: 120) reported: *"En dernier lieu, nous devons préciser que des tentatives de raccords et remontages ont été effectuées en parallèle à cette étude. Elles ne se sont soldées que par le raccord d'une tablette sur nucléus prismatique, qui vient compléter divers raccords de fragments de nucléus et éclats déjà identifiés et recollés par H. Bricker."*
2. Table 4-1 and Figure 4-1 include only pieces in the Main Area of Area 3. Nine other cases were recognized—four rejoins in the Alpha Complex, one refit in Ditch Fill, three in the Alpha Complex, and one in TP3W3. The refits include burin spalls refitted to burins and one retouched flake refitted back onto a nucleus.
3. The 39 quadrats of the Main Area exclude potential quadrats only partially excavated as well as those affected in whole or in part by the historic-age ditch.
4. The inventoried totals given in Tables 3-1 and 3-2 in Chapter 3 are higher because those tables include Test Pits Beta, 3W1, 3W3, and 3W5, which are not considered here.
5. Twelve of the 66 trials contributing to the matrix produce correlation coefficients significant at the 0.05 rejection level; the probability of this many significant correlations occurring in the matrix due to chance alone is 0.0001. Bartlett's test of significance for the correlation matrix yields a Chi-squared value of 130.27 with 66 degrees of freedom, $p<0.0001$.
6. The k-means clustering program used for the Tambourets analysis was the BMDPKM program (Engelman and Hartigan 1981) run on a DEC-2060 computer at the Tulane Computing Laboratory.
7. Several attempts were made to "unpeel" the palimpsest into two or more components, approximating through graphical or statistical means what it was not possible to do stratigraphically during excavation. Definition of "high" and "low" scatters within Archaeological Level 1 led to interpretations discussed at length in the 1987 Cambridge symposium paper (TDoc02), but the need to make arbitrary decisions about assignments seriously limits confidence in the results. A later attempt, modelled on the palimpsest disaggregation techniques used by Koetje (1991) at the French Palaeolithic site of Le Flageolet II, was statistical rather than graphical. It involved, among other things, both k-means clustering and trend surface analysis. The results, presented to a symposium of the Society for American Archaeology in 1992 (included here as TDoc01), were successful in that they were both completely replicable and quickly obtained. However, most of the objects fell into "stratigraphically" intermediate categories, and such results were operationally uninterpretable. What it was not possible to do during excavation—that is, to subdivide Archaeological Level 1 reliably—has not been possible later, at either the drafting table or the computer.

CHAPTER 5
SCRAPERS

INTRODUCTION

The series of Châtelperronian scrapers from Les Tambourets does not fit very conformably into the established typological categories for the Upper Palaeolithic that are used in Chapter 3. For purposes of the attribute analysis reported here, the series is divided into somewhat broader but still familiar artifact classes, but even this lesser degree of subdivision may suggest more typological heterogeneity than is present in the series. (The relationships among the scraper artifact classes are discussed further below, in Section V of this chapter, following the presentation of the attribute data.)

End-scrapers are scrapers, on blades or flakes, on which the scraping edge is limited to one end of the piece, at an approximate right angle to the bulbar axis; on chunks, which have an indeterminate bulbar orientation, the scraping edge is strictly limited and has a morphology similar to those on the more common flakes and blades. On **side-scrapers**, almost always made on flakes, the scraping edge modification is limited to one or both sides of the blank and is oriented approximately parallel to the bulbar axis. **End-and-side-scrapers** are also made primarily on flakes. The scraping edge occurs on all or part of one end and continues—with no or very little break in the line of retouch—down all or part of one side. There may or may not be a clear break in angle between the two components of the scraping edge. On **discoidal scrapers**, made on flakes, the scraping edge modification affects all or the great majority of the piece except for the original striking platform of the blank.

I. END-SCRAPERS

The attribute analysis of Châtelperronian end-scrapers from Les Tambourets (Figures 5-1, 5-2, and 5-3) is based on six samples, three composed of excavated tools and three composed primarily of tools collected from the surface by Louis Méroc. Two of the excavated samples—seven objects from couche B(Basal) and three from couche C, both in Area 3—are too small for most analytic purposes, but the other four samples provide a combined corpus of over 400 scraping edges.

The general procedure used in the study of end-scrapers (and other major artifact classes that are very numerous) combines a battery of univariate description, bivariate analysis, and multivariate analysis. At the start of the study, a factor analysis using all the major end-scraper attribute sets that are measured on ratio, interval, or ordinal scales[1] was employed to identify roughly but quickly some of the major factors or attribute clusters accounting for much of the variation in the sample. Bivariate analyses of various sorts were used to follow up suggestions resulting from the factor analysis as well as to investigate the roles of nominal-scale attribute sets. Finally, the relationships among the end-scraper samples at Les Tambourets were investigated by means of a cluster analysis.

The end-scrapers chosen for the factor analysis include a pooled sample from Archaeological Level 1, couche B(Basal), and couche C. This sample of 99 scraping edges is composed entirely of excavated objects, and it is a completely reliable sample of Châtelperronian end-scrapers, without Neolithic or other admixture. The following attribute sets are used in the analysis (see Appendix B for descriptions and definitions): retouch angle (ES5), retouch pattern (ES6), coded orientation angle/asymmetry direction (ES9), scraping edge width (ES10), scraping edge thickness (ES11), scraping edge length (ES12), roundness index (ES13), maximum width of blank (ES24), and maximum thickness of blank (ES25). The correlation matrix on which the factor analysis is based is shown in Table 5-1. Twelve of the 36 coefficients are significant at the 0.05 level, a result expected to occur by chance alone with a probability of 8.92×10^{-8}. Bartlett's test of significance for the matrix yields a Chi-squared value of 548.46 with 36 degrees of freedom, $P<0.0001$. As discussed by Vierra and Carlson (1981: 276–278), these data suggest the appropriateness of the matrix for factor analysis.

The major results of the factor analysis[2] are shown in Table 5-2. Three factors with eigenvalues greater than 1.0 were extracted, accounting for approximately 68% of the total variance. The five highest loadings on the unrotated first factor are for scraping edge length, width, and thickness, and for blank width and thickness. This indicates that, among the attribute sets used for the analysis, those having to do with the dimensions of the blank and the scraping edge applied to it contribute most importantly to end-scraper variation. After oblique rotation, Factor 1 is characterized by high positive loadings of thickness and width of both edge and blank. In light of the very strong correlations of edge width with blank width ($r=0.746$) and edge thickness with blank thickness ($r=0.724$), this Factor 1 may be confidently identified as a factor of blank size, a not surprising result. Rotated Factor 2 has high positive loadings for roundness index and edge length. Although roundness index is a "second order" variable calculated from both edge length and edge width and although it is significantly correlated with both, only edge width is important to this factor, which may be recognized as a factor of scraping edge shape. Rotated Factor 3, which has no really high loadings, cannot be interpreted with confidence. It may have most to do with how the scraping edge is mounted on the blank (attribute set ES9), but the relationship of this to the other sets contained in Factor 3 is not clear. Even though the rotation did not force orthogonality, the three factors are essentially uncorrelated; the highest correlation (0.174) is between Factors 1 and 2.

In summary, then, the factor analysis identifies the overall dimensions of the blank, the shape of the scraping edge, and perhaps the relationship of the edge to the blank as largely independent domains of variation in the sample of Châtelperronian end-scrapers from Les Tambourets. The analysis is incomplete because the attribute system employed measures some crucial variation (of which "nature of the blank" is probably most important here) on a nomi-

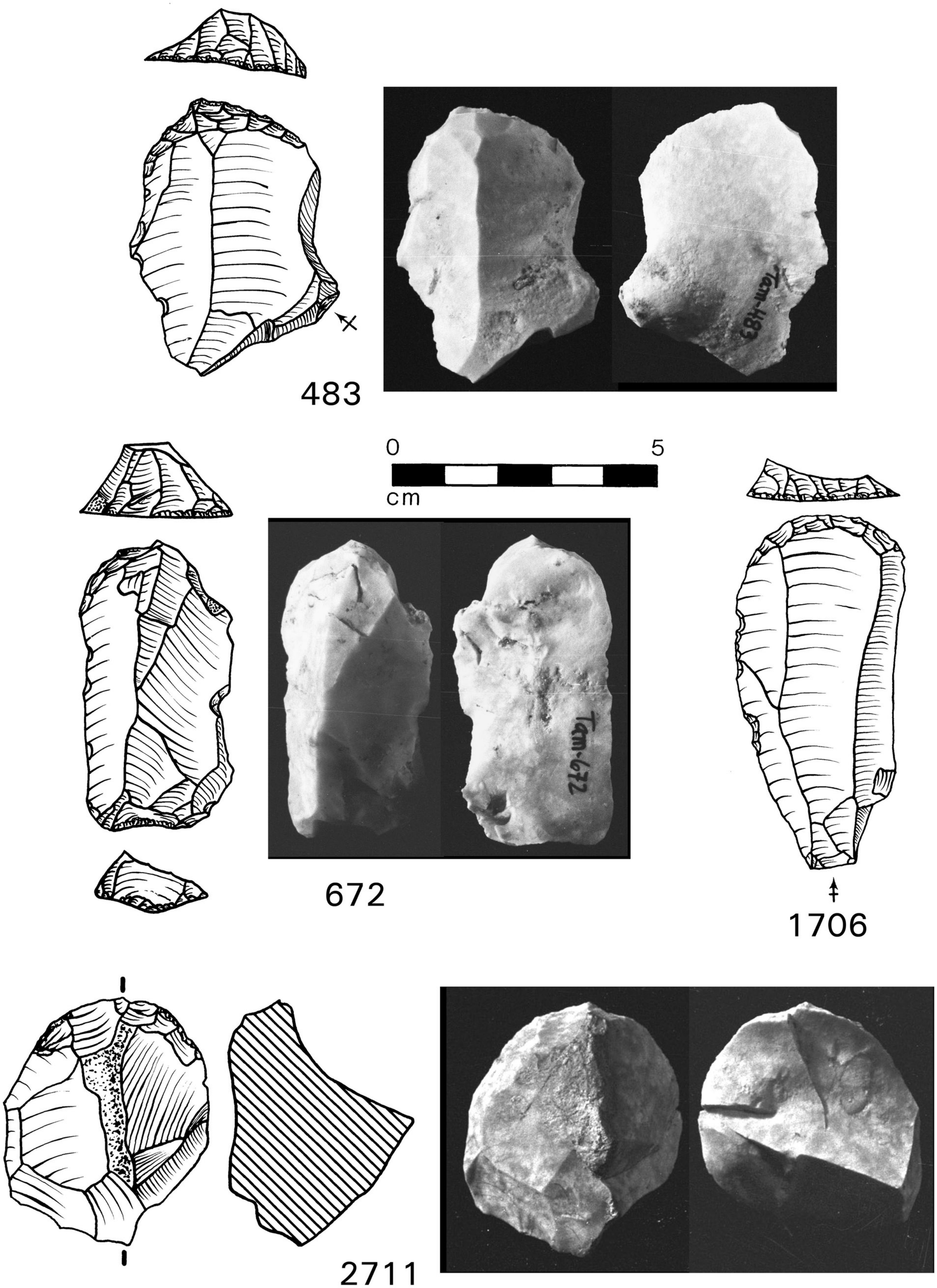


Figure 5-1. End scrapers from Archaeological Level 1 in Area 3 at Les Tambourets.

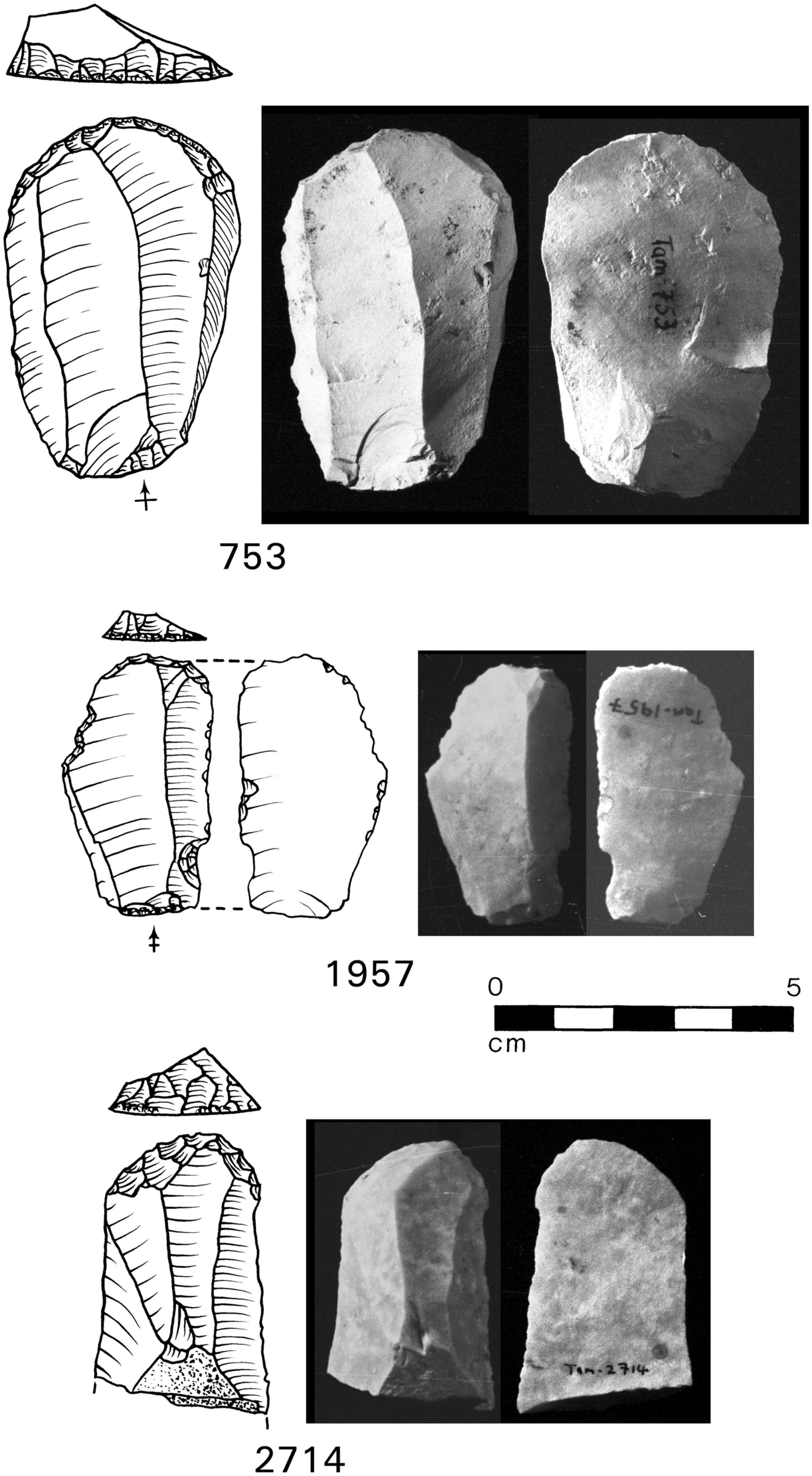


Figure 5-2. End scrapers from Archaeological Level 1 in Area 3 at Les Tambourets.

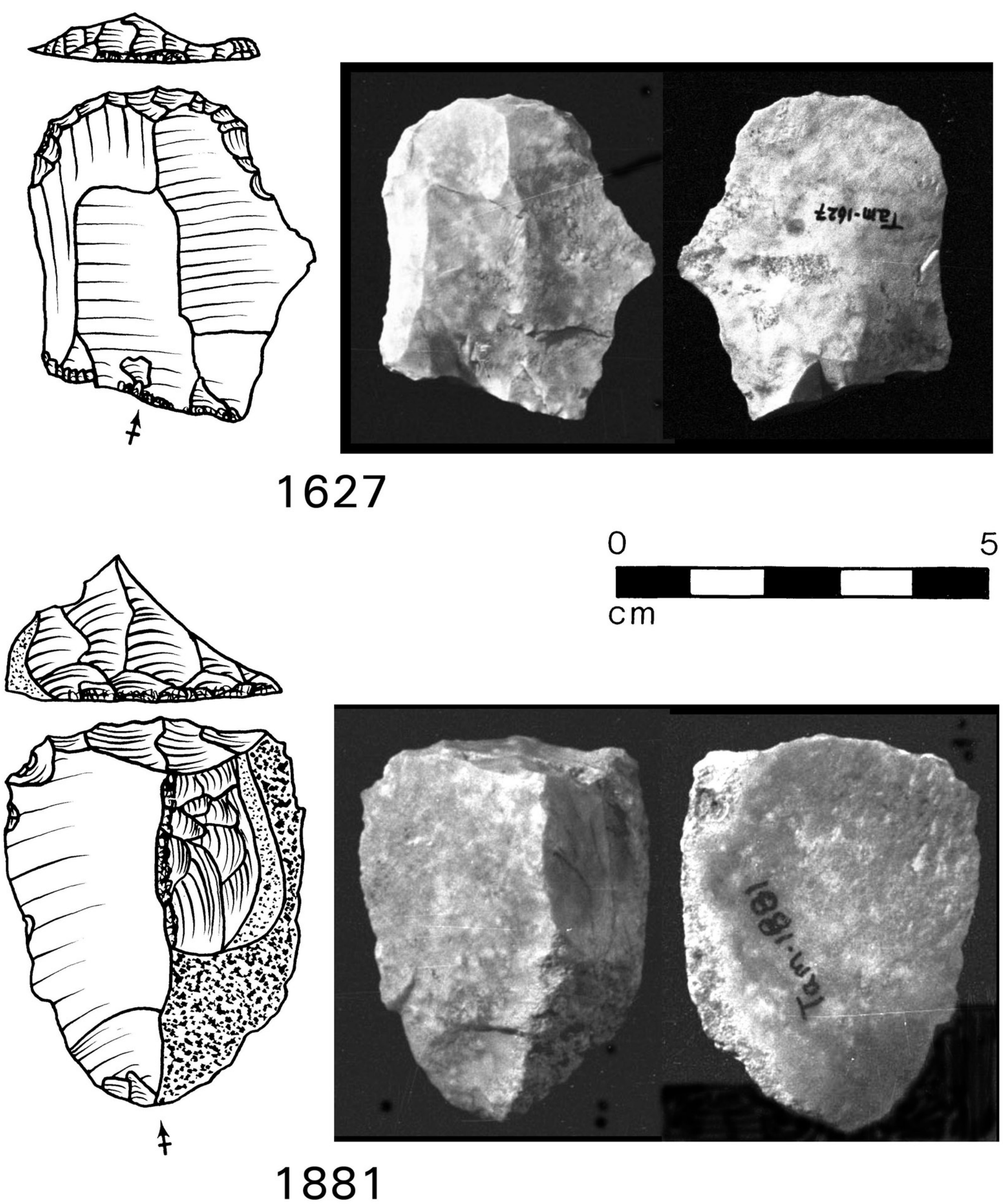


Figure 5-3. End scrapers from Archaeological Level 1 in Area 3 at Les Tambourets.

nal scale, but even with its limitations, the factor analysis is useful in suggesting attribute interactions that must be investigated using other techniques.

Distributional summaries for some of the major attribute sets of end-scrapers are shown, for each of the six samples, in Tables 5-3 and 5-4; other sets, not formally tabulated, will be discussed where relevant. Half to two-thirds of the Tambourets end-scrapers have irregular scraping edge contours (see Figure 5-2, #1957). The very regular arc-of-circle contours (see Figure 5-1, #1706) and asymmetrical contours (see Figure 5-2, #753 and #2714) are found most frequently in the Archaeological Level 1 sample (ca. 38%) and are much less common in the surface samples (see Table 5-3). Blunt point (see Figure 5-1, #483) and flattened (see Figure 5-3, #1627) contours are very infrequent in all areas. Scraping edges formed by inverse retouch (attribute set ES2) are very rare at Les Tambourets; the highest frequency, 6.74%, occurs in Archaeological Level 1. One aspect of variation of the scraping edge that was systematically observed but not formally codified is what one could call the intensity or heaviness of the retouch forming that edge. If, as must be the case, the purpose of retouching was to modify the end of the blank into an appropriate scraping edge morphology, it is understandable that all or part of the original morphology of the end of the blank was sometimes already appropriate, needing little or no modification. The presence of such pieces is a characteristic of the Tambourets end-scraper series. All or part of the scraping edge retouch is very light (small, short scars) applied over a cortical surface, a steep dorsal facet, or a broken surface. Occasionally, some

TABLE 5-1.--Correlation matrix of end-scraper attributes.

	ES5	ES6	ES9	ES10	ES11	ES12	ES13	ES24	ES25
ES 5	1.000								
ES 6	-0.011	1.000							
ES 9	-0.111	0.079	1.000						
ES10	-0.020	0.057	0.013	1.000					
ES11	0.148	-0.065	-0.003	0.581	1.000				
ES12	0.007	0.109	-0.113	0.786	0.392	1.000			
ES13	0.039	0.079	-0.190	0.264	0.066	0.774	1.000		
ES24	0.002	0.082	-0.045	0.746	0.544	0.543	0.129	1.000	
ES25	0.044	0.014	-0.006	0.442	0.724	0.281	0.028	0.611	1.000

ES 5: Retouch angle
ES 6: Retouch pattern
ES 9: Coded orientation angle/asymmetry direction
ES10: Scraping edge width
ES11: Scraping edge thickness
ES12: Scraping edge length
ES13: Roundness index
ES24: Maximum width (W) of blank
ES25: Maximum thickness of blank

TABLE 5-2.--Factor loadings and other results of the factor analysis of end-scraper attributes.

Unrotated Factor Loadings (Pattern) for Principal Components

	Factor 1	Factor 2	Factor 3	Communalities
Retouch angle	0.066	-0.028	-0.643	0.419
Retouch pattern	0.081	0.187	0.517	0.309
Coded or./as.di.	-0.087	-0.341	0.645	0.540
Edge width	0.882	0.013	0.148	0.800
Edge thickness	0.755	-0.424	-0.176	0.781
Edge length	0.825	0.518	0.081	0.956
Roundness index	0.443	0.797	-0.045	0.834
Blank width	0.831	-0.206	0.084	0.740
Blank thickness	0.699	-0.492	-0.083	0.738

Eigenvalues & Cum. % of Total Variance Explained by Factors

Factor	Eigenvalue	Cum. %
1	3.422161	38.02
2	1.520469	54.92
3	1.172426	67.95
4	0.979501	78.83
5	0.829225	88.04
6	0.560695	94.27
7	0.337811	98.03
8	0.157853	99.78
9	0.019860	100.00

(Table 5-2--continued)

Rotated Factor Loadings (Pattern)

	Factor 1	Factor 2	Factor 3
Retouch angle	0.078	0.014	-0.643
Retouch pattern	-0.044	0.197	0.514
Coded or./as.di.	0.114	-0.365	0.652
Edge width	0.733	0.374	0.152
Edge thickness	0.878	-0.078	-0.163
Edge length	0.398	0.821	0.075
Roundness index	-0.080	0.924	-0.059
Blank width	0.815	0.152	0.092
Blank thickness	0.869	-0.166	-0.069

Factor Correlations for Rotated Factors

	Factor 1	Factor 2	Factor 3
Factor 1	1.000		
Factor 2	0.174	1.000	
Factor 3	0.002	0.035	1.000

small part of the scraping edge is completely unretouched. Such pieces account for 16.85% of the scraping edges in Archaeological Level 1, 5.56% in Area 3:Méroc, 10.00% in Area 2:Méroc, and 24.44% in Area 1:Méroc.

Retouch angles (see Table 5-3) are predominantly medium (see Figure 5-1, #483 and #2711) or steep (see Figures 5-2, #753, and 5-3, #1627 and #1881), and the retouch pattern is almost exclusively non-convergent in all samples. The way in which scraping edges are mounted on blanks is shown by the distributions of asymmetry direction (see Table 5-3) and coded orientation angle/asymmetry direction (see Table 5-4). The majority of edges are either square-mounted (see Figures 5-2, #2714, and 5-3, #1881) or only slightly asymmetrical (within 10 degrees of perfect symmetry), but when asymmetry exists, it is somewhat more often to the right (see Figure 5-2, #1957) than to the left (see Figure 5-1, #483). Distributions of scraping edge dimensions and of roundness index are shown in Table 5-4. The bulbar orientation is indeterminate for approximately one-quarter of the blanks; on the remainder, the scraping edge is located very predominantly at the distal rather than at the proximal end (see Table 5-3).

Information about corner features (sets ES15 through ES18) was not collected from pieces from the Méroc surface collection because small notches and removals are frequently occurring results of accidental post-depositional damage in or at the surface of a plough zone. In the Archaeological Level 1 sample, 25 (28.09%) of the scraping edges have corner features, 14 notches and 11 removals. Both are located with approximately equal frequencies on the left and right corners. Corner notches are predominantly obverse and retouched; corner features are almost exclusively inverse and "single-blow". The distribution of tool disposition (see Table 5-3) indicates that over 80% of end-scrapers at Les Tambourets occur as the only tool on the blank.

Châtelperronian end-scrapers at Les Tambourets are very predominantly tools made on flake blanks (see Figures 5-1, #483, and 5-3, #1627 and #1881) or occasionally on chunks (see Figure 5-1, #2711); the highest frequency of blade blanks (see Figures 5-1, #672 and #1706, and 5-2, #1957 and #2714), in Archaeological Level 1, is only 17.98% (see Table 5-3). Between approximately 35% and 45% of all blanks bear at least some cortex on the dorsal surface (see Figures 5-1, #2711, 5-2, #2714, and 5-3, #1881). Distributions of blank dimensions are shown in Table 5-4. Sample values for maximum width (ES24) and maximum thickness (ES25) of the blank are based on the entire sample. Those for length of blank (ES23) are based on subsamples of complete single end-scrapers only. Blank contours (see Table 5-3) are very predominantly irregular (contour 6) (for example, Figure 5-1, #483, #1706, and #2711), and regular contours (2 through 5) (see Figure 5-2, #2714) are predominantly non-parallel. The blank cross-section immediately behind the scraping edge is more often trapezoidal than otherwise, but all three cross-sections are frequent.

The condition of blank margins (set ES28) was recorded fully only for the excavated end-scrapers; pieces from the surface collections have suffered too much post-oc-

TABLE 5-3.--Distributions of scraping edge contour and other attribute sets of end-scrapers.

	Area 3: A.L.1 n	Area 3: A.L.1 %	Area 3: Méroc n	Area 3: Méroc %	Area 2: Méroc n	Area 2: Méroc %	Area 1: Méroc n	Area 1: Méroc %	c.B Bas n	c.C n
Scraping Edge Contour (ES1)										
Arc	18	20.22	18	14.29	14	9.33	4	(8.89)	0	0
Asymmetrical	16	17.98	15	11.90	14	9.33	5	(11.11)	1	0
Blunt Point	5	5.62	9	7.14	12	8.00	6	(13.33)	0	0
Flattened	7	7.87	2	1.59	4	2.67	0	0	2	0
Irregular	43	48.31	82	65.08	106	70.67	30	(66.67)	4	3
TOTAL	89	100.00	126	100.00	150	100.00	45	(100.00)	7	3
Retouch Angle (ES5)										
Acute	4	4.49	2	1.59	2	1.33	0	0	0	1
Medium	38	42.70	47	37.30	54	36.00	13	(28.89)	3	1
Steep	35	39.33	57	45.24	67	44.67	22	(48.89)	3	1
Perpendicular	6	6.74	15	11.90	13	8.67	5	(11.11)	0	0
Overhanging	6	6.74	5	3.97	14	9.33	5	(11.11)	1	0
TOTAL	89	100.00	126	100.00	150	100.00	45	(100.00)	7	3
Retouch Pattern (ES6)										
Convergent	0	0	0	0	2	1.33	0	0	0	0
Semiconvergent	5	5.62	11	8.93	10	6.67	1	(2.22)	2	0
Non-convergent	84	94.38	115	91.27	138	92.00	44	(97.78)	5	3
TOTAL	89	100.00	126	100.00	150	100.00	45	(100.00)	7	3
Asymmetry Dir. (ES8)										
Left	25	28.08	38	30.16	54	36.00	14	(31.11)	4	1
None	31	34.83	42	33.33	43	28.67	15	(33.33)	1	1
Right	33	37.08	46	36.51	53	35.33	16	(35.56)	2	1
TOTAL	89	99.99	126	100.00	150	100.00	45	(100.00)	7	3

(Table 5-3--continued)

	Area 3: A.L.1		Area 3: Méroc		Area 2: Méroc		Area 1: Méroc		c.B Bas	c.C
	n	%	n	%	n	%	n	%	n	n
End of Blank (ES14)										
Distal	51	57.30	81	64.29	98	65.33	31	(68.89)	5	2
Proximal	12	13.48	10	7.94	16	10.67	5	(11.11)	1	1
Indeterminate	26	29.21	35	27.78	36	24.00	9	(20.00)	1	0
TOTAL	89	99.99	126	100.01	150	100.00	45	(100.00)	7	3
Tool Disposition (ES19)										
Single	72	80.90	107	84.92	132	88.00	43	(95.56)	7	2
Double	10	11.24	15*	11.90	7*	4.67	0	0	0	0
Combination	5	5.62	4	3.17	11	7.33	2	(4.44)	0	1
Other	2**	2.25	0	0	0	0	0	0	0	0
TOTAL	89	100.01	126	99.99	150	100.00	45	(100.00)	7	3
Nature of Blank (ES20)										
Blade	16	17.98	12	9.52	18	12.00	6	(13.33)	0	0
Flake	66	74.16	98	77.78	117	78.00	35	(77.78)	7	3
Chunk	7	7.87	16	12.70	15	10.00	4	(8.89)	0	0
TOTAL	89	100.01	126	100.00	150	100.00	45	(100.00)	7	3
including n with cortex (ES21)	32	35.96	56	44.44	67	44.67	15	(33.33)	1	1

(Table 5-3--continued)

	Area 3: A.L.1		Area 3: Méroc		Area 2: Méroc		Area 1: Méroc		c.B Bas	c.C
	n	%	n	%	n	%	n	%	n	n
Blank Contour (ES26)										
Contour 1	5	(11.62)	7	8.64	6	6.25	2	(6.25)	1	1
Contour 2	2	(4.65)	5	6.17	6	6.25	1	(3.13)	0	0
Contour 3	3	(6.98)	3	3.70	8	8.33	2	(6.25)	0	0
Contour 4	0	0	1	1.23	0	0	0	0	0	0
Contour 5	0	0	0	0	0	0	0	0	0	0
Contour 6	33	(76.74)	65	80.25	75	78.13	27	(84.38)	4	0
Contour 7	0	0	0	0	1	1.04	0	0	0	0
TOTAL***	43	(99.99)	81	99.99	96	100.00	32	(100.01)	5	1
Blank Cross-Section (ES27)										
Triangular	24	26.97	39	30.95	36	24.00	12	(26.67)	3	2
Trapezoidal	36	40.45	51	40.48	68	45.33	24	(53.33)	2	0
Amorphous	29	32.58	36	28.57	46	30.67	9	(20.00)	2	1
TOTAL	89	100.00	126	100.00	150	100.00	45	(100.00)	7	3

Notes: * The scraping edge at one end of a double tool is not included in the studied sample because of damage.

** The two scraping edges in question are part of a double end-scraper on a combination tool.

*** The attribute set ES26 is tabulated for complete single end-scrapers only.

TABLE 5-4.--Distributions of scraping edge width and other attribute sets of end-scrapers. Sample values shown are mean ($\bar{X}$) and standard deviation (s).

	Area 3: A.L.1	Area 3: Méroc	Area 2: Méroc	Area 1: Méroc	Area 3: c.B (Basal)	Area 3: c.C
N (scraping edges)	89	126	150	45	7	3
Scraping Edge Width (ES10) in mm						
$\bar{X}$	28.56	29.38	26.75	25.31	28.43	37.00
s	9.70	9.31	9.45	10.27	7.08	9.54
Scraping Edge Thickness (ES11) in mm						
$\bar{X}$	11.23	12.36	10.61	8.91	10.00	13.67
s	5.93	5.21	4.69	4.83	4.32	6.43
Scraping Edge Length (ES12) in mm						
$\bar{X}$	8.21	8.71	7.24	7.22	7.57	9.67
s	4.29	4.26	4.01	4.27	3.36	1.15
Roundness Index (ES13) in degrees						
$\bar{X}$	114.38	118.79	108.15	113.18	109.00	113.33
s	30.09	29.76	32.86	30.08	32.11	29.67
Blank Width (ES24) in mm						
$\bar{X}$	35.93	37.48	35.57	31.36	36.14	39.00
s	8.68	9.86	10.05	9.89	6.84	11.27
Blank Thickness (ES25) in mm						
$\bar{X}$	17.08	18.09	16.23	12.38	13.29	16.00
s	7.01	6.92	6.46	5.46	5.47	4.58

(Table 5-4--continued)

	Area 3: A.L.1	Area 3: Méroc	Area 2: Méroc	Area 1: Méroc	c.B (Basal)	Area 3: c.C
Coded Orient. Angle/ Asymm. Dir. (ES9)						
$\bar{X}$	0.25	0.04	0.09	0.09	-1.29	0.00
s	1.38	1.38	1.83	1.59	1.98	1.00
N(Arc-of-Circle)	18	18	14	4	0	0
Radius of Circle (ES3) in cm						
$\bar{X}$	1.83	1.72	1.57	1.44	0	0
s	0.45	0.65	0.45	0.63	0	0
Degrees of Arc (ES4) in degrees						
$\bar{X}$	111.11	110.56	84.29	97.50	0	0
s	24.23	31.34	31.06	26.30	0	0
N(Complete Singles)	43	81	96	32	5	1
Blank Length (ES23) in mm						
$\bar{X}$	50.93	51.57	49.19	43.75	51.40	52.00
s	9.85	11.44	9.94	13.16	5.94	0

cupational damage to justify attempts to record so-called utilization removals on the margins. In the sample from Archaeological Level 1, 32 (44.44%) of the 72 complete end-scrapers have both margins unmodified; on the others, some kind of modification is present on at least one margin. On 30 examples (41.67%), the heaviest modification is utilization damage (see Figure 5-1, #672 and #1706), 3 on both margins, 16 on the left only, and 11 on the right only. On the remaining ten examples (13.89%), the heaviest modification is marginal retouch, one on both margins, five on the left only, and four on the right only. Three of the retouched pieces bear utilization on the unretouched margin, bringing the total frequency of end-scrapers with utilization damage on the margins to 33 (45.83%).

For the Tambourets series as a whole, only one-quarter or fewer of the end-scrapers bear marginal retouch of any kind (Table 5-5), and the retouch is predominantly partial rather than continuous. Inverse marginal retouch is nearly absent (two cases in the entire series). The most commonly appearing types of marginal retouch are fine, heavy, and stepped (see Table 5-5), and very rarely is there more than one retouch type on a given piece. The distribution of marginal retouch type by zone (set ES32) is shown cross-tabulated by retouch type in Table 5-6. For all samples, marginal retouch occurs slightly more frequently along the left margin (zones 1, 3, and 5) than along the right (zones 2, 4, and 6). Restricting consideration to complete single end-scrapers only, it can be seen that marginal retouch occurs most frequently in the anterior third of the piece (just behind the scraping edge), least frequently in the posterior third, and with intermediate frequencies in the medial third. Table 5-6 was constructed as a cross-tabulation of two attribute sets in order to show a distinctive characteristic unique to the sample from Area 2. On complete pieces from Area 2, fine and heavy marginal retouch occur almost exclusively on left margins, whereas stepped retouch occurs almost exclusively on right margins. This difference is highly significant in a statistical sense,[3] but its cultural significance remains unclear. It should perhaps be considered a stylistic characteristic of Area 2 end-scrapers not shared by those from other areas.

Marginal notches are found on 12 (16.67%) of the 72 single end-scrapers in Archaeological Level 1. Most (14 of 20 tabulated notches) are obverse (see Figure 5-2, #1957);

TABLE 5-5.--Distributions of several attribute sets codifying marginal retouch on end-scrapers.

	Area 3: A.L.1	Area 3: Méroc	Area 2: Méroc	Area 1: Méroc	Area 3: c.B (Basal)	Area 3: c.C
Occurrence of Marginal Retouch (ES28)						
N (singles)	72	107	132	43	7	2
n with marg. retouch	10	21	31	5	2	1
% with marg. retouch	13.89	19.63	23.48	(11.63)		
N (complete singles)	43	81	96	32	5	1
n with marg. retouch	7	14	25	3	1	1
% with marg. retouch	(16.28)	17.28	26.04	(9.38)		
N (broken singles)	29	26	36	11	2	1
n with marg. retouch	3	7	6	2	1	0
% with marg. retouch	(10.34)	(26.92)	(16.67)	(18.18)		
Extent of Marginal Retouch (ES31)						
Continuous	2	8	13	4	2	0
Partial	8	13	18	1	0	1
TOTAL (singles)	10	21	31	5	2	1
Marginal Retouch Type (ES29)						
Fine	3	5	8	2	1	0
Heavy	3	9	12	3	1	0
Scaled	0	3	2	0	0	1
Stepped	3	3	6	0	0	0
Aurignacian	0	1	0	0	0	0
Mixed	1	0	3	0	0	0
TOTAL (singles)	10	21	31	5	2	1

retouched (n=9) and single-blow (n=11) notches are approximately equally frequent. With consideration limited to complete pieces, marginal notches occur with nearly equal frequencies in the anterior, medial, and posterior thirds, but they occur almost exclusively on the left margin (14 of 16 cases) rather than the right. In some assemblages, marginal notches provide information about practices of hafting stone tools, but the data from Les Tambourets do not suggest that end-scrapers were hafted.

End-scraper attribute sets ES36 through ES40—concerning flint variety, double patination, heat alteration, and several characteristics of the striking platform—are discussed elsewhere in this report as part of analyses concerning more than a single artifact class.

The immediately preceding paragraphs have presented a descriptive summary of variation within the Tambourets end-scraper series primarily in terms of single attribute sets. Such a description permits, among other things, some understanding of the "modal" end-scraper at Les Tambourets—most commonly, Châtelperronian end-scrapers from Les Tambourets are single tools, made on rather thick flakes with non-rectilinear edges, have irregular scraping edges made by non-convergent retouch, etc., etc. Another important result of attribute analysis is the investigation of attribute interactions. Such interactions that have been found to be significant in one or more of the Tambourets samples are discussed in the paragraphs that follow. The factor analysis of the excavated sample provides an organi-

TABLE 5-6.--Cross-tabulation of marginal retouch type (ES29) and marginal retouch zone (ES32) of single end-scrapers. Each occurrence of retouch in a given zone is tabulated; totals are, therefore, greater than the number of end-scrapers. Occurrences on complete (C) and broken (B) blanks are tabulated separately.

Zone	Type*	Area 3: A.L.1	Area 3: Méroc	Area 2: Méroc	Area 1: Méroc
1	F	2C	3C	5C	1C + 1B
	H	1C + 1B	2C + 2B	10C + 3B	2C
	S		1C + 1B		
	T		2C	1C	
	A		1C		
2	F	1C	1C	1C + 1B	1B
	H	1C + 1B	2C + 2B	1C + 1B	1C + 1B
	S	1C	1B	1C + 1B	
	T	1C	1B	7C	
	A		1C		
3	F	2C	3C	5C	1C + 1B
	H	1C	1B	7C + 4B	2C
	S		1C + 1B		
	T	1B	1C		
4	F	1C	2C	1C + 2B	
	H	1B	2C	1C + 1B	1C
	S		1C + 1B		
	T	1C	1B	5C	
	A		1C		
5	F	1C	1C	4C	1C
	H		1C + 1B	3C + 1B	1C
	T	1C	1C	1C	
6	F		2C	1C	1C
	H		2C + 1B		
	S			1C	
	T	1C	1B	3C	

Note: F = fine; H = heavy; S = scaled; T = stepped; and A = Aurignacian.

zational framework for this part of the study.

The first and major factor of end-scraper variation was shown to be a factor of size of the blank and, because of very significant correlations, size of the scraping edge. The relationships among the metric dimensions of the scraping edge and the blank and the roundness of the scraping edge are shown as a correlation matrix in Table 5-7; end-scrapers on broken blanks are included here. Table 5-8 is a similar correlation matrix dealing with the dimensions of the blank only, but because the samples are restricted here to complete single end-scrapers, length of the blank can be included. The three blank dimensions are strongly and significantly correlated in all samples. Even stronger and more highly significant correlations occur between edge width and blank width and between edge thickness and blank thickness. For these dimensions, approximately 40% to 70% (depending on the sample) of the variation in scraping edge is determined by the size of the blank. Although blank size is a basic factor of end-scraper variation, it is itself a result of some underlying variables that include the characteristics of the raw material available, the goals of the *débitage* process, and the techniques used to achieve the goals. Some part, at least, of the result of this underlying variation is codified by the attribute set "nature of blank" (ES20), which was not included in the factor analysis. In all samples, nature of the blank has a significant effect (as

TABLE 5-7.--Relationships among several attribute sets of end-scraper scraping edges and blanks. Lower half-matrix tabulates correlation coefficients (r); upper half-matrix tabulates probability values (P). The first listing for each group of four is for Area 3:Archaeological Level 1, N = 89. The second listing is for Area 3:Méroc, N = 126. The third listing is for Area 2:Méroc, N = 150. The fourth listing is for Area 1:Méroc, N = 45.

	Edge Wid.	Edge Th.	Edge Len.	Roundness Index	Blank Width	Blank Thickness
Edge Width		<.001 <.001 <.001 <.001	<.001 <.001 <.001 >.001	.01>P>.001 .10>P>.05 .01>P>.001 .05>P>.02	<.001 <.001 <.001 <.001	<.001 <.001 .05>P>.02 <.001
Edge Thickness	.567 .523 .408 .540		<.001 <.001 <.001 <.001	>.10 >.10 .05>P>.02 .02>P>.01	<.001 <.001 <.001 <.001	<.001 <.001 <.001 <.001
Edge Length	.807 .756 .741 .870	.408 .358 .348 .581		<.001 <.001 <.001 <.001	<.001 .01>P>.001 <.001 <.001	.01>P>.001 >.10 .10>P>.05 <.001
Roundness Index	.302 .164 .251 .296	.108 .057 .195 .386	.778 .731 .795 .678		>.10 >.10 >.10 >.10	>.10 .05>P>.02 >.10 .05>P>.02
Blank Width	.771 .635 .635 .825	.552 .343 .348 .660	.583 .307 .325 .669	.165 -.146 -.049 .157		<.001 <.001 <.001 <.001
Blank Thickness	.442 .405 .204 .473	.724 .675 .655 .821	.294 .131 .147 .492	.052 -.190 .081 .318	.645 .523 .452 .600	

tested by the analysis of variance[4] upon blank thickness). Chunks are thicker than flakes, which are in turn thicker than blades, and varying proportions of blank types in different samples produce different possibilities, at the beginning of the end-scraper manufacturing process, for the final results. Scraping edge thickness may be determined in part by which end of the blank it is mounted on (in addition to maximum blank thickness, as already discussed). In the sample from Archaeological Level 1, scraping edges at the proximal end are significantly thicker than those at the distal end;[5] such differences are not significant at the 0.05 level in the other samples. Edge thickness itself may be a partial determinant of scraping edge retouch angle. In the sample from Area 2 (but not in the others), less steep retouch angles appear on significantly thinner scraping edges than do the steeper angles.[6]

The second major factor of end-scraper variation was identified as a factor of scraping edge shape, best represented in the attribute system by the roundness index. This index is strongly and very significantly correlated with scraping edge length in all samples (see Table 5-7), but its correlations with the other edge dimensions and the blank dimensions are much weaker. Edge length, for its part, is very strongly correlated with the other two linear dimensions of the edge. It is this network of interrelationships that underlies the weak correlation between rotated Factors 1 and 2 (see Table 5-2); the shape (roundness) of the scraping edge is not unrelated to the factor of blank size, but a very small part of the variation in the former is explained by variation in the latter. A significant interaction between scraping edge contour and roundness index might be expected, with the blunt point contour having significantly

TABLE 5-8.--Relationships among blank length, width, and thickness of complete single end-scrapers. The lower half-matrix tabulates correlation coefficients (r); the upper half-matrix tabulates probability values (P). The first listing for each group of four is for Area 3:Archaeological Level 1, N = 43. The second listing is for Area 3:Méroc, N = 81. The third listing is for Area 2:Méroc, N = 96. The fourth listing is for Area 1:Méroc, N = 32.

	Blank Length	Blank Width	Blank Thickness
Blank Length		.01>P>.001 <.001 ca. .001 .02>P>.01	.01>P>.001 <.001 <.001 <.001
Blank Width	.452 .526 .324 .431		<.001 <.001 <.001 <.001
Blank Thickness	.440 .599 .468 .683	.613 .545 .449 .635	

higher index values. In the Tambourets series, this is in fact true only for the sample from Area 2.[7]

The third factor of end-scraper variation has to do, at least in part, with the way the scraping edge is mounted on the blank, as best represented in the attribute system by set ES9, coded orientation angle/asymmetry direction. For some reason not understood (which may have to do with a somewhat different function performed by end-scrapers of different contours), the mean values of ES9 vary considerably when tabulated separately for different edge contours. Blunt point contours have the lowest means, from -1.22 to -0.20, indicating the most pronounced tendency toward left asymmetry. The overall differences, as tested by analysis of variance, are significant in the Méroc sample from Area 3.[8] It seems probable, therefore, that scraping edge contour, which could not be included in the factor analysis, is to some extent another determinant of the kind of variation treated by Factor 3.

The discussion of attribute variation in the preceding paragraphs and the data presented in the accompanying tables make it clear that although the end-scrapers in the several samples analyzed are quite similar, they are by no means identical. Of the four principal samples, the end-scrapers collected by Méroc from the surface of Area 1 seem, in general, to differ most consistently from the rest, but each individual sample has its own peculiarities with respect to one or more attribute sets. A systematic investigation of inter-sample relationships was carried out by calculating a measure of difference between all possible sample pairs and by using these measures to construct sample clusters based on the magnitude of intersample similarities and differences. The measure on which the clustering was based in the Mahalanobis generalized distance statistic, D^2, a multivariate measure of formal difference or distance (in this case typological/technological distance) between several groups of objects. This statistic permits the use of groups of different sample sizes and different linear scales (Doran and Hodson 1975: 210). Correlation between and among variables does not distort the calculation of D^2, as it does for the calculation of simple Euclidean distance, because the variables are transformed in order to remove correlation (Rightmire 1969: 158; Solomon 1971: 66–67). Furthermore, the significance of D^2 values can be readily determined. These characteristics of D^2 make it very well suited for the kind of analysis at issue here.

The end-scraper attribute sets used in the computation of generalized distance and the subsequent cluster analysis were the following: ES5, ES9, ES10-ES13, and ES23-ES25. In other words, all but one of the non-nominal-scale sets used in the factor analysis were used here, and length of blank (ES23) was added. Retouch pattern (ES6) was eliminated because the attributes of this set are virtually invariant both within and among samples. In order to be able to include length of blank, the samples were restricted to complete single end-scrapers.

The values of D^2 for each pair of samples are shown in the lower half-matrix of Table 5-9.[9] Probability values for D^2 are obtained using the F distribution, according to the following formula (Rao 1952: 247):

TABLE 5-9.--Relationships among five samples of complete single end-scrapers, based on variation in nine attribute sets (ES5, ES9, ES10-ES13, ES23-ES25). Lower half-matrix contains values of the Mahalanobis generalized distance statistic (D^2). Upper half-matrix contains 2-tailed probability values for the distance measures.

	1	2	3	4	5
1		>.20	>.20	.12	>.20
2	.20		>.20	.040	.14
3	.46	.24		.15	>.20
4	1.07	.98	.73		>.20
5	4.34	3.92	2.76	3.50	

Sample 1. Area 3:A.L.1 N = 43
Sample 2. Area 3:Méroc N = 81
Sample 3. Area 2:Méroc N = 96
Sample 4. Area 1:Méroc N = 32
Sample 5. Area 3:c.B(Basal) N = 5

$$F = \frac{n_1 n_2 (n_1+n_2-p-1)}{p(n_1+n_2)(n_1+n_2-2)} \times D^2$$

where p is the number of variables used in the analysis. The degrees of freedom are v_1=p and v_2=n_1+n_2-1-p. The probabilities for the tabulated distance measures are shown in the upper half-matrix of Table 5-9. It is immediately obvious that the Archaeological Level 1 sample is most similar to (that is, least distant from) Méroc's surface-collected sample from the same area, which is a very satisfying result. The rather discordant position of the Area 1 end-scrapers with reference to those from the other three large samples is also quite clear, particularly from the lower probability figures. Sample 5 is, of course, too small for its inclusion in this analysis to have much meaning. It is, however, a matter of possible interest (to which the discussion will return later in this study) that the end-scrapers excavated from Area 3:couche B(Basal) appear to be most similar to those from Area 2:Méroc rather than to those from Area 3:Archaeological Level 1 or from Area 3:Méroc.

The D^2 measure of distance (or dissimilarity) was converted into a measure of *similarity* by calculating its 10-complement (=10-D^2), and, using this similarity measure, the five samples were clustered utilizing the weighted pair-group method (WPGM) of Sokol and Sneath (1963). The resulting dendrogram (Figure 5-4) represents graphically the typological/technological relationships among the samples. In brief, the two samples from Area 3, one excavated and one collected from the surface, are very, very similar. The sample from Area 2, just to the south of Area 3 on the same +30m terrace and separated from it only by a

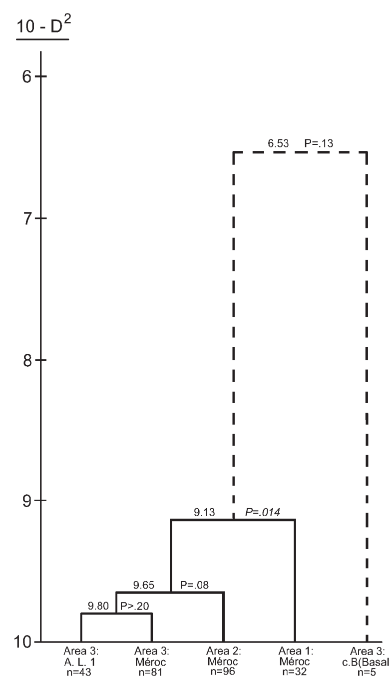


Figure 5 4. Dendrogram showing relationships among end scraper samples at Les Tambourets based on a similarity measure, as discussed in the text.

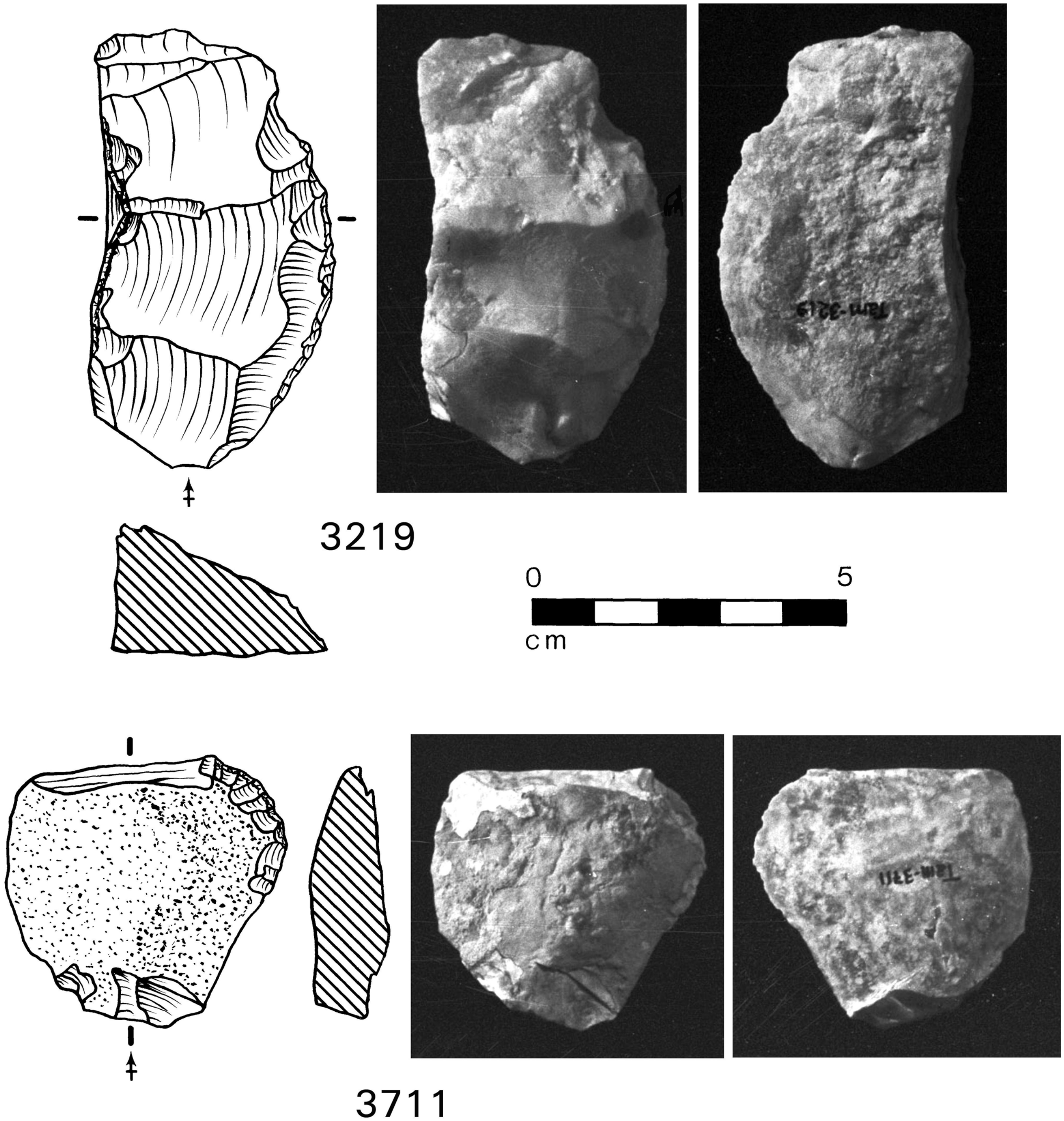


Figure 5-5. Side scrapers from Archaeological Level 1 in Area 3 at Les Tambourets.

modern road, is similar to both Area 3 samples but clearly distinguished from them. The sample from Area 1, situated at one corner of the site and on the lower, +15m terrace, is distinctly different. This difference is consistent with the combined distributional data on all major tool classes, as discussed in Chapter 3.

II. SIDE-SCRAPERS

The attribute analysis of side-scrapers from Les Tambourets (Figures 5-5 and 5-6) is based primarily on the excavated sample from Area 3:Archaeological Level 1 and the two samples collected by Méroc from the surfaces of Areas 3 and 2. The Méroc collection sample from Area 1 and the excavated sample from Area 3:couche C are too small to be useful, and only one side-scraper was found in the excavated assemblage sample from Area 3:couche B(Basal).

Scraping edge contours (Table 5-10) are predominantly irregular (see Figure 5-6, #4057, right margin, #6792, and #2902), although a few more regular contours exist—for example, arc-of-circle (see Figure 5-5, #3219 and #3711) and asymmetrical (see Figure 5-6, #4057, inverse scraper on left margin). Inverse scraping edges, generally infrequent, at-

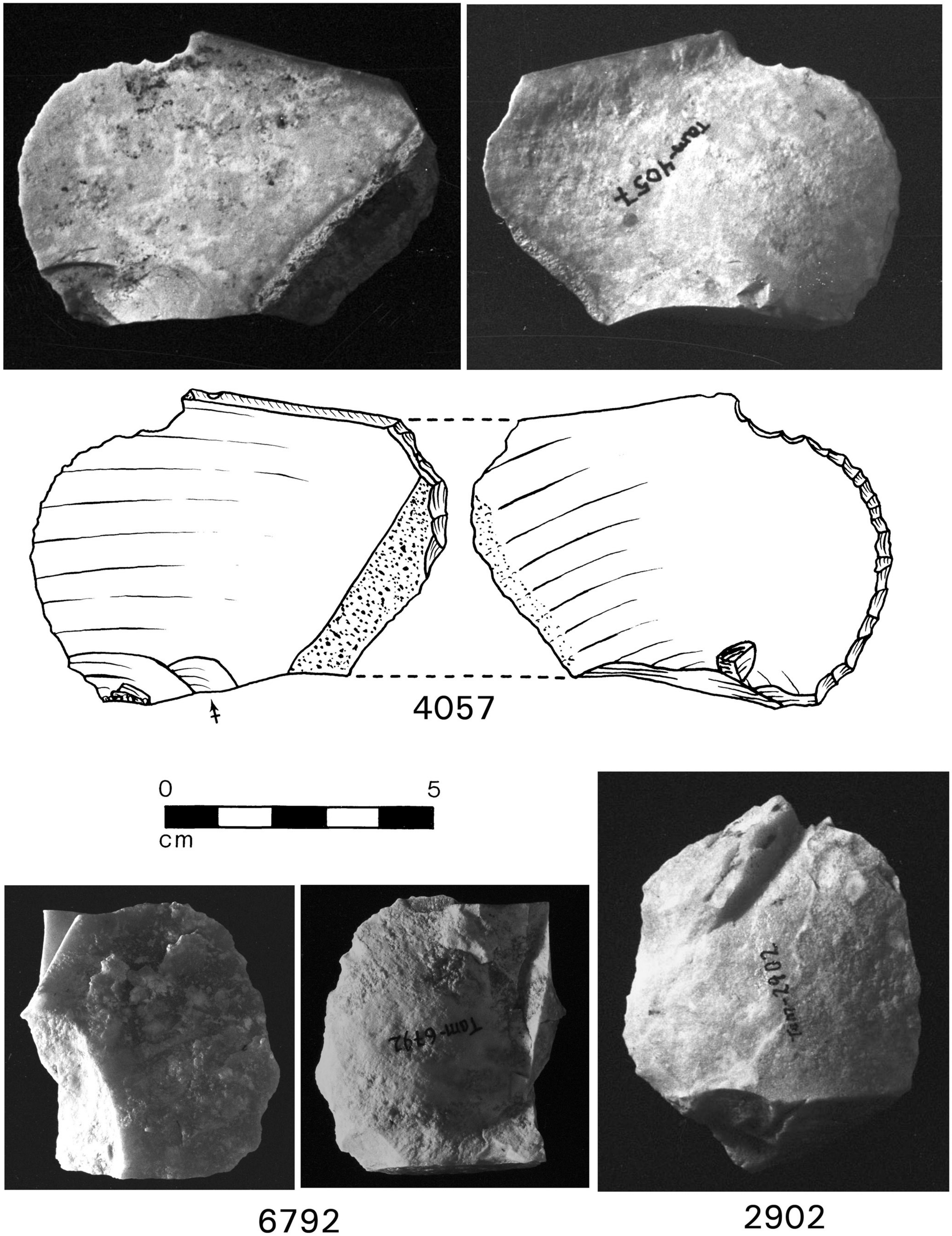


Figure 5-6. Side scrapers from Archaeological Level 1 in Area 3 at Les Tambourets.

TABLE 5-10.--Distributions of scraping edge contour and other attribute sets of side-scrapers.

	Area 3: A.L.1		Area 3: Méroc		Area 2: Méroc		Ar.1: Méroc	Ar.3: c.C
	n	%	n	%	n	%	n	n
Scraping Edge Contour (SS1)								
Arc	8	(24.24)	5	9.80	5	(10.42)	0	1
Asymmetrical	2	(6.06)	7	13.73	2	(4.17)	1	0
Blunt Point	1	(3.03)	5	9.80	5	(10.42)	0	1
Flattened	1	(3.03)	0	0	1	(2.08)	1	0
Irregular	21	(63.64)	34	66.67	35	(72.92)	5	2
TOTAL	33	(100.00)	51	100.00	48	(100.01)	7	4
Retouch Angle (SS5)								
Acute	1	(3.03)	0	0	3	(6.25)	1	0
Medium	15	(45.45)	28	54.90	15	(31.25)	4	2
Steep	16	(48.48)	16	31.37	23	(47.92)	2	2
Perpendicular	1	(3.03)	5	9.80	3	(6.25)	0	0
Overhanging	0	0	2	3.92	4	(8.33)	0	0
TOTAL	33	(99.99)	51	99.99	48	(100.00)	7	4
Asymmetry Direction[Φ] (SS8)								
Left	9	(27.27)	24	47.06	17	(35.42)	5	2
None	10	(30.30)	12	23.53	10	(20.83)	2	0
Right	14	(42.42)	15	29.41	21	(43.75)	0	2
TOTAL	33	(99.99)	51	100.00	48	(100.00)	7	4
Location of Scraping Edge (SS14)								
Left	10	(30.30)	21	41.18	27	(56.25)	3	2
Right	22	(66.67)	30	58.82	21	(43.75)	4	2
Indeterminate	1	(3.03)	0	0	0	0	0	0
TOTAL	33	(100.00)	51	100.00	48	(100.00)	7	4

(Table 5-10--continued)

	Area 3: A.L.1		Area 3: Méroc		Area 2: Méroc		Ar.1: Méroc	Ar.3: c.C
	n	%	n	%	n	%	n	n
Tool Disposition (SS15)								
Single	25	(75.76)	32	62.75	37	(77.08)	7	0
Double	6	(18.18)	14	27.45	8	(16.67)	0	4
Combination	2	(6.06)	3	5.88	2	(4.17)	0	0
Other	0	0	2*	3.92	1**	(2.08)	0	0
TOTAL	33	(100.00)	51	100.00	48	(100.00)	7	4
Nature of Blank (SS16)								
Blade	0	0	1	1.96	1	(2.08)	0	0
Flake	31	(93.94)	50	98.04	47	(97.92)	7	4
Chunk	2	(6.06)	0	0	0	0	0	0
TOTAL	33	(100.00)	51	100.00	48	(100.00)	7	4
including n with cortex (SS17)	20	(60.61)	18	35.29	20	(41.67)	3	4
Blank Contour (SS23)								
Contour 1	1	(5.56)	0	0	0	0	0	2
Contour 2	0	0	0	0	0	0	0	1
Contour 3	0	0	0	0	0	0	0	0
Contour 4	0	0	0	0	0	0	0	1
Contour 5	1	(5.56)	0	0	0	0	0	0
Contour 6	16	(88.89)	20	(95.24)	28	(100.00)	5	0
Contour 7	0	0	1	(4.76)	0	0	0	0
TOTAL⊕⊕	18	(100.01)	21	(100.00)	28	(100.00)	5	4

(Table 5-10--continued)

	Area 3: A.L.1 n	Area 3: A.L.1 %	Area 3: Méroc n	Area 3: Méroc %	Area 2: Méroc n	Area 2: Méroc %	Ar.1: Méroc n	Ar.3: c.C n
Blank Cross-Section (SS24)								
Triangular	5	(15.15)	10	19.61	3	(6.25)	1	1
Trapezoidal	4	(12.12)	11	21.57	14	(29.17)	1	1
Amorphous	24	(72.73)	30	58.82	31	(64.58)	5	2
TOTAL	33	(100.00)	51	100.00	48	(100.00)	7	4

Notes:

Φ Measured as if the piece were an end-scraper, with the scraping edge at the end or corner of the blank

* A double side-scraper is on the same blank with a truncated flake.

** The side-scraper is on the same blank with a double dihedral burin.

ΦΦ Attribute set SS23 is tabulated for complete single side-scrapers only.

tain their highest frequency (15.15%) in Archaeological Level 1 (see Figure 5-6). Medium or steep retouch angles are found on more than three-quarters of the scraping edges. As would be expected for scraping edges applied to the lateral margins of blanks, retouch pattern is almost exclusively non-convergent (93.94% in Archaeological Level 1, 98.04% in Area 3:Méroc, and 100.00% in the other samples). Sample values for the scraping edge dimensions and the roundness index are shown in Table 5-11.

The way in which the scraping edge is mounted on the blank is recorded for side-scrapers *as if* the scraping edge were located at an end of the blank rather than on the side, in order to provide some point of comparison with end-scrapers (cf. Appendix B, section III, attribute sets SS8, SS9, and SS10). The majority of side-scraper edges, like those of end-scrapers, are either square-mounted or within ten degrees of it, but there is no clear dominance in the series of either left or right asymmetry. Location of the scraping edge with respect to the blank in its true bulbar orientation is measured directly by set SS14 (see Table 5-10), and again the samples are heterogeneous. A right-margin location is most frequent for the two Area 3 samples (see Figures 5-5, #3219 and #3711, and 5-6, #6792 and #2902), but not for the others.

Although the majority of side-scrapers are single-edged, double side-scrapers are not infrequent (see Table 5-10). On one example each in Archaeological Level 1 (see Figure 5-6, #4057) and Area 2:Méroc and on three examples in Area 3:Méroc, the direction of scraping edge retouch on the two edges differs, one side being obverse and the other inverse. Side-scrapers at Les Tambourets are made almost exclusively on flakes (see Table 5-10), often cortical flakes (see Figures 5-5, #3711, and 5-6, #4057). As shown in the tabulation of blank dimensions (see Table 5-11), the blanks are quite broad for their length; mean length values exceed mean width values by only a few millimeters, if at all. As would be expected for such blanks, the blank contour is almost exclusively the non-rectilinear "contour 6" (see Table 5-10). Because the scraping edges have been applied to the *margins* of (frequently cortical) blanks, the blank cross-section immediately behind the scraping edge is predominantly amorphous.

Attribute interactions between pairs of continuous variates are shown as a correlation matrix in Table 5-12. The three linear dimensions of the scraping edge are significantly and positively correlated in most samples. Round-

TABLE 5-11.--Distributions of scraping edge width and other attribute sets of side-scrapers. Sample values shown are mean ($\bar{X}$) and standard deviation (s).

	Area 3: A.L.1	Area 3: Méroc	Area 2: Méroc	Area 1: Méroc	Area 3: c.C
N (scraping edges)	33	51	48	7	4
Scraping Edge Width (SS10) in mm					
$\bar{X}$	32.76	32.43	31.08	27.71	34.50
s	10.99	11.40	9.98	12.24	14.39
Scraping Edge Thickness (SS11) in mm					
$\bar{X}$	11.18	11.41	11.21	6.71	14.00
s	4.03	5.15	5.59	3.25	5.10
Scraping Edge Length (SS12) in mm					
$\bar{X}$	7.30	7.78	7.54	6.86	8.00
s	3.84	4.47	5.38	3.98	2.83
Roundness Index (SS13) in degrees					
$\bar{X}$	94.64	100.75	96.29	101.57	102.00
s	30.20	31.69	45.73	23.43	15.63
Blank Thickness (SS22) in mm					
$\bar{X}$	20.00	18.16	17.17	12.86	28.00
s	9.23	5.79	6.13	2.97	13.86
Coded Orient. Angle/ Asymmetry Dir. (SS9)*					
$\bar{X}$	0.48	-0.39	0.15	-0.71	0.50
s	1.82	2.11	2.30	0.49	3.11

(Table 5-11--continued)

	Area 3: A.L.1	Area 3: Méroc	Area 2: Méroc	Area 1: Méroc	Area 3: c.C
N (Arc-of-Circle)	8	5	5	0	1
Radius of Circle (SS3) in cm					
$\bar{X}$	2.00	2.35	2.30	0	4.00
s	1.12	2.20	1.16	0	0
Degrees of Arc (SS4) in degrees					
$\bar{X}$	95.00	104.00	68.00	0	70.00
s	32.95	31.31	21.68	0	0
N (Complete Singles)	18	21	28	5	0
Blank Width (SS21) in mm					
$\bar{X}$	49.33	43.67	43.39	45.20	0
s	11.26	12.31	10.35	8.32	0
Blank Length (SS19) in mm					
$\bar{X}$	54.78	45.43	47.46	40.40	0
s	12.41	12.32	11.42	6.88	0

Note: * Measured as if the piece were an end-scraper, with the scraping edge at an end or corner of the blank

TABLE 5-12.--Relationships among several attribute sets of the scraping edges and blanks of complete single side-scrapers. Lower half-matrix tabulates correlation coefficients (r); upper half-matrix tabulates probability values. The first listing for each group of four is for Area 3:Archaeological Level 1, N = 18. The second listing is for Area 3:Méroc, N = 21. The third listing is for Area 2:Méroc, N = 28. The fourth listing is for Area 1:Méroc, N = 5.

	Edge Width Thickness (SS10)	Edge Thickness (SS11)	Edge Length (SS12)	Roundness Index (SS13)	Blank Length (SS19)	Blank Width (SS21)	Blank (SS22)
S		>.10	.01>P>.001	>.10	>.10	>.10	>.10
S		.01>P>.001	.01>P>.001	>.10	.01>P>.001	>.10	>.10
1		<.001	<.001	>.10	<.001	.10>P>.05	.01
0		>.10	.02>P>.01	>.10	.02>P>.01	>.10	>.10
S	.373		>.10	>.10	.02>P>.01	>.10	.10>P>.05
S	.587		.05>P>.02	>.10	>.10	>.10	>.10
1	.632		.01>P>.001	.10>P>.05	.05>P>.02	>.10	<.001
1	.505		>.10	>.10	>.10	>.10	>.10
S	.685	.114		.02>P>.01	>.10	>.10	>.10
S	.569	.495		.01>P>.001	>.10	.05>P>.02	>.10
1	.714	.567		<.001	>.10	>.10	.10>P>.05
2	.952	.253		>.10	>.10	>.10	>.10
S	-.158	-.266	.581		>.10	>.10	>.10
S	-.258	.002	.617		.02>P>.01	>.10	>.10
1	.228	.372	.799		>.10	>.10	>.10
3	.330	-.441	.589		>.10	.05>P>.02	>.10
S	.392	.586	-.021	-.351		.01>P>.001	.01>P>.001
S	.599	.199	.037	-.546		>.10	>.10
1	.618	.394	.196	-.152		.05>P>.02	.01>P>.001
9	.944	.710	.798	.009		>.10	.10>P>.05
S	.159	.374	.029	-.094	.602		.05>P>.02
S	.239	.173	.501	.241	.341		.05>P>.02
2	.351	.270	.240	.182	.424		.05>P>.02
1	.131	-.325	.374	.916	-.159		>.10
S	.088	.457	-.316	-.388	.670	.487	
S	.267	.362	.206	-.059	.347	.453	
2	.486	.795	.357	.243	.539	.392	
2	.735	.435	.584	-.234	.834	-.530	

ness index is most consistently correlated with scraping edge length. The positive correlation between scraping edge width and blank length, highly significant in all samples except Archaeological Level 1, reflects the fact that on a side-scraper the line measured as scraping edge width is often nearly parallel to the line measured as blank length; the longer the blank length, the longer scraping edge "width" can be. Finally, the three dimensions of the blank have a significant positive correlation in most samples. The only significant interaction between nominal-scale sets and other sets appears in the Archaeological Level 1 sample, where scraping edge thickness differs significantly by scraping edge contour, as measured by the analysis of variance;[10] the mean thickness for side-scrapers with irregular contours is much greater than those for the other contours.

III. END-AND-SIDE-SCRAPERS

End-and-side-scrapers (Figure 5-7) are an infrequently occurring artifact class at Les Tambourets, but three samples (from Area 3:Archaeological Level 1, Area 3:Méroc, and Area 2:Méroc) are large enough to contribute usefully to attribute analysis. There are, in addition, four end-and-side-scrapers from Area 3:couche B(Basal) and one from Area 1:Méroc.

The attribute set "scraping edge contour," used to measure variation in end-scrapers and side-scrapers, is of no utility in the study of end-and-side-scrapers; all examples (at least in the Tambourets samples) would be "irregular," an essentially meaningless observation in the absence of contrast. The retouch direction is almost exclusively obverse. One scraping edge (in Area 3:couche B(Basal) is inverse, and three (one each in Archaeological Level 1, Area 3:Méroc, and Area 2:Méroc) are mixed, with the retouch at the end and that on the side appearing on different faces (see Figure 5-7, #2832). The retouch angle is predominantly steep in the samples collected by Méroc and medium or steep in Archaeological Level 1 (Table 5-13). Scraping edge dimensions and roundness index are shown in Table 5-14. The samples appear to be heterogeneous with respect to scraping edge location (see Table 5-13), but the sample sizes are, of course, all quite small. The great majority of end-and-side-scrapers are the only tool on the blank in question. With the exception of one scraper in Area 3:couche B(Basal) that is made on a chunk, all examples occur on flake blanks, approximately half of which are cortical (see Figure 5-7, #5923 and #3904). The dimensions of the blank, for complete single tools only, are shown in Table 5-14.

Significant attribute interactions within the rather abbreviated attribute system for end-and-side-scrapers are limited to correlations between continuous variates. The correlation matrix, which it does not seem necessary to reproduce here, demonstrates four points: a) that there are the by now expectable positive intercorrelations among the blank dimensions; b) that scraping edge width is significantly determined by the length and width of the blank; c) that edge thickness is determined primarily by blank thickness; and, d) that variation in roundness index is determined primarily by variation in edge length.

IV. DISCOIDAL SCRAPERS

Discoidal scrapers from Les Tambourets (Figures 5-8, 5-9, 5-10, and 5-11) studied by attribute analysis include 15 tools from Area 3:Archaeological Level 1, 13 from Area 3:Méroc, 17 from Area 2:Méroc, and 4 from Area 1:Méroc. Not included in the summary tabulations is one discoidal scraper from Area 3:couche C.

The great majority of scraping edges are formed with obverse retouch (attribute set DS1; cf. Appendix B, section V); one scraping edge (in Archaeological Level 1) is inverse and four (three in Archaeological Level 1 and one in Area 3:Méroc) are mixed, obverse in part and inverse in another part (see Figure 5-10, #6713). In a few cases, the irregularity of the edge approaches a true denticulation (see Figures 5-8, #5881, and 5-11, #431). Retouch angles are predominantly medium or steep (Table 5-15). *All* discoidal scrapers are made on flake blanks, approximately half of which are cortical (see Figures 5-8, #1295+2244, #5881, and #6765, and 5-11, #431). The distributions of scraping edge thickness and of the three dimensions of the blank are shown in Table 5-15. (The inability to include scraping edge width and length or roundness index is explained in detail in Appendix B, section V, q.v.) The near equality in the means of blank length and blank width is to be expected for a class of scrapers called "discoidal." The only attribute interactions present are among the dimensions of the blank, edge thickness with blank thickness, and (in Area 3:Méroc only) edge thickness with blank length; in each case, the interaction takes the form of a significant positive correlation.

V. RELATIONSHIPS AMONG SCRAPER CLASSES

The Châtelperronian scrapers from Les Tambourets were sorted, for purposes of attribute analysis, into four classes: end-scrapers, side-scrapers, end-and-side-scrapers, and discoidal scrapers. The impression received after handling the objects themselves is, however, that such a four-way subdivision of the series overstates the variation really present in the series, particularly with respect to the separation of end-scrapers and side-scrapers. Such a separation, a typological distinction conforming to long-established typological practice (e.g., de Sonneville and Perrot 1954; 1956b), gives primacy to one aspect of scraper variation—the relationship of the scraping edge to the bulbar axis of the blank—to the exclusion of aspects that are just as surely important, such as the characteristics of the scraping edge itself and the characteristics of the blank. Whereas in some (or many) Upper Palaeolithic assemblages, covariation among scraper attributes may be such that the defining distinction between end-scrapers and side-scrapers is an operationally useful short-cut to the separation of tool classes that differ in multiple and complex other ways, this is not necessarily the case at Les Tambourets, where most scrapers are made on very similar blanks.

An attempt to clarify the typological relationships among the four scraper classes in a systematic and multivariate fashion was made using a statistical technique called discriminant analysis. One use of this technique is "...to dis-

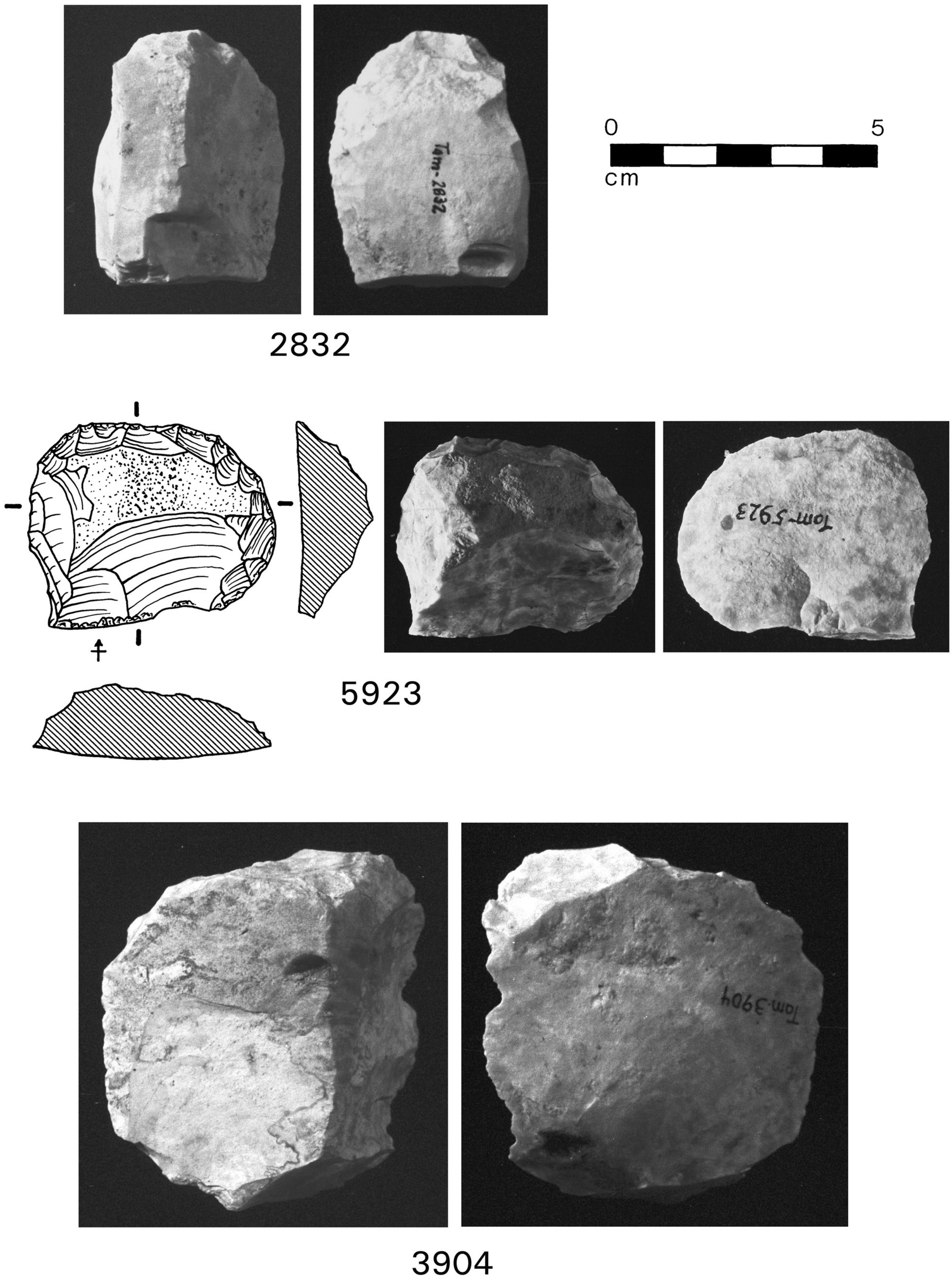


Figure 5-7. End and side scrapers from Archaeological Level 1 in Area 3 at Les Tambourets.

TABLE 5-13.--Distributions of retouch angle and other attribute sets of end-and-side-scrapers.

	Area 3: A.L.1	Area 3: Méroc	Area 2: Méroc	Area 3: c.B(Bas)
Retouch Angle (EA2)				
Acute	1	0	0	0
Medium	6	4	3	2
Steep	5	11	11	2
Perpendicular	1	1	1	0
Overhanging	1	1	0	0
TOTAL	14	17	15	4
Location of Scraping Edge (EA7)				
End + Left	9	4	10	1
End + Right	5	12	5	3
End + Both	0	1	0	0
Indeterminate	0	0	0	0
TOTAL	14	17	15	4
Tool Disposition (EA8)				
Single	14	14	15	3
Double	0	1	0	0
Combination	0	2	0	1
Other	0	0	0	0
TOTAL	14	17	15	4

cover and emphasise those attributes which discriminate between...known groups" (Doran and Hodson 1975: 209) through the calculation of "discriminant functions" or "canonical variables" (also called "canonical variates"). A brief description of the use of the technique is given by Doran and Hodson (1975: 210), as follows:

> "The functions are calculated by a procedure similar to principal components so that each successive canonical variate accounts for the maximum possible separation between group centroids. As with principal components, it is hoped, and is often found, that the first few canonical variates account for most of the inter-group variance. This allows the group centroids and individual units to be plotted in a space of reduced dimensions, often two dimensions..., so that interrelationships between the groups may be appreciated visually."

The results of a discriminant analysis provide, among other things, an evaluation of the adequacy or utility of the typological distinctions that have created the separate groups used in the analysis. The scrapers chosen for discriminant analysis are a pooled sample of all complete single scrapers from Area 3:Archaeological Level 1 and those collected from the surface of Area 3 by Méroc. The pooled sample is composed of 202 artifacts: 124 end-scrapers, 39 side-scrapers, 21 end-and-side-scrapers, and 18 discoidal scrapers. Because all scrapers in the total sample must be evaluated in terms of the same attribute sets and because nominal-scale attributes are not appropriate for this analysis, only those parts of each scraper-class attribute system that apply to all other classes can be used. The characteristics of the blank are represented by its three linear dimensions and the characteristics of the scraping edge by retouch angle (an ordinal-scale attribute) and scraping edge thickness.

Roundness index, an attribute set of great utility in characterizing scraping edge morphology for most scraper classes, is of no use for discoidal scrapers (cf. Appendix B, section V) and cannot be employed in the discriminant analysis. It is, however, possible to calculate or to measure directly another characteristic of the scraping edge that applies to all four scraper classes—the actual length

TABLE 5-14.--Distributions of scraping edge width and other attribute sets of end-and-side-scrapers. Sample values shown are mean ($\bar{X}$) and standard deviation (s). Samples for EA3 through EA6 and EA15 include all end-and-side-scrapers. Samples for EA12 and EA14 include complete single end-and-side-scrapers only.

		Area 3: A.L.1	Area 3: Méroc	Area 2: Méroc	Area 3: c.B(Bas)
Scraping Edge Width (EA3)					
	n	14	13*	15	4
	$\bar{X}$	48.93	45.85	42.00	39.25
	s	9.27	9.22	10.93	10.24
Scraping Edge Thickness (EA4)					
	n	14	17	15	4
	$\bar{X}$	14.14	14.53	13.60	15.75
	s	7.17	4.62	4.37	6.95
Scraping Edge Length (EA5)					
	n	14	15**	15	4
	$\bar{X}$	20.79	27.00	22.87	19.00
	s	8.08	7.46	8.40	10.42
Roundness Index (EA6)					
	n	14	13*	15	4
	$\bar{X}$	153.50	196.92	185.00	164.50
	s	35.33	30.29	35.77	55.45
Blank Length (EA12)					
	n	11	10	15	2
	$\bar{X}$	52.18	48.20	49.13	41.50
	s	10.61	9.99	10.36	4.95
Blank Width (EA14)					
	n	11	10	15	2
	$\bar{X}$	49.82	44.90	41.40	41.00
	s	7.99	9.62	10.12	18.38

(Table 5-14--continued)

	Area 3: A.L.1	Area 3: Méroc	Area 2: Méroc	Area 3: c.B(Bas)
Blank Thickness (EA15)				
n	12Φ	17	15	4
$\bar{X}$	20.58	20.06	17.60	20.25
s	8.44	4.86	4.87	3.30

Notes:
* Three slightly broken scraping edges and one on a double-sided tool are excluded.

** One slightly broken scraping edge and one on a double-sided tool are excluded.

Φ Two pieces with missing data are excluded.

in millimeters of the curving line of scraping edge retouch (ignoring the minor irregularities that result from the concavity of the retouch scars themselves). This measurement, termed "perimeter length", was calculated for end-scrapers, side-scrapers, and end-and-side-scrapers according to the following formula:

Perimeter length = RI(p/sin P) sin R

where RI=roundness index expressed in radians, p=0.5(Edge Width), P=0.5(RI), and R=0.5(3.14159). (The value of R is the value of a right angle expressed in radians.) For discoidal scrapers, perimeter length was measured directly from drawings of the pieces. The discriminant analysis is, then, based on six attribute sets, three of the scraping edge itself and three of the blank.

The discriminant analysis[11] eliminated two of the attribute sets, using only scraping edge thickness, perimeter length, blank length, and blank width in the calculation of the canonical variables. These four attribute sets permitted the specification of three canonical variables, as follows:

Canonical variable 1=0.075(Edge Thickness)-0.079(Perimeter Length)+0.020(Blank Length)+0.014(Blank Width)+1.343

Canonical variable 2 = 0.070(Edge Thickness)+0.015(Perimeter Length)+0.051(Blank Length)-0.119(Blank width)+0.806

Canonical variable 3 = -0.172(Edge Thickness)+0.014(Perimeter Length)+0.001(Blank Length)-0.032(Blank Width)+2.713

The first canonical variable is by far the most important, and the first two taken together account for almost all of the intergroup variation in the sample (Table 5-16). The calculation program used adds variables (attribute sets) to the discriminant function in order of their importance. The first variable to be entered is "...the variable that adds most to the separation of the groups..." (Jennrich and Sampson 1981: 519); the second variable entered is the most discriminating of the remaining variables, and so on until no purpose is served by adding more variables. The order of entry of the four attribute sets retained by the analysis and the means and standard deviations for each set in each of the four groups is shown in Table 5-16. Given the attribute sets available for use, perimeter length is the most important overall discriminator, but it alone would be of little use in the separation of end-scrapers and side-scrapers. Similarly, blank width alone cannot separate side-scrapers from end-and-side-scrapers. The need for a multivariate approach is clearly indicated by these data.

The adequacy of the initial typological separation of the Tambourets scrapers into four classes may be judged, in part, by the results of reclassification of each of the 202 scrapers into the four given classes on the basis of the relationships among the four most discriminating attribute sets, as determined by the analysis. The results of such reclassification, shown in Table 5-16, indicate that whereas discoidal scrapers are an objectively distinct class within the Tambourets scraper series, the other three scraper classes overlap to a considerable extent. This is shown graphically in the scatterplot of all 202 scrapers along the axes of the first two canonical variates (Figure 5-12). As the awkward hyphenated name implies, end-and-side-scrapers are in some sense an intermediate or transgressive class, and these scrapers are the only ones to have been distributed among all four scraper groups by the reclassification.

The most serious inadequacy of the initial typological separation is indicated by the overlap between end-scrapers and side-scrapers, classes that might be expected to contain distinctly different kinds of tools. What this typological overlap documented by the discriminant analysis has to tell us about the Tambourets scraper series may be further

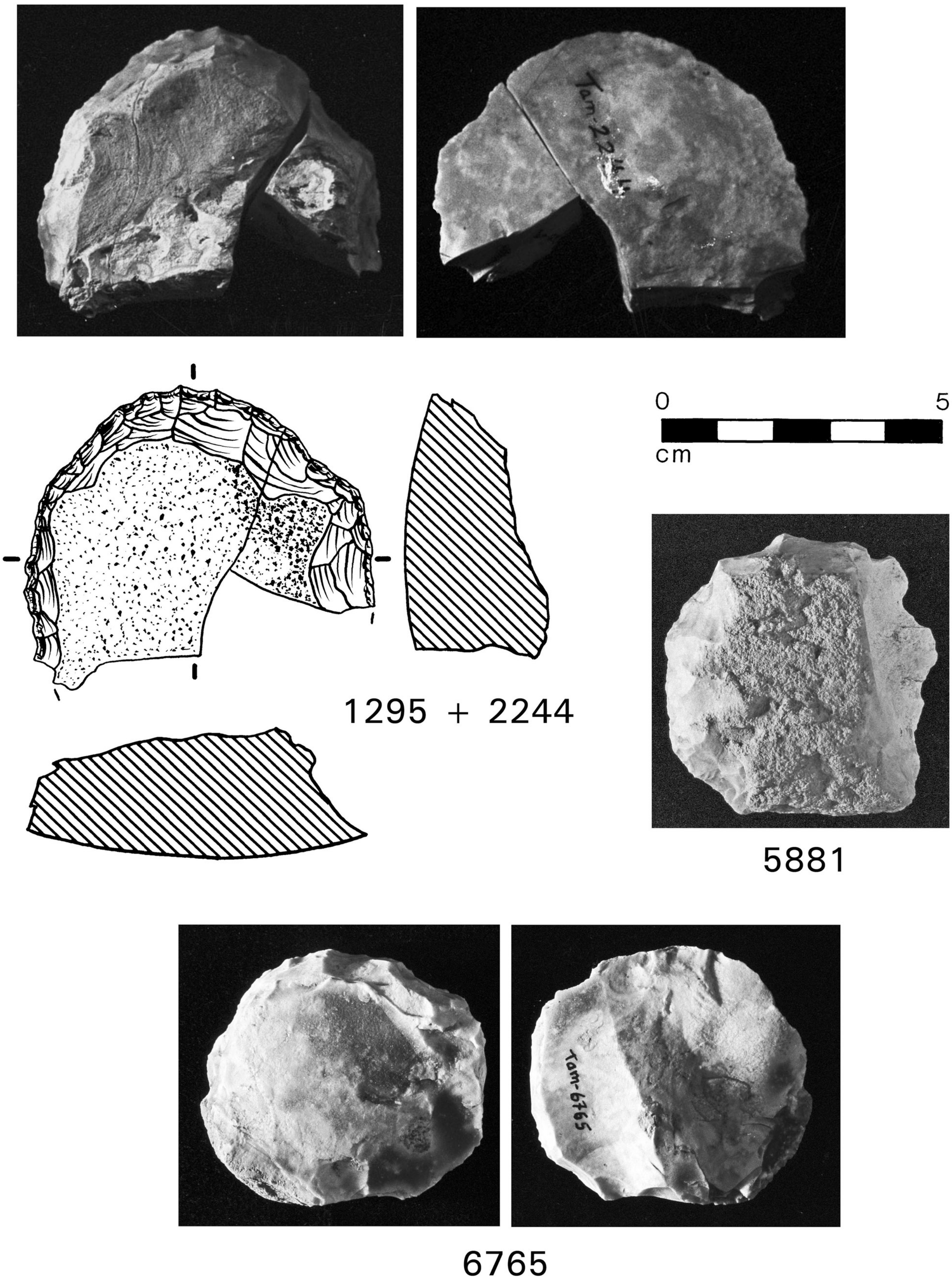


Figure 5-8. Discoidal scrapers from Archaeological Level 1 in Area 3 at Les Tambourets. Scraper 1296+2244 is a rejoined piece; the larger fragment (catalogue #2244) was recovered from Archaeological Level 1, but the smaller fragment (catalogue #1295) was recovered from the overlying couche B (basal) in the same square—see Table 4 1 and Figure 4 1.

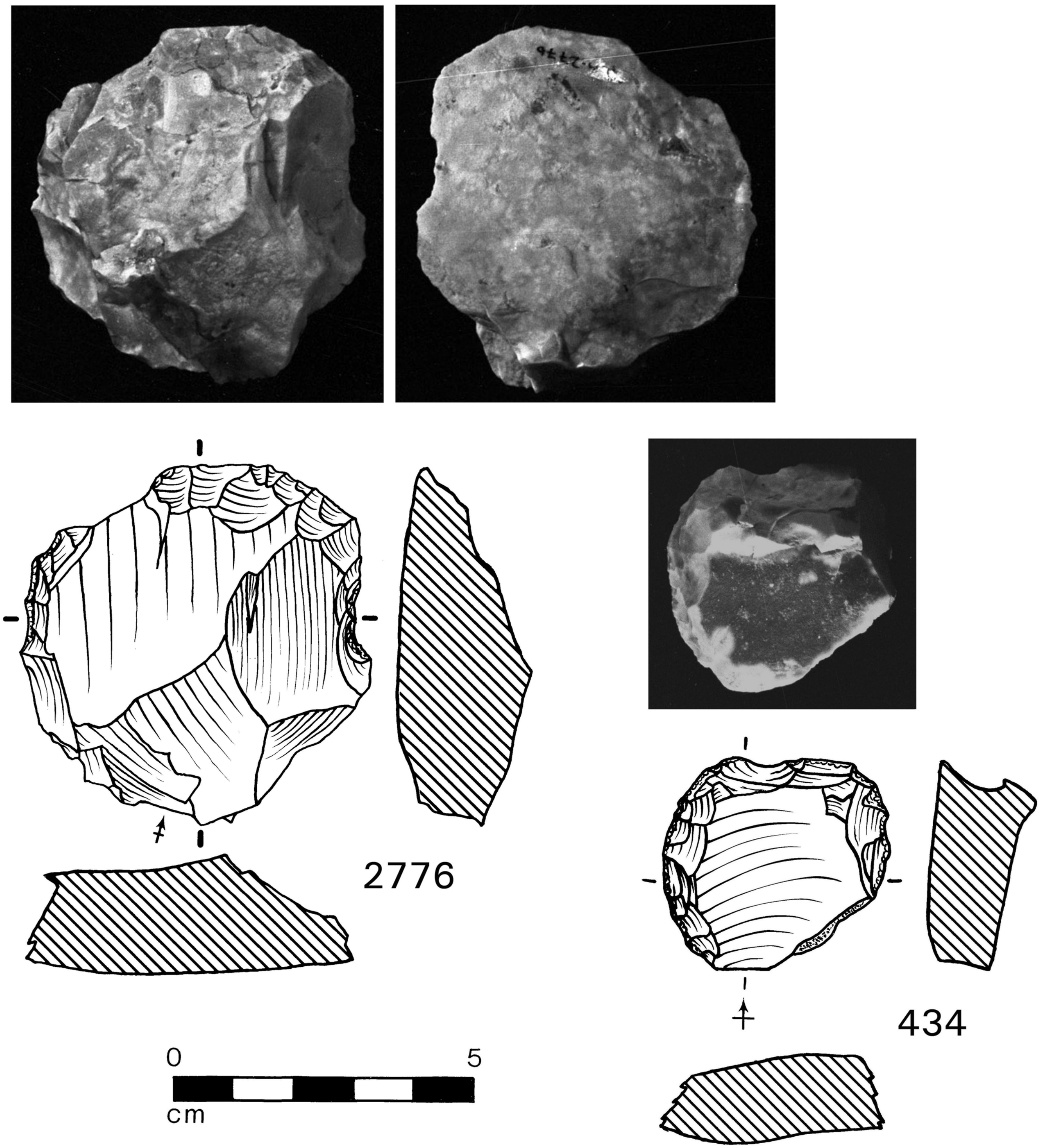
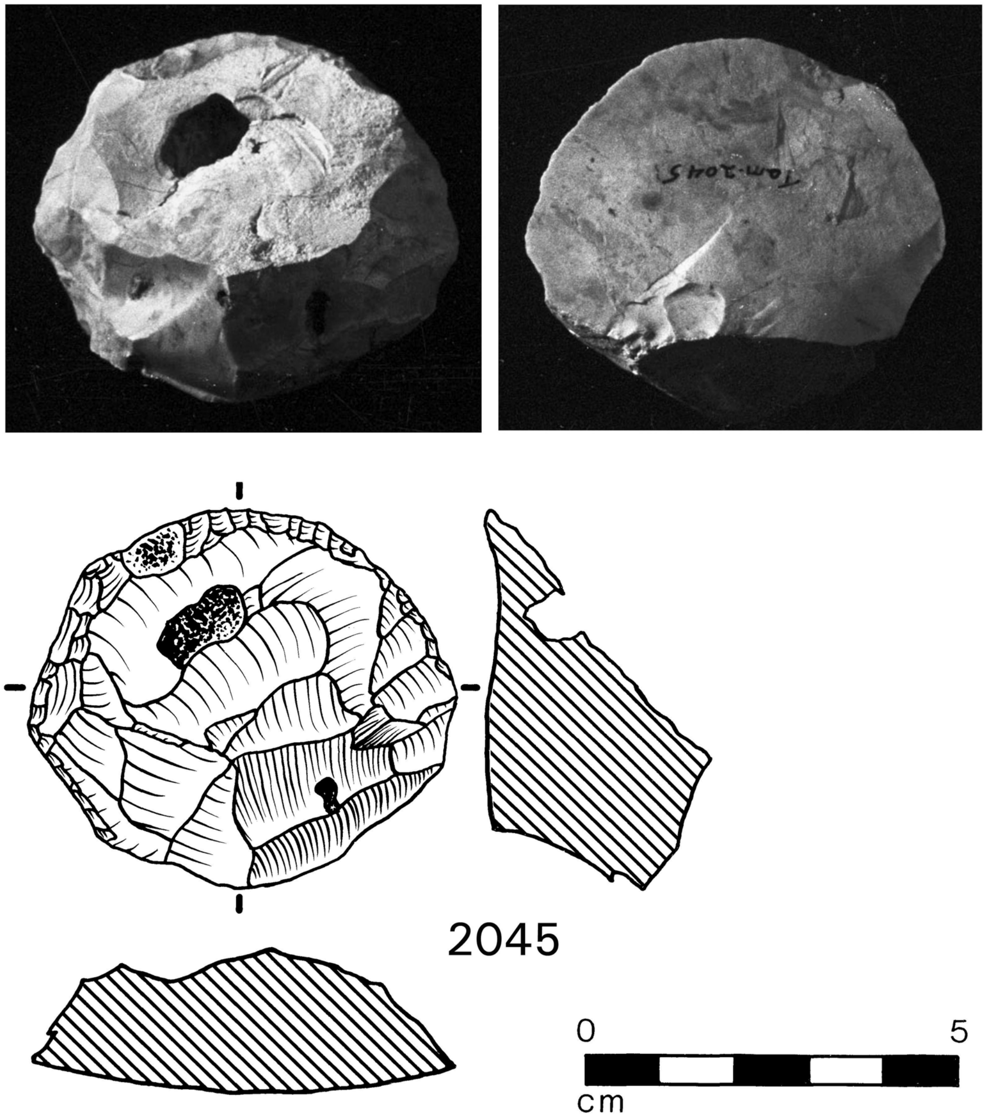


Figure 5-9. Discoidal scrapers from Archaeological Level 1 in Area 3 at Les Tambourets.



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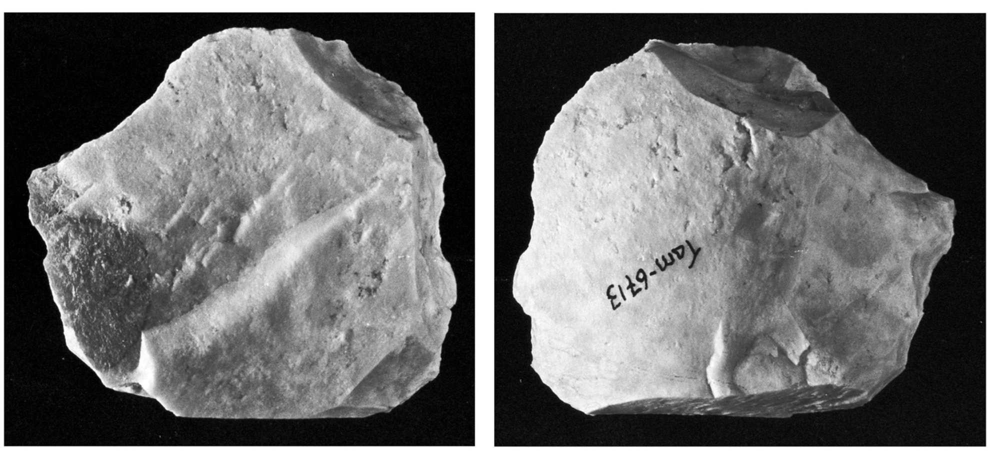

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Figure 5-10. Discoidal scrapers from Archaeological Level 1 in Area 3 at Les Tambourets.

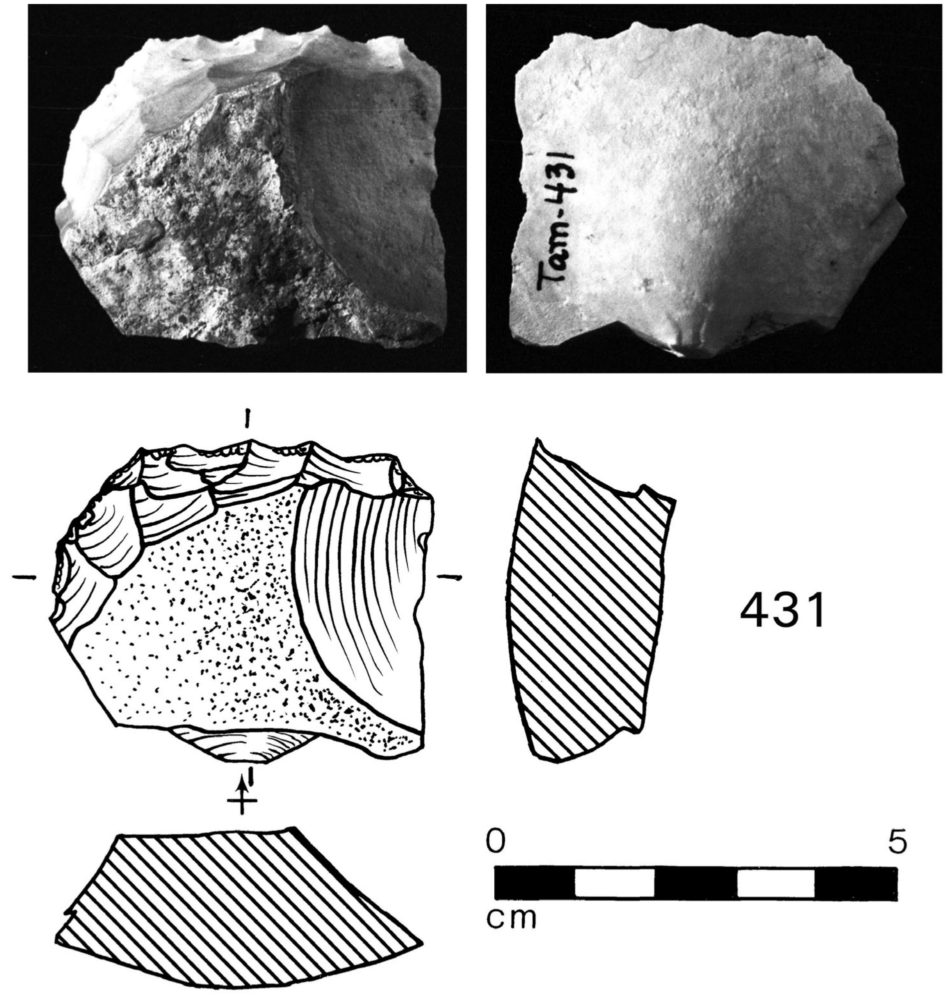

Figure 5-11. Discoidal scrapers from Archaeological Level 1 in Area 3 at Les Tambourets.

clarified by a brief consideration of individual attribute sets. A series of tests of the significance of difference between end-scrapers and side-scrapers with respect to single attribute sets was performed for the three largest samples available to attribute analysis (Area 3:Archaeological Level 1, Area 3:Méroc, and Area 2:Méroc). The results of these tests may be briefly summarized as follows. Among the attribute sets of the scraping edge itself, side-scrapers have, in all samples, scraping edges that are wider[12] and of a more open arc (i.e., less "rounded" as measured by roundness index).[13] There are no significant differences for other dimensions of the scraping edge, for scraping edge contour, or for retouch angle. With respect to the blank, side-scrapers are made more often on flakes[14], and the blanks, whatever their nature, are wider.[15]

In summary, the Châtelperronian scrapers from Les Tambourets may be characterized as having a low degree of internal typological differentiation. Tools classified as end-scrapers and side-scrapers, which together account for the major part of the series, are very similar kinds of tools. The morphology of their scraping edges is similar, as is the kind of blank on which they are made, despite the fact that they are mounted differently with respect to the bulbar axis of the blank. The Tambourets scraper series conforms in some sense to the expected Upper Palaeolithic model insofar as the majority of the scraping edges are mounted at an end of the blank rather than on a side, approximately parallel to the bulbar axis, conformable to a Middle Palaeolithic model. It seems more appropriate, however, to say that the relationship of the scraping edge to the bulbar axis was apparently a matter of little concern to the Tambourets artificers. They did not often produce the long, narrow, blade blanks that, in other (mostly later) tool-making traditions of the French Upper Palaeolithic, allowed the exploitation of the full potential of the end-scraper model (a potential that in some cases may have included hafting end-scrapers for more efficient use). What they did instead was to create very similar scraping edges on the *sides* of relatively wide blanks (almost always flakes) and on the *ends* of relatively narrower blanks of the same length (usually flakes). The clearest typological differentiation within the Tambourets scraper series is the presence of discoidal scrapers. These tools have such a long perimeter length, wrapping around such a large proportion of the circumference of the blank, that only a small portion of the scraping edge is likely to have been in contact at any one time with the material being

TABLE 5-15.--Distributions of retouch angle and other attribute sets of discoidal scrapers. Sample values shown are mean ($\bar{X}$) and standard deviation (s).

	Area 3: A.L.1	Area 3: Méroc	Area 2: Méroc	Area 3: c.B(Bas)
Retouch Angle (DS2)				
Acute	0	0	0	0
Medium	5	5	8	2
Steep	8	8	7	2
Perpendicular	1	0	0	0
Overhanging	1	0	2	0
TOTAL	15	13	17	4
Scraping Edge Thickness (DS3)				
n	15	13	17	4
$\bar{X}$	16.33	15.23	13.59	13.50
s	4.01	6.44	3.95	2.52
Blank Length* (DS7)				
n	6	12	14	3
$\bar{X}$	51.33	47.67	44.71	46.33
s	5.79	6.34	9.49	6.66
Blank Width* (DS9)				
n	6	12	14	3
$\bar{X}$	53.17	50.25	44.00	45.67
s	4.62	9.99	6.24	5.13
Blank Thickness* (DS10)				
n	6	12	14	3
$\bar{X}$	21.67	20.08	17.14	17.33
s	4.41	6.87	4.40	1.53

Note: * Samples include complete pieces only.

Table 5-16.--Canonical variables and other results of the discriminant analysis of scrapers from Area 3.

Canonical Variables

	Canonical Variable 1	Canonical Variable 2	Canonical Variable 3
Eigenvalue	3.567	0.227	0.001
Cumulative percentage of total dispersion	93.98	99.97	100.00
Group means for:			
End-scrapers	0.833	0.306	0.003
Side-scrapers	0.856	-0.910	0.017
End-and-side-scrapers	-1.929	-0.202	-0.093
Discoidal scrapers	-5.341	0.098	0.049

Attribute Sets Retained by the Analysis

		ES*	SS	EA	DS
1. Perimeter length	$\bar{X}$	37.44	36.64	75.52	120.94
	s	14.43	12.53	21.60	21.31
2. Blank width	$\bar{X}$	37.90	46.28	47.48	51.22
	s	10.27	12.03	8.94	8.54
3. Edge thickness	$\bar{X}$	12.10	10.36	13.95	16.11
	s	5.87	3.36	6.59	5.73
4. Blank length	$\bar{X}$	51.35	49.74	50.29	48.89
	s	10.88	13.08	10.26	6.25

Comparison of Initial Classifications (rows) and Reclassification (columns)

	ES*	SS	EA	DS
ES (n = 124)	90	23	11	0
SS (n = 39)	11	26	2	0
EA (n = 21)	1	3	14	3
DS (n = 18)	0	0	2	16

Correct reclassifications of:
End-scrapers: 90 of 124, 72.58%
Side-scrapers: 26 of 39, 66.67%
End-and-side-scrapers: 14 of 21, 66.67%
Discoidal scrapers: 16 of 18, 88.89%
All scrapers in the sample: 146 of 202, 72.28%

NOTE: * ES = end-scrapers; SS = side-scrapers; EA = end-and-side-scrapers; DS = discoidal scrapers

worked by the tool. In this sense, some functional differentiation, not now understood, most probably underlies the evident typological differentiation. End-and-side-scrapers appear to lie in an intermediate position along this axis defined primarily by perimeter length. Considered most generally, then, the Tambourets scraper series contains two kinds of tools: a) scrapers with a restricted scraping edge located rather indifferently with respect to the bulbar axis (end-scrapers and side-scrapers); and, b) scrapers with a very extensive scraping edge (discoidal scrapers). These two kinds are not completely distinct, because each overlaps typologically with the end-and-side-scrapers.

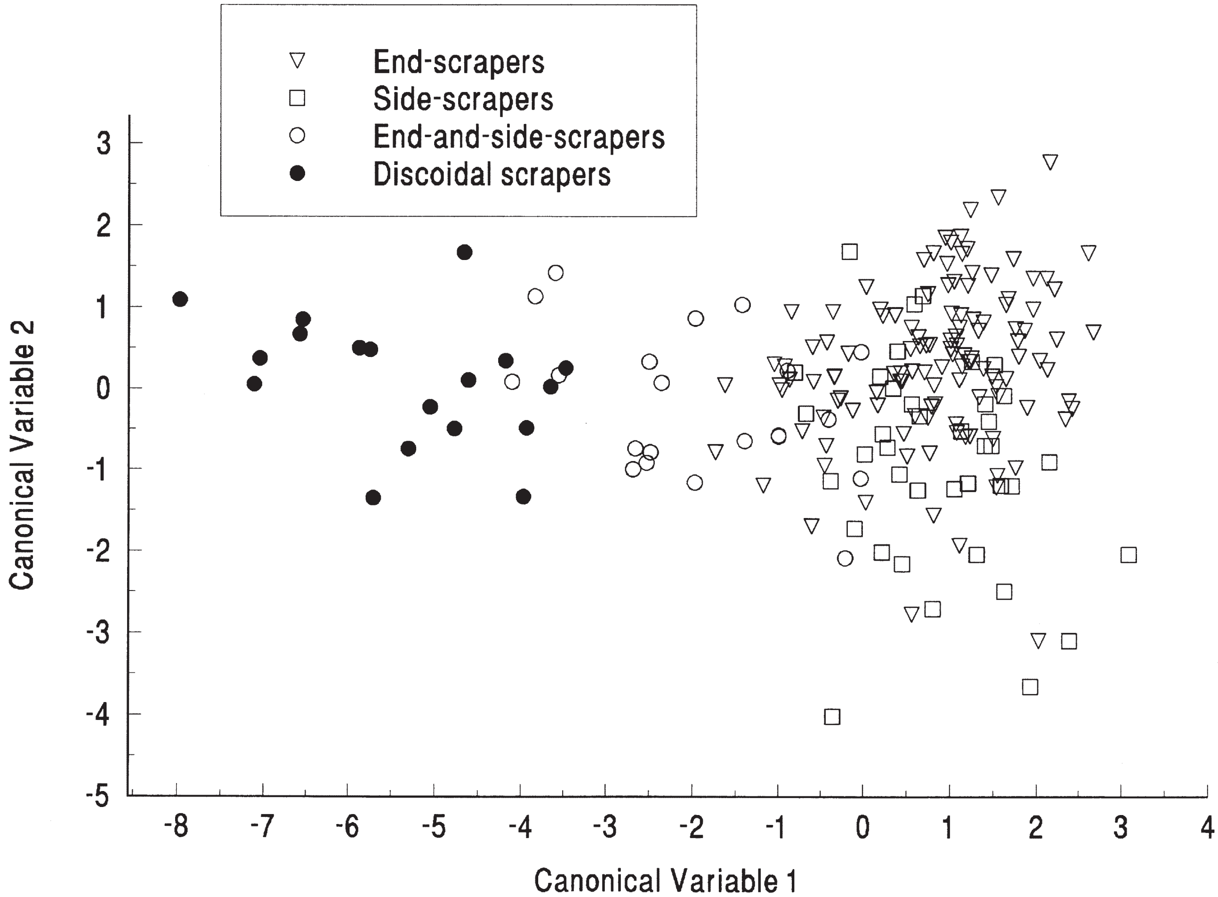

Figure 5-12. Scatterplot of studied scrapers from Archaeological Level 1 in Area 3 at Les Tambourets plotted along the axes of the first two canonical variates resulting from a discriminant analysis, as discussed in the text.

ENDNOTES

1. "...the defining characteristics of a ratio scale are: (a) that it is meaningful to speak of the difference between a pair of measurements and to compare it with the difference between another pair of measurements; and (b) the zero point on the scale is not arbitrary but really means something" (Doran and Hodson 1975: 37). Scraping edge width (attribute set ES10; cf. Appendix B, section II) and scraping edge thickness (ES11), for example, are measured on a ratio scale. "Scales which satisfy condition (a) but not condition (b) are called interval scales" (Doran and Hodson 1975: 37). Attribute set ES9, coded orientation angle/asymmetry direction, is measured on an interval scale; the intervals between values are equal, but the zero point is arbitrary. For measurements on an ordinal scale, "it is meaningful to rank observations but not to work with the intervals between them" (Doran and Hodson 1975: 37). Retouch angle (ES5) and retouch pattern (ES6) are both ordinal-scale variables. A nominal scale is "...one where a number of distinct observations are possible, but no comparisons at all can reasonably be made between these observations" (Doran and Hodson 1975: 37). End of blank (ES14), nature of blank (ES20), and occurrence of cortex (ES21) are measured on a nominal scale.
2. The method of initial factor extraction was "principal components," and a "direct oblimin" method of oblique rotation was employed. The BMDP4M program (Frane et al. 1981) was run on a DEC-20 computer at the Tulane Computing Laboratory.
3. Chi-squared=29.63 with 2 degrees of freedom, P<0.0001.
4. For Area 3:Archaeological Level 1, F=9.86, df=2 and 86, and P(1-tailed)<0.005. For Area 3:Méroc, F=34.70, df=2 and 123, and P(1-tailed)<0.005. For Area 2:Méroc, F=4.08, df=2 and 147, and 0.025>P(1-tailed)>0.01. For Area 1:Méroc, F=7.51, df=2 and 42, and P(1-tailed)<0.005.
5. t=1.74; df=61; P(1-tailed)=0.04.
6. F=2.57; df=4 and 145; 0.05>P(1-tailed)>0.025.
7. F=5.34; df=4 and 145; P(1-tailed)<0.005.
8. F=3.51; df=4 and 121; 0.02>P(2-tailed)>0.01.
9. The values of D^2 were computed using program BMDP3D (Dixon 1981: 94–103), run on the DEC-20 computer at the Tulane Computing Laboratory.
10. F=3.50, df=4 and 28, 0.05>P(2-tailed)>0.02.
11. The analysis was performed using the "Stepwise Discriminant Analysis" program, BMDP7M (Jennrich and Sampson 1981), run on a DEC-20 computer at the Tulane Computing Laboratory.
12. For Area 3:Archaeological Level 1, t=2.05, df=120, and P[1-tailed]=0.021. For Area 3:Méroc, t=1.85, df=175, and P[1-tailed]=0.033. For Area 2:Méroc, t=2.73, df=196, and P[1-tailed]=0.003.
13. For Area 3:Archaeological Level 1, t=3.22, df=120, and P[1-tailed]=0.001. For Area 3:Méroc, t=3.59, df=175, and P[1-tailed]<0.0005. For Area 2:Méroc, t=1.97, df=196, 0.025>P[1-tailed]>0.01.
14. The attributes of "nature of blank" were grouped into "flakes" and "others" in order to achieve adequate cell sizes for testing by Chi-squared. For Area 3:Archaeological Level 1, Chi-squared=5.78, df=1, P=0.016. For Area 3:Méroc, Chi-squared=10.88, df=1, P=0.0001. For Area 2:Méroc, Chi-squared=10.14, df=1, P=0.001.
15. For Area 3:Archaeological Level 1, t=5.67, df=105, P[1-tailed]<0.0005. For Area 3:Méroc, t=2.57, df=145, 0.01>P[1-tailed]>0.005. For Area 2:Méroc, t=3.76, df=176, P[1-tailed]<0.0005.

CHAPTER 6
BACKED TOOLS

INTRODUCTION

All so-called "backed tools" ("*outils à dos*"), whatever their form, have at least part of one edge of the blank blunted and destroyed by a series of small, abrupt removals originating from one or the other face. Such a series of removals, as well as the morphology thereby created, is termed "the back." It is possible in English to extend this terminology into verbal, adjectival, and gerundial forms ('the blank has been backed,' 'a backed point,' 'the process of backing,' etc.). Considered technologically, backing is simply a special and extreme form of marginal retouch. Distinctive attribute combinations that distinguish backing from other kinds of marginal retouch are specified in Table B-1 of Appendix B.

Most of the backed tools from Les Tambourets are Châtelperron points, the characteristic and most frequently occurring backed tool of the Châtelperronian tool-making tradition, but there are small samples of other backed forms as well. Each kind of backed tool found at Les Tambourets is briefly defined below by way of introduction, and the following sections of this chapter provide fuller descriptive analyses and distributional information.

The essential defining characteristics of **Châtelperron points** may be specified as follows. The tool in question is made on a blade blank (as opposed to a flake or a bladelet), it is backed along one edge, the backing helps to create a point at the anterior (usually distal) end, and the shape of the line of backing departs greatly from a straight line toward the anterior end of the piece in such a way that it 'cuts across' the width of the blank and intersects the opposite margin well 'behind' (posterior of) the original end of the blank. The shape of the backed edge is customarily described as "curved" (*courbé*, *cintré*, *en arc de cercle* in French—see Brézillon 1971: 306–307 for a useful summary), but it is argued in the following section of this chapter that this terminology is too restrictive to be accurate. Similarly, whether the backing is continuous or partial, or whether it is heavy or light, or whether and to what extent the general outline of the piece is asymmetrical—all of which have been used by de Sonneville-Bordes and Perrot (1956b: 547) to distinguish between their Types 46 and 47)—are, in my opinion, aspects of variation *within* a single tool class, that of the Châtelperron point. These and other aspects of variation are dealt with by this study in terms of a formal attribute system (Appendix B, section VI). It should be mentioned, finally, that the term "Châtelperron knife" (*couteau de Châtelperron*) is a frequently used alternative name for this tool class. I have chosen to use the term "point" because it is an accurate morphological description (the tools *are* pointed) whatever may have been their function or functions.

An **Abri Audi knife** is a similar tool, pointed and with a curving back, but the blank on which it is made is a flake (or, sometimes, a wide blade). All **shouldered pieces** (*pièces à cran*) are partially backed, and the examples available for study are almost all fragmentary. The line of partial backing, which has narrowed the piece, curves out rather abruptly, within a short linear distance, to meet the original unbacked portion of the edge of the blank in such a way as to form a pronounced shoulder or *cran*. These pieces are recognized as a separate type, No. 57, in the list of de Sonneville-Bordes and Perrot (1956b: 548), but they are, of course, a very patterned, specialized variant of the general category of partially backed pieces. The location of the partial backing (at one or both ends of the blank vs. in the middle of the blank) may, in some assemblages, provide important information about the technique of manufacture of completely backed tools of which the shouldered pieces are unfinished intermediate stages.

All pieces designated "***lames à dos***" are completely and regularly backed, and all fit within Type 58 (completely backed blades) of the de Sonneville-Bordes and Perrot type list (1956b: 548). The French terminology is retained here in order to distinguish these objects from the irregular and/or unfinished objects assigned to the residual category of "pieces with partial and/or irregular backing" (see below). If the distal extremity of the blank is present on the portion available for study, it is not pointed or, at best, has a very crude and blunt point. Such pieces cannot be considered Châtelperron points despite their complete, regular backing.

Pieces with partial and/or irregular backing make up a residual category, and the lack of patterning among the pieces assigned to it strongly suggests that they are by-products of unsuccessful manufacture rather than finished tools in their own right. Most of the examples available for study are fragmentary and only partially backed. The line of partial backing does not, however, meet the unbacked portion of the edge of the blank so abruptly as to form a shoulder. Some of the objects are completely backed (at least on the fragmentary portion preserved), but the backing is irregular in direction, extent, or linear outline, often because the shape of the blank is itself irregular where it is affected by the backing. Because on some examples the backing is both partial *and* irregular, what the de Sonneville-Bordes and Perrot type-list would separate into (completely) backed blades, Type 58, and partially backed blades, Type 59, are here included in the same category.

Eléments tronqués, which although characteristic of some stages of the later Gravettian are occasionally found in other contexts, are blade (not bladelet) tools that are both backed along one margin and truncated by steep retouch at one or both extremities.

Naturally backed knives (*couteaux à dos naturel*) have the same gross morphology as the backed tools discussed above, but the back is here a "natural" feature, usually a steep dorsal facet, that existed from the time the blank was struck from the core. It was not created by steep retouch removals as a modification to the blank. Indeed, a naturally backed knife may have no retouch on it at all, and in this case it does not meet the traditional criterion that requires chipped stone artifacts to be retouched if they are to be recognized as "tools." This is undoubtedly the reason why naturally backed knives are not included in the de Sonneville-Bordes and Perrot type-list for the Upper Palaeolithic. On the other hand, patterned utilization damage on the edge opposite the natural back may suggest strongly that *some* objects of this kind were *used* as tools, and they have been recognized as such in Middle Palaeolithic assemblages (Bordes 1961: 33; Debéneth and Dibble 1994: 53–54), as well as in Châtelperronian assemblages (A. Leroi-Gourhan 1963: 80). Such pieces exist at Les Tambourets, and they are discussed here along with backed tools.

There are, finally, a few **backed fragments** from Les Tambourets. These very small, broken objects were almost certainly parts of backed tools of some kind, but it is impossible to be more specific. They are not included in the descriptive analyses that follow.

I. CHÂTELPERRON POINTS

Both the Tulane excavations and Louis Méroc's surface collecting make it clear that the Châtelperronian tool-making tradition is the only significant representative of the Upper Palaeolithic that is found at Les Tambourets. Although a few rolled and/or heavily patinated objects characteristic of the Lower and Middle Palaeolithic are present in the surface collections, there is no reason to suspect the presence of a late Mousterian of Acheulian Tradition occupation at the site. For these reasons, *all* Châtelperron points that have been found at Les Tambourets—those excavated from Archaeological Level 1 or from other levels (Figures 6-1, 6-2, 6-3, and 6-4) as well as those collected from the surface (Figures 6-5 and 6-6)—may be *with near certainty* considered to be not only "Châtelperron points" in a typological sense, but also products of artificers participating in the Châtelperronian tool-making tradition, parts of some truly Châtelperronian assemblage whether or not they have been found *in situ*. This combination of circumstances provides the archaeologist with a welcome opportunity to examine the typological characteristics of a large sample of Châtelperron points made at the same site during a limited span of time. So that the unusual potential of Les Tambourets might be realized, *every* Châtelperron point excavated by Tulane or present in the Méroc Collection in 1978 was included in the attribute analysis. This total studied sample includes 231 Châtelperron points, of which 103 are complete or almost complete tools.

Attribute variation in Châtelperron points was investigated using a combination of multivariate, bivariate, and univariate techniques. As was done for end-scrapers, a factor analysis was employed to seek a preliminary understanding of the main patterns of variation within the artifact class, but the attribute system used in the study of Châtelperron points (Appendix B, section VI) is not well suited for the use of standard factor analysis. The great majority of Châtelperron point attribute sets measure variation on a nominal scale. Only five sets are appropriately used in the factor analysis: a) length of the tool (CH17 or CH18); b) maximum width of the tool (CH19); c) maximum thickness of the tool (CH20); d) minimal extent of backing (CH6); and, e) divergence of the backed edge (CH22), recorded as a ratio. The extent of backing (an ordinal-scale variable) is represented by the minimal extent (CH6) rather than the maximal extent (CH5) because the within-sample variation of the latter is close to zero. The sample analyzed includes all 103 complete and almost complete Châtelperron points from the site.

The correlation matrix on which the factor analysis is based is shown in Table 6-1. Four of the ten correlation coefficients located off the diagonal have probabilities of 0.05 or less. The two measures suggested by Vierra and Carlson (1981: 276–278) indicate that there is enough patterning in the data to make them appropriate for factor analysis.[1] The major results of the factor analysis are shown in Table 6-2.[2] Only two factors with eigenvalues greater than 1.0 were extracted; together these account for approximately 63% of the total variance.

Because such a small number of attribute sets could be used in the factor analysis, it is not surprising that its results are essentially banal. The first factor is a factor of gross size, and the second factor is concerned with the only aspects of the backing that could be included in the analysis. Despite a weak positive correlation between tool length and divergence of the backed edge (see Table 6-1),[3] the two factors are essentially uncorrelated.

Several of the Châtelperron point attribute sets are composed of dichotomous attributes, and many more (the majority of the attribute system) can be collapsed into dichotomies in a meaningful fashion because of preponderant frequencies of only one attribute in a nominal-scale set of three or more attributes. Because this is the case, it is possible to investigate multivariate interaction among almost all Châtelperron point attribute sets using Boolean factor analytic techniques (Mickey et al. 1981). The 14 sets listed below were chosen for the analysis and coded in binary form, 1 or 0:

CH2: Completeness of backing. Complete = 1
CH4: Priority backing direction. Bidirectional = 1
CH5: Maximal extent of backing. Heavy = 1
CH6: Minimal extent of backing. Heavy = 1
CH8: Backing side. Left = 1
CH9: Bulbar orientation of butt. Proximal = 1
CH10: Nature of the edge opposite the backing. Retouched = 1
CH13: Point type. Retouched (any direction) = 1
CH14: Butt type. Retouched (any direction) = 1
CH21: Outline of backed edge. Outline 1b = 1
CH22: Divergence of backed edge. Very divergent = 1
CH23: Outline of edge opposite the backing. Outline 1a = 1
CH24: Divergence of edge opposite the backing. Very divergent = 1
CH26: *Lame à crête*. Presence = 1

The sample analyzed includes the 103 complete and almost complete Châtelperron points used in the standard factor analysis.

The principal results of the Boolean factor analysis

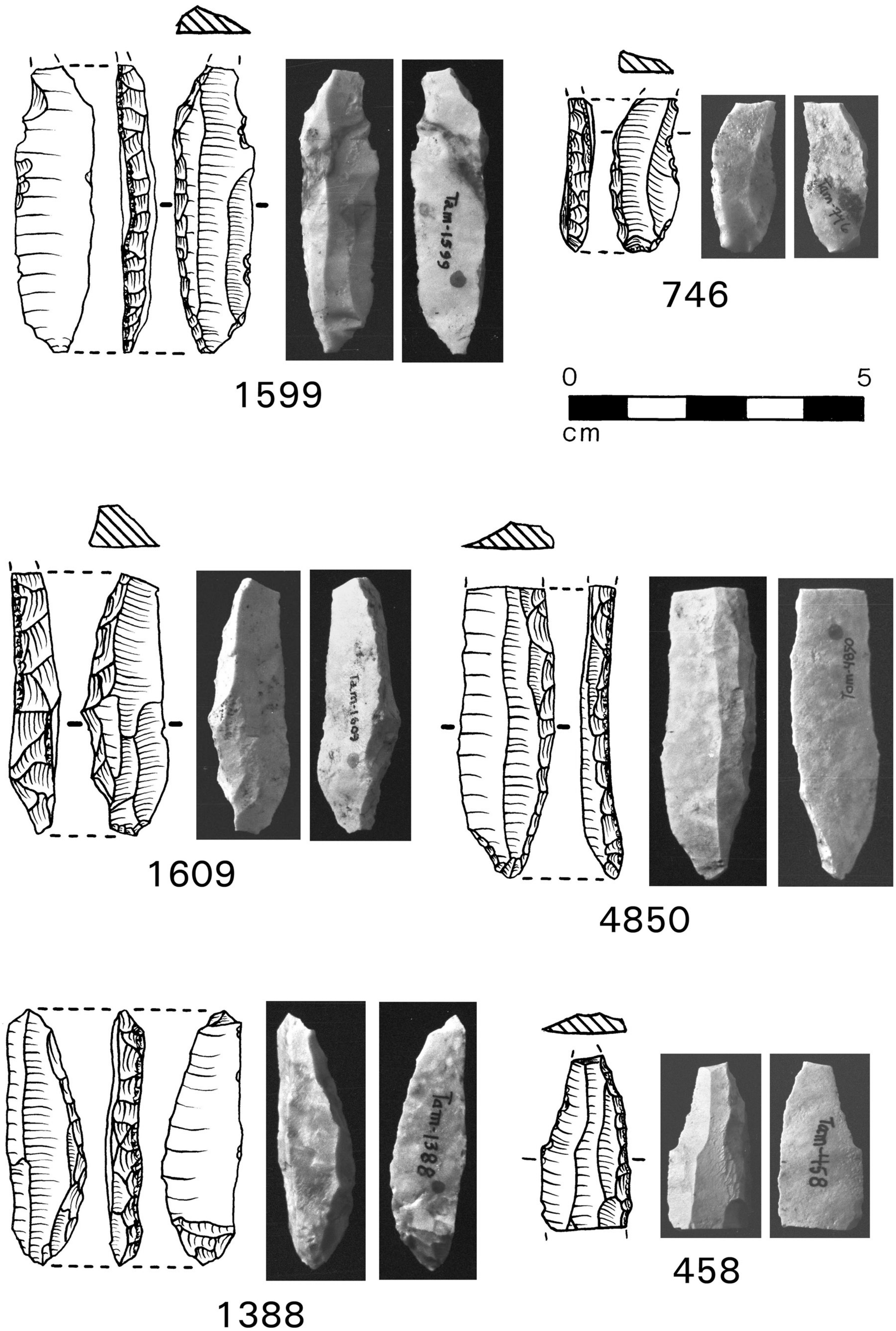

Figure 6-1. Châtelperron points from Archaeological Level 1 in Area 3 at Les Tambourets.

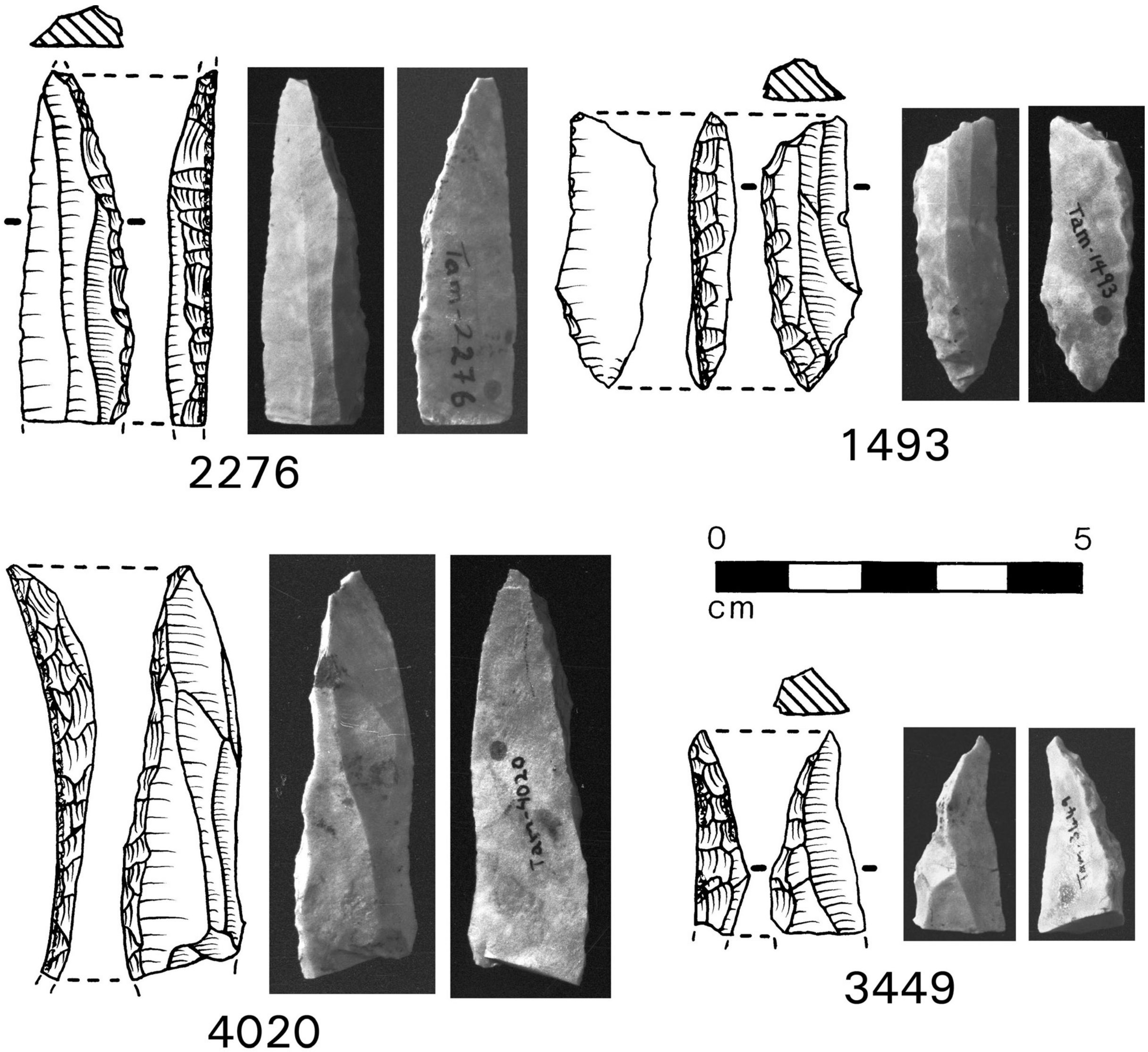

Figure 6-2. Châtelperron points from Archaeological Level 1 in Area 3 at Les Tambourets.

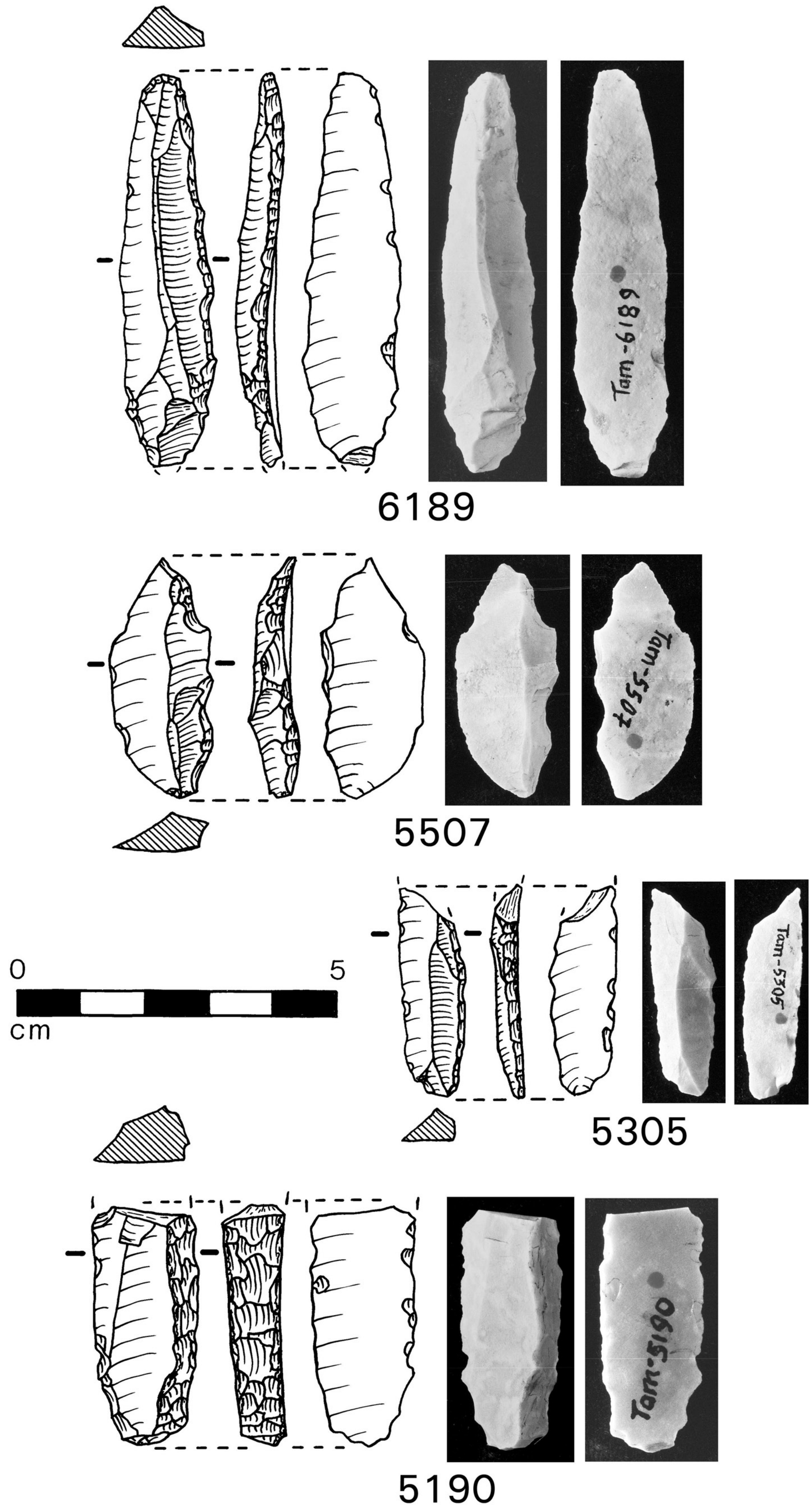

Figure 6-3. Châtelperron points from Area 3 at Les Tambourets. #6189, #5305: Archaeological Level 1; #5507: couche B (basal); #5190: couche B.

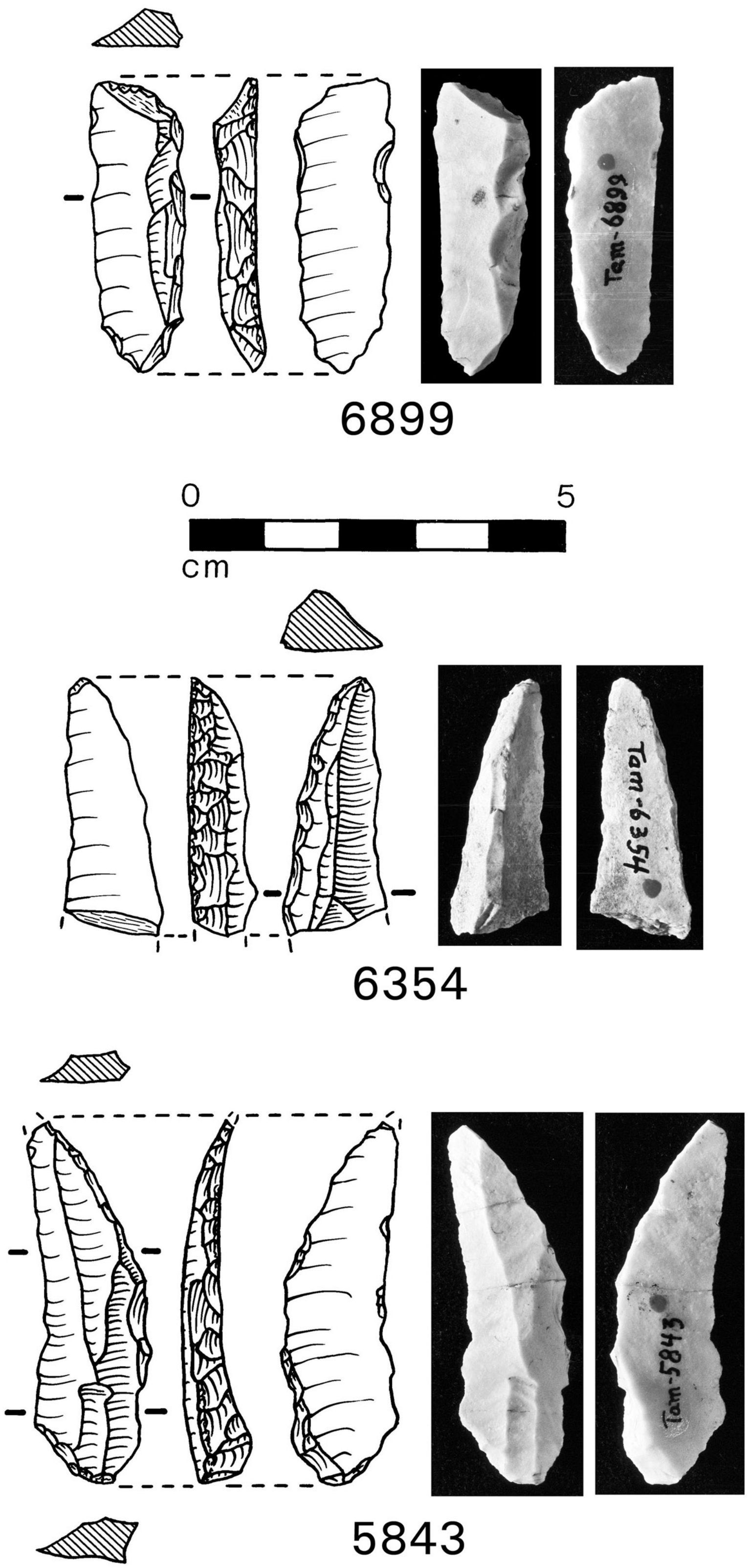

Figure 6-4. Châtelperron points from Les Tambourets. #6899: Area 3, couche B; #6354: Area 3, couche C; #5843: Area 2, Test Pit 2E1, Stratum III, Archaeological Level P.

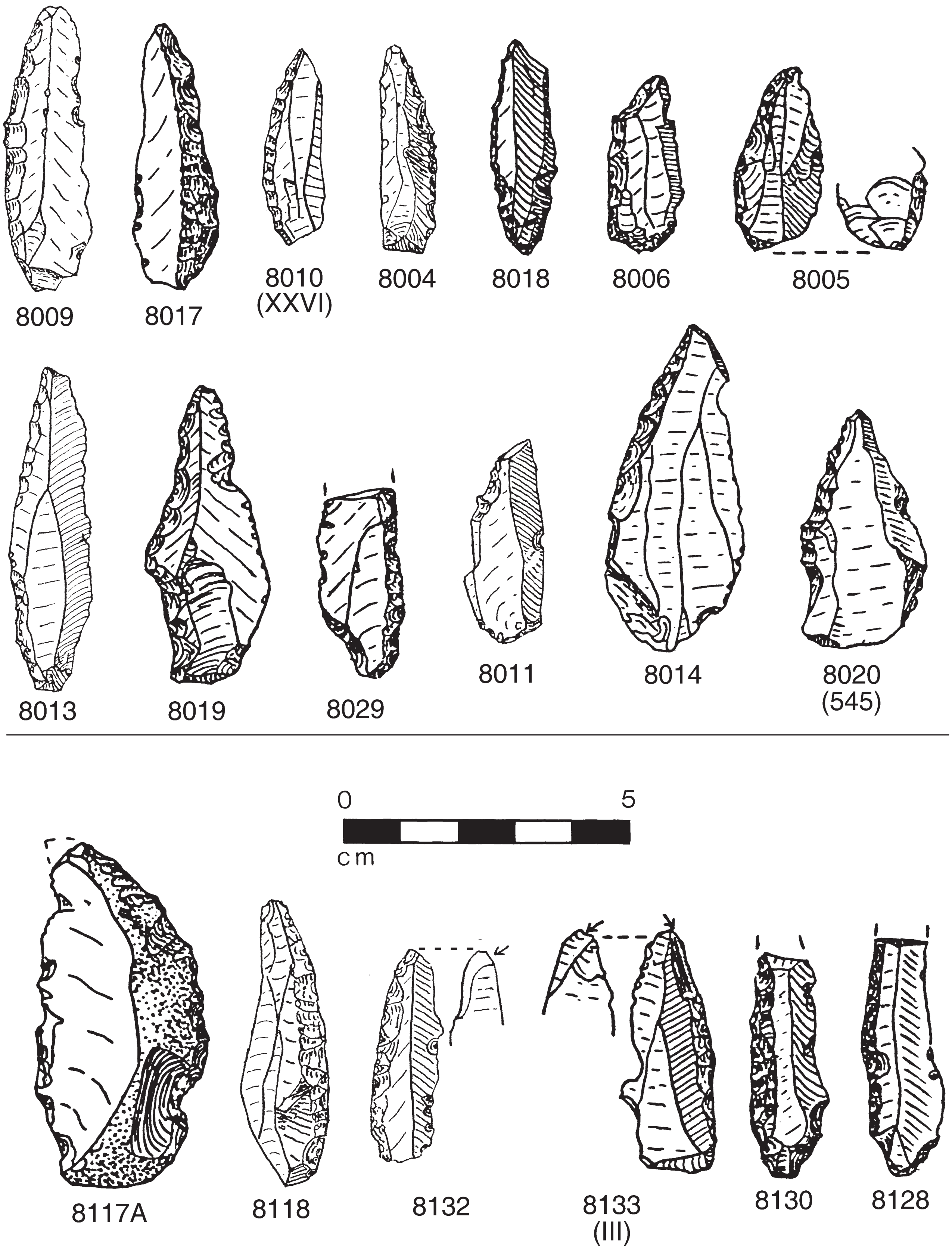

Figure 6-5. Top: Châtelperron points in the Méroc Collection from Area 1 at Les Tambourets. Bottom: Abri Audi knife (#8117A) and Châtelperron points (the five other pieces) in the Méroc Collection from Area Tambourets-Terssac at Les Tambourets. Roman and Arabic numbers in parentheses beneath the catalogue numbers refer to the specially numbered series assembled by Méroc (Méroc and Bricker 1984: 55). All drawings in this figure are those of L. Méroc.

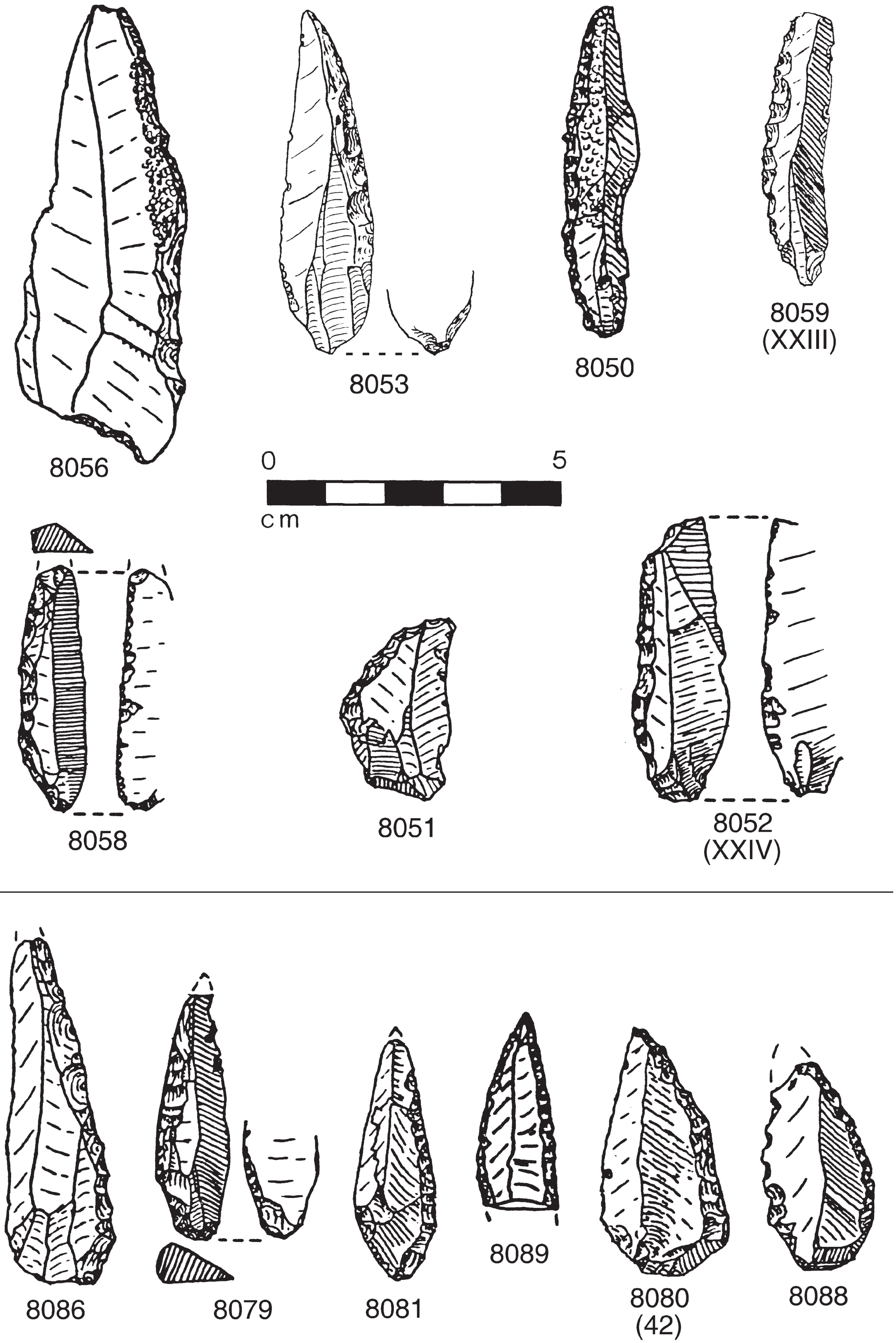

Figure 6-6. Châtelperron points in the Méroc Collection from Area 2 (top) and Area 3 (bottom) at Les Tambourets. Significance of numbers in parentheses is the same as in Figure 6-5. All drawings in this figure are those of L. Méroc.

TABLE 6-1.--Correlation matrix of some Châtelperron point attributes.

	CH6:	CH17/18:	CH19:	CH20:	CH22:
CH6	1.000				
CH17/18	0.060	1.000			
CH19	0.132	0.504	1.000		
CH20	-0.185	0.411	0.452	1.000	
CH22	-0.161	0.199	-0.100	-0.017	1.000

CH6 : Minimal extent of backing
CH17: Length of tool
(CH18: Estimated length of tool)
CH19: Maximum width of tool
CH20: Maximum thickness of tool
CH22: Divergence of backed edge (ratio)

are shown in Table 6-3.[4] Because the use of this technique seems not to be widespread in the literature of prehistoric archaeology, several explanatory remarks are in order here. The nature of the factor loadings for each variable and the factor scores for each case are radically different from the kind of loadings and scores from standard factor analysis. In a Boolean factor analysis, both the loadings and the scores are binary, either 0 or 1. This difference is particularly important for the interpretation of the factors through an examination of the factor loadings.

> "...in classical factor analysis, it is desirable to have each variable associated with one factor (a variable should not have sizeable loadings for several factors). In Boolean analysis, a variable may have a loading of one for several factors" [Mickey et al. 1981: 538].

The goals of both kinds of factor analysis are essentially similar—to express the variation in the sample along a number of dimensions (the factors) that is significantly less than the number of dimensions represented by the original variables. The success of a Boolean factor analysis is expressed in terms of the accuracy of a set of predictions about the cases in the sample; these predictions or estimates are made on the basis of the factors isolated by the analysis.[5] In short, the fewer the *discrepancies* between the predicted characteristics of the cases in the sample and the actual or observed characteristics, the more adequate has been the analysis.

Five factors were requested of the analysis, and the five retained are shown in Table 6-3. Four major clusters of variation (represented by factors 1 through 4) were identified. Three of the variables (retouch on the edge opposite the backing, a retouched point type, and the presence of a *lame à crête*) occurred so infrequently in the sample that they have positive loadings for none of the factors. Five of the variables load positively onto one factor only, four variables load onto two different factors, and two variables load onto three different factors. The latter two variables (heavy maximal backing and proximal butt location) are so frequent in the sample that their value in interpreting the factors to which they make a contribution is limited. The best interpretative clues are provided by those variables that load positively onto one or two factors only.

Although comparative data on the use of Boolean factor analysis for similar lithic attribute applications are not yet available, the present analysis appears to be reasonably successful in formal terms. The presence of only 180 discrepancies in the 1,442 predictions or estimates (12.48% discrepancies) means that there has been an 87.52% success rate in predicting binary responses from the factors identified. It is, of course, true that the real variation in the sample has been greatly understated by the forcing of attribute sets into a binary format, but the ability of the factoring technique to handle correctly such a high percentage of the variation it was given seems to be a strong argument for the use of the technique.

Factor 1 documents a positive association of a completely backed edge located on the left margin of the blank that curves across the body of the piece to help form the point at the distal end of the blank, with a very divergent edge opposite the backing. The significance here of the two attributes of gross morphology is not immediately clear. There is, furthermore, no obvious functional explanation for the association of complete backing with the left margin rather than the right one.

Factor 2, which documents an association of heavy, bidirectional backing with a very pronounced curvature of the back across the anterior end of the tool, to help form the point at the distal end, is readily understood in terms of mechanical contingencies (Sackett 1966: 371, 377). The more strongly the heavy backing curves across the body of the blade, the greater the thickness of the material to be removed by backing and thus the more likely it is that bidirectional backing will be used to accomplish the task.

Factor 3 speaks to an association of a strongly curved

TABLE 6-2.--Factor loadings and other results of the factor analysis of Châtelperron point attributes.

Unrotated Factor Loadings (Pattern) for Principal Components

	Factor 1	Factor 2	Communalities
Minimal extent of backing	0.005	0.773	0.598
Tool length	0.810	-0.078	0.662
Tool width	0.817	0.281	0.747
Tool thickness	0.765	-0.156	0.610
Divergence of backed edge	0.071	-0.722	0.527

Eigenvalues & Cumulative Percentage of Total Variance Explained by Factors

Factor	Eigenvalue	Cum. %
1	1.914684	38.29
2	1.229415	62.88
3	0.974753	82.38
4	0.462727	91.63
5	0.418421	100.00

Rotated Factor Loadings (Pattern)

	Factor 1	Factor 2
Minimal extent of backing	0.030	0.774
Tool length	0.807	-0.081
Tool width	0.826	0.278
Tool thickness	0.760	-0.159
Divergence of backed edge	0.048	-0.723

Factor Correlations for Rotated Factors

	Factor 1	Factor 2
Factor 1	1.000	
Factor 2	-0.028	1.000

and heavily backed edge with an edge opposite the backing on which most of the continuous curvature (without a sharp break in angle) goes to help form one or both extremities (the butt being located at the proximal end). This is clearly a factor of gross morphology, but how the variation dealt with by this factor differs from that dealt with by Factor 1 is not obvious.

Factor 4, which associates heavy, bidirectional backing, a retouched butt, and a strongly curved (or angled) edge opposite the backing, seems to have most to do with how the butt is formed. If it is formed by retouch (a major modification of part of the edge opposite the backing), it is likely that the outline of that edge will depart markedly from a straight line. Why heavy, bidirectional backing should be included here is not clear.

Only one attribute set—minimum extent of backing—loads positively onto Factor 5. An examination of factor scores shows that all this factor has done is to isolate all

TABLE 6-3.--Factor loadings and other results of the Boolean factor analysis of dichotomous or dichotomized Châtelperron point attributes.

Factor Loadings After Five Steps

	Factor #: 1	2	3	4	5	Totals of: Code 0	Code 1	Discreps. Neg.	Pos.
Completeness of backing	1	0	0	0	0	46	57	8	17
Max. extent of backing	0	1	1	1	0	17	86	9	2
Min. extent of backing	0	0	0	0	1	84	19	0	0
Priority backing dir.	0	1	0	1	0	56	47	19	2
Backing side	1	0	0	0	0	49	54	11	17
Bulbar orient. of butt	1	1	1	0	0	9	94	8	2
Nature of edge opp. bk.	0	0	0	0	0	99	4	0	4
Point type	0	0	0	0	0	96	7	0	7
Butt type	0	0	0	1	0	72	31	0	5
Outline of backed edge	1	1	0	0	0	23	80	7	6
Divergence of bk. edge	0	1	1	0	0	21	82	7	2
Outline of edge opp. bk.	0	0	1	0	0	57	46	4	3
Diverg. of edge opp. bk.	1	0	0	1	0	48	55	12	10
Lame à crête	0	0	0	0	0	85	18	0	18

Summary of Discrepancies After Five Steps

Total tests = 1442 (103 cases x 14 variables)
Total positive discrepancies = 95
Total negative discrepancies = 85
Total discrepancies = 180 (12.48% of tests)

the pieces that are heavily backed along the entire length of the backed edge. Such a one-variable factor is not particularly informative; it would appear that five factors is one too many for these data.

Although attempts to interpret the results of the two factor analyses have left much that is still not understood, several clear statements about Châtelperron point attribute covariation justify the use of such analyses as preliminary investigative tools. There is, as expected, a general factor of gross size, but (somewhat unexpectedly) gross size is not strongly related to either the extent of backing or the curvature of the back. A second important factor is a cluster of mechanical contingencies that involve variation in both gross morphology and backing direction. A third factor suggests that there is a relationship between butt treatment and gross morphology that needs further investigation, and yet other clusters remain unexplained. All these suggestions are followed up in the different kind of analyses reported on below.

Distributional summaries for some of the major attribute sets of Châtelperron points are shown in Tables 6-4, 6-5, and 6-6. The data are shown separately for each of the seven samples (which were pooled for the factor analyses discussed above)—excavated samples from Archaeological Level 1 and couche B (basal) in Area 3, surface samples from Méroc's Areas 1, 2, 3, and Tambourets-Terssac, and a "General" sample. The latter is composed primarily (n=28) of pieces from the Méroc Collection not assignable to a specific area, but it includes as well small numbers of surface-collected pieces from Méroc's Areas 4 (n=2) and Ferme (n=2) and a few excavated pieces from couches B(Upper) (n=6) and C (n=1) in Area 3 and from Test Pit 2E1 (n=1) in Area 2.

Although there is some variation among samples in the distribution of portions represented (set CH1), it is usually the case that approximately half the Châtelperron points in each sample are complete (see Figures 6-2, #1493, and 6-5, #8010 and #8006) or almost so (see Figures 6-1, #1599 and #1609, and 6-6, #8079) (see Table 6-4). Fragmentary point (see Figure 6-2, #3449) and butt (see Figure 6-1, #4850) portions occur in nearly equal frequencies in most samples. The backing on many of the tools (nearly 30% of the total sample)is only partial (set CH2) (see Figures 6-5, #8014 and #8020, and 6-6, #8053), sometimes because a steep dorsal facet serves as a satisfactory "natural back" along some part of the margin in question. Several pieces from the Méroc Collection are extreme examples of this phenomenon; *lames à crête* (set CH26) have been modified by back-

TABLE 6-4.--Distributions of portion and other attribute sets of Châtelperron points.

	Area 3: A.L.1		Area 3: Méroc		Area 2: Méroc		Area 1: Méroc		Area T-T: Méroc		General		Area 3: C.B(Bas)
	n	%	n	%	n	%	n	%	n	%	n	%	n
Portion (CH1)													
Complete	5	(17.86)	10	(40.00)	12	(36.36)	20	33.90	5	(12.20)	12	(30.00)	2
Almost Complete	7	(25.00)	5	(20.00)	6	(18.18)	8	13.56	6	(14.63)	5	(12.50)	0
Point	7	(25.00)	5	(20.00)	3	(9.09)	14	23.73	10	(24.39)	11	(27.50)	2
Segment	3	(10.71)	1	(4.00)	4	(12.12)	7	11.86	11	(26.83)	7	(17.50)	1
Butt	6	(21.43)	4	(16.00)	8	(24.24)	10	16.95	9	(21.95)	5	(12.50)	0
TOTAL	28	(100.00)	25	(100.00)	33	(99.99)	59	100.00	41	(100.00)	40	(100.00)	5
Completeness of Backing (CH2)													
Complete	24	(85.71)	14	(56.00)	22	(66.67)	46	77.97	29	(70.73)	29	(72.50)	4
Partial	4	(14.29)	11	(44.00)	11	(33.33)	13	22.03	12	(29.27)	11	(27.50)	1
TOTAL	28	(100.00)	25	(100.00)	33	(100.00)	59	100.00	41	(100.00)	40	(100.00)	5
Priority Cross-Section (CH3)													
I	11	(39.29)	9	(36.00)	14	(42.42)	25	42.37	16	(39.02)	18	(45.00)	2
II	12	(42.86)	7	(28.00)	5	(15.15)	18	30.51	13	(31.70)	14	(35.00)	1
III	4	(14.29)	4	(16.00)	12	(36.36)	13	22.03	10	(24.39)	5	(12.50)	2
IV	0	(0)	5	(20.00)	0	(0)	2	3.39	2	(4.88)	3	(7.50)	0
V	1	(3.57)	0	(0)	0	(0)	1	1.69	0	(0)	0	(0)	0
VI	0	(0)	0	(0)	2	(6.06)	0	0	0	(0)	0	(0)	0
TOTAL	28	(100.01)	25	(100.00)	33	(99.99)	59	99.99	41	(99.99)	40	(100.00)	5

(Table 6-4--continued)

	Area 3: A.L.1 n	Area 3: A.L.1 %	Area 3: Méroc n	Area 3: Méroc %	Area 2: Méroc n	Area 2: Méroc %	Area 1: Méroc n	Area 1: Méroc %	Area T-T: Méroc n	Area T-T: Méroc %	General n	General %	Area 3: c.B(Bas) n
Priority Backing Direction (CH4)													
Bidirectional	17	(60.71)	6	(24.00)	12	(36.36)	18	30.51	15	(36.59)	16	(40.00)	2
Ventral	11	(39.29)	19	(76.00)	21	(63.64)	41	69.49	26	(63.41)	24	(60.00)	3
Dorsal	0	(0)	0	(0)	0	(0)	0	0	0	(0)	0	(0)	0
TOTAL	28	(100.00)	25	(100.00)	33	(100.00)	59	100.00	41	(100.00)	40	(100.00)	5
Maximum Extent of Backing (CH5)													
Heavy	23	(82.14)	16	(64.00)	19	(57.58)	43	72.88	29	(70.73)	32	(80.00)	3
Medium	4	(14.29)	9	(36.00)	12	(36.36)	15	25.42	12	(29.27)	8	(20.00)	2
Light	1	(3.57)	0	(0)	2	(6.06)	1	1.69	0	(0)	0	(0)	0
TOTAL	28	(100.00)	25	(100.00)	33	(100.00)	59	99.99	41	(100.00)	40	(100.00)	5
Minimum Extent of Backing (CH6)													
Heavy	6	(21.43)	3	(12.00)	4	(12.12)	14	23.73	4	(9.76)	14	(35.00)	1
Medium	13	(46.43)	9	(36.00)	18	(54.55)	24	40.68	23	(56.10)	15	(37.50)	3
Light	9	(32.14)	13	(52.00)	11	(33.33)	21	35.59	14	(34.15)	11	(27.50)	1
TOTAL	28	(100.00)	25	(100.00)	33	(100.00)	59	100.00	41	(100.01)	40	(100.00)	5
Generalized Cross-Section of Backing (CH7)													
Triangular	16	(57.14)	13	(52.00)	26	(78.79)	39	66.10	26	(63.41)	23	(57.50)	4
Trapezoidal	12	(42.86)	12	(48.00)	7	(21.21)	20	33.90	15	(36.59)	17	(42.50)	1
TOTAL	28	(100.00)	25	(100.00)	33	(100.00)	59	100.00	41	(100.00)	40	(100.00)	5

(Table 6-4--continued)

	Area 3: A.L.1		Area 3: Méroc		Area 2: Méroc		Area 1: Méroc		Area T-T: Méroc		General		Area 3: c.B(Bas)
	n	%	n	%	n	%	n	%	n	%	n	%	n
Backing Side (CH8)													
Left	16	(57.14)	12	(48.00)	16	(48.48)	31	52.54	24	(58.54)	15	(37.50)	2
Right	12	(42.86)	13	(52.00)	17	(51.52)	28	47.46	16	(39.02)	25	(62.50)	3
Indeterminate	0	(0)	0	(0)	0	(0)	0	0	1	(2.44)	0	(0)	0
TOTAL	28	(100.00)	25	(100.00)	33	(100.00)	59	100.00	41	(100.00)	40	(100.00)	5
Bulbar Orientation of Butt (CH9)													
Proximal	20	(71.43)	24	(96.00)	32	(96.97)	49	83.05	32	(78.05)	31	(77.50)	4
Distal	4	(14.29)	0	(0)	1	(3.03)	2	3.39	4	(9.76)	0	(0)	0
Indeterminate	4	(14.29)	1	(4.00)	0	(0)	8	13.56	5	(12.20)	9	(22.50)	1
TOTAL	28	(100.01)	25	(100.00)	33	(100.00)	59	100.00	41	(100.01)	40	(100.00)	5
Nature of Edge Opposite the Backing (CH10)													
Unmodified	1	(3.57)	4	(16.00)	3	(9.09)	4	6.78	5	(12.20)	3	(7.50)	4
Utilized	26	(92.86)	19	(76.00)	27	(81.82)	51	86.44	35	(85.37)	33	(82.50)	1
Retouched	1	(3.57)	2	(8.00)	3	(9.09)	4	6.78	1	(2.44)	4	(10.00)	0
TOTAL	28	(100.00)	25	(100.00)	33	(100.00)	59	100.00	41	(100.01)	40	(100.00)	5
Lame à Crête (CH26)													
On lame à crête	2	(7.14)	2	(8.00)	6	(18.18)	5	8.47	5	(12.20)	4	(10.00)	1

TABLE 6-5.--Distributions of point type and other attribute sets of Châtelperron points.

	Ar.3: A.L.1	Ar.3: Méroc	Ar.2: Méroc	Ar.1: Méroc	Ar.T-T: Méroc	Gen.	Ar.3: cB(B)
Point Type (CH13)							
Unretouched	14	14	14	33	15	24	4
Obverse	2	1	3	1	1	1	0
Inverse-1	0	0	0	1	1	1	0
Inverse-2	0	0	1	0	0	0	0
Obverse/Inverse-1	0	0	0	0	0	0	0
Obverse/Inverse-2	0	0	0	0	0	0	0
TOTAL	16	15	18	35	17	26	4
Butt Type (CH14)							
Unretouched-1	1	1	6	5	4	2	0
Unretouched-2	7	13	9	19	7	14	2
Obverse-1	0	0	0	0	0	0	0
Obverse-2a	2	0	0	2	2	0	0
Obverse-2b	3	0	2	1	3	1	0
Obverse-3a	0	1	1	1	0	1	0
Obverse-3b	0	0	1	0	1	0	0
Obverse-4	3	2	1	2	2	1	0
Inverse-1	0	0	0	0	0	0	0
Inverse-2a	0	0	0	1	0	0	0
Inverse-2b	1	0	1	0	0	0	0
Inverse-3a	0	0	0	0	0	0	0
Inverse-3b	0	0	1	0	0	0	0
Inverse-4	0	2	0	2	0	2	0
Obverse/Inverse	1	0	0	1	1	0	0
TOTAL	18	19	22	34	20	21	2
Vachons Retouch at Butt (CH15)	1	0	0	1	0	0	0

ing at the anterior tip only, leaving most of the back a "*dos naturel*." The use of *lames à crête* as blanks for Châtelperron points (see Figure 6-5, #8017) is a quantitatively minor but still characteristic feature of the series from Les Tambourets (see Table 6-4).

The major characteristics of the backing are shown in Table 6-4 in various ways. Priority cross-section (set CH3) and maximum extent of backing (set CH5) both refer to the greatest modification of the original blank effected by the backing removals. The majority of the Châtelperron points from Les Tambourets are heavily backed, having priority cross-sections "I" (see Figure 6-1, #1609) or "II" (see Figure 6-2, #1493). The generalized cross-section of the blank (set CH7) is predominantly triangular; in samples like those studied here, where heavy backing is in a large majority, the cross-section at issue is the resultant cross-section *created* by the heavy backing, usually at the anterior end of the piece. The distribution of minimum extent of backing (set CH6) shows that few pieces are heavily backed along their entire length; indeed, on about one-third of the objects, part of the backing is light—that is, with cross-section "V" (see Figure 6-3, #5305)or "VI" (see Figure 6-1, #458). On most pieces, the backing is done from the ventral surface only (set CH4) (see Figures 6-1, #4850, and 6-5, #8004), but there is great variation among samples; for example, some bidirectional backing is found on over 60% of the pieces in the excavated sample from Area 3 (see Figure 6-1, #746), but on only 24% of those in Méroc's surface-collected sample from the same area (see Figure 6-6, #8080). Frequencies of left-backed and right-backed Châtelperron points (set CH8) are nearly equal in most samples. A gibbosity along the line of backing (set CH27) appears on only three pieces in the entire sample (see Figure 6-5, #8019). Only a few pieces bear any cortex (set CH31) (see Figure 6-6, #8056).

The unbacked margin of the blank almost always bears utilization damage scars (set CH10) (see Figures 6-1, #1599, and 6-3, #6189 and #5305). On the few examples where the edge opposite the backing is retouched, obverse retouch

TABLE 6-6.--Distributions of width and other attribute sets of Châtelperron points. Sample values shown are mean ($\bar{X}$) and standard deviation (s).

	Ar.3: A.L.1	Ar.3: Méroc	Ar.2: Méroc	Ar.1: Méroc	Ar.T-T: Méroc	Gen.	Ar.3: cB(B)
N (all portions)	28	25	33	59	41	40	5
Width (CH19) in mm							
$\bar{X}$	13.29	15.72	15.49	14.31	14.12	14.25	13.60
s	2.42	2.98	3.68	3.20	2.06	2.78	1.95
Thickness (CH20) in mm							
$\bar{X}$	5.89	6.00	6.85	5.25	6.05	6.13	6.40
s	1.59	1.50	2.12	1.27	1.48	2.13	1.82
W x 100 / Th	226	262	226	273	233	232	213
N (Complete + Almost Complete)	12	15	18	28	11	17	2
Length (CH17/CH18) in mm							
$\bar{X}$	42.08	42.46	46.83	40.18	42.73	43.94	36.50
s	12.94	7.68	13.93	8.31	9.26	8.20	0.71
Width (CH19) in mm							
$\bar{X}$	12.83	16.67	15.67	14.54	14.46	15.00	15.50
s	2.89	3.24	4.59	3.64	2.50	2.87	0.71
L x 100 / W	328	255	299	276	296	293	235
Thickness (CH20) in mm							
$\bar{X}$	6.25	6.33	7.50	5.39	6.55	6.76	6.50
s	1.42	1.40	2.36	1.34	1.81	2.46	2.12
Backed Side Divergence Index (CH22)							
$\bar{X}$	9.58	6.66	6.93	8.48	9.54	6.92	5.40
s	10.53	3.75	2.95	3.54	4.96	2.86	1.09

predominates (11 partial, 2 continuous) over inverse retouch (2 partial).

Distribution of the various extremity types is shown in Table 6-5. Most points are unretouched (set CH13); the anterior tip is formed by the simple intersection of the backing and the unmodified opposite margin (see Figure 6-2, #1493, #4020, #3449). When retouch is used to form the point, it is almost always obverse retouch (see Figure 6-6, #8089). The majority of butts are unretouched as well (set CH14) (see Figure 6-5, #8009); on most of these, all or part of the striking platform of the blade is still present (butt type Unretouched-2) (see Figures 6-1, #746, and 6-5, #8013). However, butts are more likely to be formed with the aid of retouch than are points, with obverse retouch predominating (see Figures 6-1, #4850, and 6-4, #5843 and #5190). The "Vachons"-style thinning of the butt is found on only two pieces from Les Tambourets, an Inverse-2b butt from Area 3:Archaeological Level 1 (see Figure 6-1, #1388) and an Obverse/Inverse butt from Area 1:Méroc.

The metric dimensions of Châtelperron points (sets

TABLE 6-7.--Distributions of outline of backed edge and other attribute sets of Châtelperron points.

	Ar.3: A.L.1	Ar.3: Méroc	Ar.2: Méroc	Ar.1: Méroc	Ar.T-T: Méroc	Gen.	Ar.3: cB(B)
Outline of Backed Edge (CH21)							
Outline 1a	1	0	0	0	0	0	0
Outline 1b	9	12	13	25	7	13	1
Outline 2a	2	3	5	3	4	4	1
Outline 2b	0	0	0	0	0	0	0
TOTAL	12	15	18	28	11	17	2
Outline of Edge Opposite the Backing (CH23)							
Outline 1a	5	5	7	17	2	8	1
Outline 1b	4	7	5	3	4	6	1
Outline 2a	0	1	0	2	2	0	0
Outline 2b	3	2	6	6	3	3	0
TOTAL	12	15	18	28	11	17	2
Gross Morphology (CH25)							
Classic Châtelperronoid	7	10	12	24	6	12	1
Parallel Châtelp.	1	1	1	2	1	1	0
Subparallel Châtelp.	1	2	4	1	2	3	0
Foliate Châtelp.	1	2	1	0	0	1	0
Subfoliate Châtelp.	0	0	0	0	1	0	1
Parallel	0	0	0	1	0	0	0
Subparallel	1	0	0	0	0	0	0
Bellied	1	0	0	0	1	0	0
TOTAL	12	15	18	28	11	17	2

CH17-CH20) are shown in Table 6-6. Sample values of width and thickness are given for all pieces, broken or not, but all three dimensions of complete and almost complete pieces are tabulated separately, as well. Although width and thickness means for fragmentary portions (not shown separately in the table) are usually slightly smaller than those for complete and almost complete pieces, these differences are generally not significant at the 0.05 level.[6] This suggests that the complete and almost complete Châtelperron points at Les Tambourets provide a metrically representative sample of the tool class; they are not just the larger pieces whose robusticity has more effectively resisted breakage.

The outline of the backed edge (set CH21, determined for complete and almost complete pieces only), on all but one example (Table 6-7), diverges from a straight line primarily toward the anterior end of the piece, thus contributing in a major way to the formation of the point. Most of the time, this divergence takes the form of a smooth, continuous curve (Outline 1b of set CH21) (see Figures 6-1, #1609, and 6-6, #8053), but in some cases, the line of backing diverges with a sharp break in angle (Outline 2a) (see Figures 6-2, #1493, and 6-5, #8006), creating what could be seen as an oblique truncation across the anterior end of the piece. The extent of this divergence, whether smooth or sharply broken, is measured by the backed edge divergence index (set CH22). Mean values of this index for the Tambourets samples vary from 5.40 to 9.58 (see Table 6-6), but all are in the range defined as "very divergent." The outline of the edge opposite the backing (set CH23; see Table 6-7) varies much more than that of the backed edge. The outline is continuously curved (Outlines 1a and 1b) (see Figures 6-3, #5507, and 6-6, #8058) more often than sharply angled (Outlines 2a and 2b) (see Figures 6-2, #1493, and 6-6, #8080), and the divergence contributes most often to extremity formation, particularly to that of the butt. Interpretation of the extent of divergence of the edge opposite the backing (not separately tabulated) is best done as a component of gross

TABLE 6-8.--Relationships among several metric dimensions of complete and almost complete Châtelperron points. Lower half-matrix tabulates values of the correlation coefficient (r); upper half-matrix tabulates probability values (P). The first listing for each group of six is for Area 3:Archaeological Level 1, N = 12. The subsequent listings in each group are: Second, Area 3:Méroc, N = 15; Third, Area 2:Méroc, N = 18; Fourth, Area 1:Méroc, N = 28; Fifth, Area Tambourets- Terssac:Méroc, N = 11; Sixth, "General", N = 17.

		Length	Width	Thickness
Length	1		.10>P>.05	>.10
	2		>.10	>.10
	3		.01>P>.001	.05>P>.02
	4		<.001	.05>P>.02
	5		.10>P>.05	>.10
	6		>.10	.10>P>.05
Width	1	.536		.02>P>.01
	2	.242		>.10
	3	.695		.01>P>.001
	4	.651		.10>P>.05
	5	.588		>.10
	6	.027		.05>P>.02
Thickness	1	.355	.675	
	2	.178	.294	
	3	.469	.636	
	4	.382	.350	
	5	.213	.381	
	6	.438	.512	

morphology (set CH25), as discussed next below.

The majority of Châtelperron points from Les Tambourets (see Table 6-7) have the classic Châtelperronoid morphology—a *curving* back creates an asymmetrical point. However, the parallel and subparallel Châtelperronoid morphologies are also well represented in the series. A few examples have foliate or subfoliate Châtelperronoid morphologies, and these pieces are of particular interest in light of previous suggestions (Lacorre 1933: 81; Pradel 1963: 582; Bricker 1978) that the *fléchettes* of the earliest Gravettian ("Bayacian") have their typological prototypes in some kinds of Châtelperron points of the Châtelperronian. One piece not included in Table 6-7 because the butt is missing (see Figure 6-6, #8089) is even more like a *fléchette*; it has continuous obverse retouch on the edge opposite the backing and an asymmetrically foliate gross morphology.

The description of Châtelperron points from Les Tambourets given in the preceding paragraphs primarily in terms of single attribute sets must now be supplemented by a consideration of attribute interaction. The factor analyses discussed earlier, which provided a preliminary overview of attribute interactions in the sample, serve as a guide to the organization of the following paragraphs. Unless otherwise noted, a pooled sample, from all areas of Les Tambourets, is the basis for statements about attribute interaction.

One undoubted cluster of interrelationships was identified by the factor of gross size. Although length, width, and thickness of the tool are significantly intercorrelated in the pooled sample of all complete and almost complete pieces (see Table 6-1), these correlations are not very strong ones. The highest correlation coefficient, between length and width, is 0.504; approximately 75% of the variation in one dimension is not explained by variation in the other. It is not surprising, therefore, that in the rather small individual samples (Table 6-8), the correlation coefficients are frequently not significant at the 0.05 level. For the series as a whole, the relationships among the dimensions are described by the following multiple regression equation:

$$\text{Length}=1.14(\text{Width})+1.20(\text{Thickness})+18.00$$

for which the standard error of estimate is 8.54mm.

The dimensions of the piece interact significantly with several non-metric attribute sets as well. Châtelperron points on which there is some bidirectional backing are significantly shorter ($\bar{X}$=40.09mm, s=10.24mm) than those on which the backing is from the ventral surface only ($\bar{X}$ =44.93mm, s=9.48mm).[7] There is also a tendency for the shorter tools to have a greater divergence of the backed edge.[8] These relationships might be interpreted to mean that the more extensive modification of the blank that bidirectional backing is often used to accomplish has the effect of reducing the original length more than does the use of ventral backing only. Finally, an analysis of variance of width by portion produces the expected information that width decreases significantly from the butt toward the point;[9] the differences between adjacent portions are not significant at the 0.05 level, but points are significantly narrower than butts.

The attributes of several other sets vary significantly according to the portion of the tool represented. Partial backing is more frequent on complete and almost complete pieces than on fragmentary portions,[10] but there are no significant differences *among* the fragmentary portions with respect to this attribute. There is, then, at Les Tambourets no significant tendency to leave the medial or posterior portions of the blank unbacked. Points have significantly higher frequencies of both heavy backing and bidirectional backing than segments or butts (for maximal extent of backing.[11] These relationships, which are clearly understandable in technological terms, are central to the cluster of covariation identified by Boolean factor 2. It is, however, the case that the extent of backing on some Châtelperron points does not change along the length of the piece. On the complete and almost complete pieces, where variation can be investigated most accurately, 23 examples (22.33%) have the same minimum extent of backing as maximum extent; in the majority of cases (n=19), the backing is heavy from one end to the other.

In the sample as a whole (all portions, complete and fragmentary), there is a clear and very significant association between heavy backing and bidirectional backing; 85 of the 165 heavily backed Châtelperron points are also bidirectionally backed (at least in part), whereas bidirectional backing appears on only 1 of the 66 pieces with medium or light backing.[12] This is a relationship dealt with by Boolean factors 2 and 4.

Another kind of attribute interaction identified by Boolean factor 4 was the association of very divergent edges opposite the backing with butts formed by retouch on that edge. This relationship appears very clearly in a bivariate cross-tabulation; 23 (74.19%) of the 31 complete or almost complete tools with retouched butts have a very divergent edge opposite the backing, whereas this is true of only 30 (47.62%) of the tools with unretouched butts. This difference is highly significant.[13] Another interaction concerns the relationship between the bulbar orientation of the butt and how it is made. Although the great majority of butts are located at the proximal end of the blank, those few located at the distal end are almost all retouched butts (4 retouched out of a total of 5 distal butts vs. 26 retouched out of a total of 87 proximal butts). This significant difference[14] suggests that on those rare occasions when the tool's orientation was not concordant with the bulbar orientation of the blank, the natural distal end required some modification before a satisfactory butt morphology was obtained.

Variation in Châtelperron point samples from different areas of Les Tambourets was investigated by the use of several multivariate measures of morphological distance. The Mahalanobis generalized distance statistic, D^2, was calculated on the basis of the five ratio- and ordinal-scale attribute sets used previously for the factor analysis (sets CH6, CH17 or CH18, CH19, CH20, and CH22). The samples used included the complete and almost complete Châtelperron points from Area 3:Archaeological Level 1, Area 3:couche B(Basal), Area 3:Méroc, Area 1:Méroc, Area 2:Méroc, and Area Tambourets-Terssac:Méroc. The distances resulting from this analysis are shown in Table 6-9 and in Figure 6-7, which is a dendrogram based on a measure of similarity derived from the distance measures ($12\text{-}D^2$).

In order to be able to use more of the Châtelperron point attribute sets, including those that measure variation on a nominal scale, a different measure of distance, the Euclidean distance, had to be employed. Because the Euclidean distance, defined (Engelman 1981: 459) as

$$d_{jk} = [\Sigma_i(x_{ij}-x_{ik})^2]^{1/2}$$

assumes independence of attributes (Doran and Hodson 1975: 138), the Châtelperron point attribute sets used in this analysis were chosen to exclude significantly correlated or associated pairs. For example, bidirectional backing was used, but the very significantly associated attribute, heavy backing, was excluded. The analysis was based on 12 variables—2 ratios, 8 percentages, and 2 means—of Châtelperron points in the same six samples used for the calculation of the Mahalanobis generalized distance statistic. The ratios were those of complete or almost complete to fragmentary portions and of points to butts (both based on variation within attribute set CH1). The next eight variables were the percentages, in each sample, of partial backing (CH2), bidirectional backing (CH4), triangular cross-section (CH7), left backing (CH8), retouched edge opposite the backing (CH10), use of a *lame à crête* as a blank (CH26), retouched butts (CH14), and parallel or subparallel Châtelperronoid gross morphology (CH25). The remaining variables were the sample means for complete and almost complete pieces of maximum width (CH9) and backed edge divergence index (CH22). The variables were standardized before the Euclidean distances were calculated.[15] Sample sizes varied, of course, among variables—all pieces, completes and almost completes, or butts only, as applicable. The results of this analysis and the cluster analysis based on it are shown in Table 6-10 and Figure 6-8. (The use of the Euclidean distance does not permit calculation of the probability of the distances between samples or clusters.)

The dendrograms (see Figures 6-7 and 6-8) showing the results of the cluster analysis, carried out using the weighted pair-group method (WPGM) of Sokol and Sneath (1963), are quite similar in the groupings they effect. Both techniques indicate that the excavated Châtelperron points from Area 3 are most similar to those collected by Méroc from the surface of the Tambourets-Terssac area, immediately northeast of Area 3 but located on the +15m terrace

TABLE 6-9.--Relationships among six samples of complete and almost complete Châtelperron points, based on variation in five attribute sets (CH6, CH17/18, CH19, CH20, CH22). Lower half-matrix tabulates values of the Mahalanobis generalized distance statistic (D^2). Upper half-matrix tabulates 2-tailed probability values for the distance measures.

	1	2	3	4	5	6
1		.08	>.20	.19	>.20	>.20
2	2.52		.16	>.20	>.20	>.20
3	2.76	10.38		>.20	>.20	>.20
4	1.37	1.01	2.56		.010	>.20
5	0.90	1.34	2.40	1.99		>.20
6	0.50	1.46	6.54	0.99	0.94	

Sample 1.	Area 3:A.L.1	N = 12
Sample 2.	Area 3:Méroc	N = 15
Sample 3.	Area 3:c.B(Basal)	N = 2
Sample 4.	Area 1:Méroc	N = 28
Sample 5.	Area 2:Méroc	N = 18
Sample 6.	Area Tambourets-Terssac:Méroc	N = 11

rather than, like Area 3, on the +30m terrace of the Volp and Garonne. Both techniques agree also that the Châtelperron points collected from the surface of Area 3 are most similar to those from the surface of Area 1, southeast of Area 3 and again on the lower or +15m terrace. The only substantive difference in the two dendrograms concerns the closest affinities of the Châtelperron points from Area 2; they obviously have similarities to those of both primary clusters. That these primary clusters are quite different is shown by the very low probability at their joining node in Figure 6-7. The sample from Area 3:couche B(Basal) is too small for meaningful interpretation.

The dissimilarity between the excavated and surface-collected Châtelperron points from Area 3 is a puzzling finding. It is quite different from the results of the cluster analysis of end-scrapers (see Figure 5-4), where the excavated and surface-collected samples from Area 3 were very similar, forming the tightest cluster. The explanation would seem to lie in a stronger localization of morphological attributes for Châtelperron points than for end-scrapers. The Tulane excavations affected only a small part of the southern margin of Area 3, and it is clear that the Châtelperron points recovered are not representative of those from the area as a whole (whereas excavated end-scrapers seem to be quite representative). If this is true, the cluster analysis of Châtelperron points, based of necessity on very broad lateral provenience units, will have diminished utility for the general study of time-space systematics at Les Tambourets.

II. ABRI AUDI KNIVES AND *ELÉMENTS TRONQUÉS*

Two objects from Les Tambourets, both part of Méroc's surface collection from Area Tambourets-Terssac (Table 6-11), conform to the definition of Abri Audi knives (see Figure 6-5, #8117A), and as such, they were not included in the studied series of Châtelperron points. Both have strongly curved backs (cf. the "classic Châtelperronoid" gross morphological attribute of set CH25), and both are made on flake blanks. However, in both cases the backing, on the right margin, is only partial, and it represents a rather minimal modification of a pre-existing natural back. On the example illustrated, the natural back is a steep, completely cortical, dorsal facet; the backing, which is light except near the point, affects all but the posterior part of the margin. The other example is made on what might be called an elongate *éclat à crête*, a blank that would be a *lame à crête* if it were a few millimeters longer or narrower. The *crête*, which is partly cortical, forms the steep natural back, and the (heavy) backing removals affect only the anterior portion of the margin. It appears obvious that these pieces simply extend the range of variation of the Châtelperron points of Les Tambourets slightly beyond the boundary of length : width ratio that distinguishes flakes from blades. On the

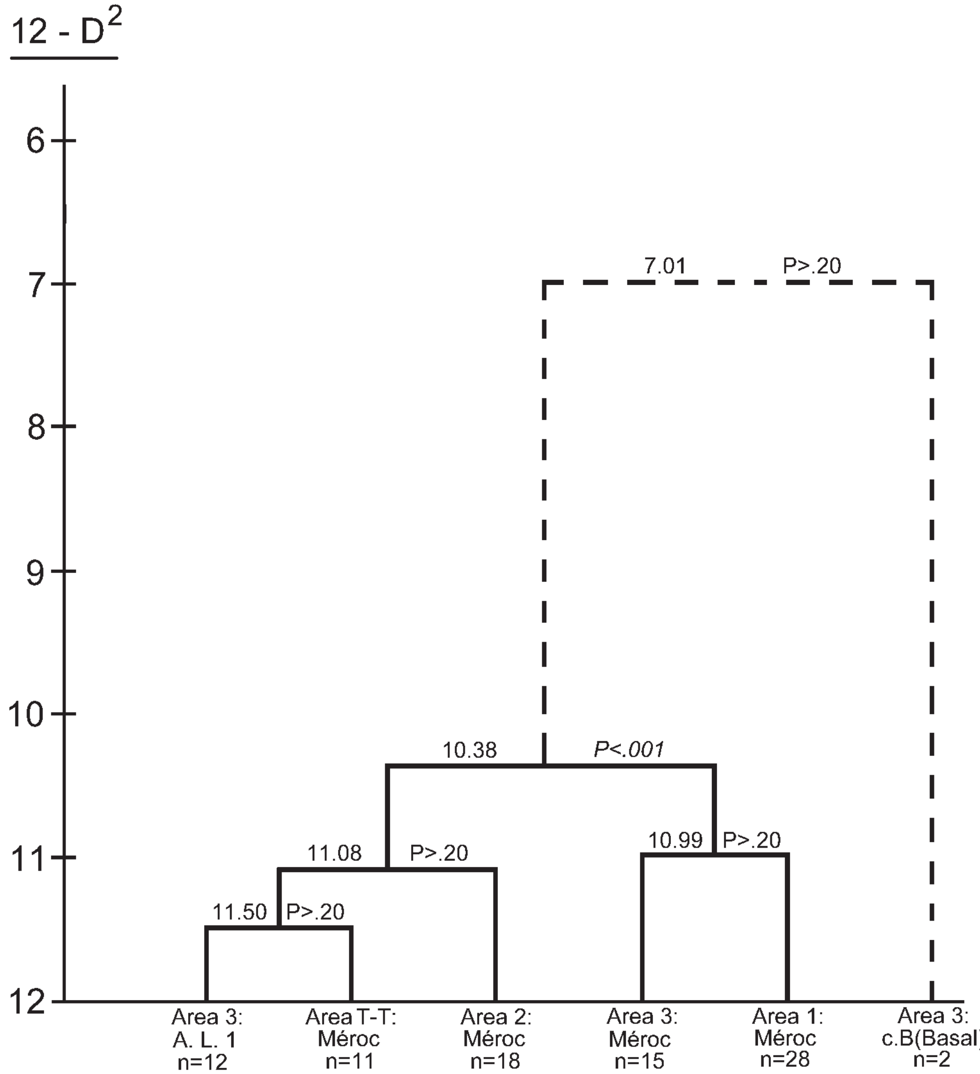

Figure 6-7. Dendrogram showing relationships among Châtelperron point samples at Les Tambourets based on a similarity measure, 12-D2, as discussed in the text.

basis of this technical (and unhelpfully mechanical) distinction, Abri Audi knives exist at Les Tambourets, but they do not comprise a separate class of backed tools independent of Châtelperron points.

The one *élément tronqué* from Les Tambourets (not illustrated) is part of the Méroc surface collection from Area 2 (see Table 6-11). It is apparently fragmentary, having a complex concave truncation toward the distal end of the blade blank and a broken surface at the other end, toward proximal. Complete medium (cross-section IV) and light (cross-section V) backing, from the ventral face only, extends along the left margin. The broken length is 27mm; maximum width and thickness are 12mm x 4mm, respectively. Other than to state that it cannot be a fragment of a Châtelperron point, it is impossible to specify the significance of this unique surface find.

III. SHOULDERED PIECES

Shouldered pieces have been found in all major areas of the site (see Table 6-11), but they are very infrequent (Figure 6-9, #234 and #2708). They have been pooled into one (still very small) sample for descriptive purposes. The attribute system used for the study of shouldered pieces (as well as for some other backed tools) is explained in Section VII of Appendix B.

Some attribute distributions for shouldered pieces are shown in Tables 6-12 and 6-13. All examples are by definition partially backed, and all available for study from Les Tambourets are fragmentary. The backing present is predominantly from the ventral face only, and at least some heavy backing is found on most pieces. Of the three distal extremities, one is bluntly pointed by a combination of backing and retouch on the opposite edge, and the other two are unpointed—one broad, sharp, feather edge (see Figure 6-9, #234) and one steep hinge fracture. One of the five proximal extremities has retouch on the edge opposite the backing; the other examples have unretouched proximal ends, usually with the striking platform preserved. All the blanks are blades, and one is cortical. On those regions where the partial backing is present, it has reduced the

TABLE 6-10.--Relationships among six samples of Châtelperron points, based on twelve variables (as explained in the text). Half-matrix tabulates values of the Euclidean distance statistic.

	1	2	3	4	5	6
1						
2	5.90					
3	6.49	5.74				
4	3.58	3.40	4.66			
5	5.75	4.09	5.51	3.96		
6	3.67	4.93	5.96	3.45	4.81	

Sample 1. Area 3:A.L.1
Sample 2. Area 3:Méroc
Sample 3. Area 3:c.B(Basal)
Sample 4. Area 1:Méroc
Sample 5. Area 2:Méroc
Sample 6. Area Tambourets-Terssac:Méroc

width of the blank by about one-third of the original width, on average.

Two of the pieces show clearly that the backing *curves* across the distal end of the blank (see Figure 6-9, #2708), and on one of these, the curving back combines with obverse retouch to form a recognizable point type of Châtelperron points. On a third example, backing and obverse retouch at the proximal end combine to form a typical "Obverse-2a" Châtelperron butt type. There is, then, good justification for the notion that at least some of the shouldered pieces are fragments of unfinished Châtelperron points that broke during manufacture. The most useful information to be sought from a study of the shouldered pieces is some indication of the reduction sequence used for the manufacture of Châtelperron points.

In the pooled sample of all Châtelperron points from Les Tambourets, the orientation of the tool is concordant with the bulbar orientation of the blank in at least 83% of cases (see Table 6-4)—butt proximal, point distal. Using this model, to which the three pieces discussed in the preceding paragraph conform, it is instructive to investigate the relationship between the location of the partial backing and the bulbar axis of the shouldered pieces. On two of the three distal portions, the backing affects the actual distal extremity; the unbacked part of the margin, beyond the shoulder, is located more proximally, in the middle third of the blank. The situation is reversed on the third example; the partial backing starts proximally of the unmodified natural distal extremity. On four of the five shouldered segments, the partial backing is located on the end of the portion nearest to the (missing) distal extremity; the bulbar orientation of the fifth segment is indeterminate. With the five proximal portions, it is again the case that four of them have the partial backing located toward distal, leaving the original proximal extremity unmodified. The exception is the "Obverse-2a" butt mentioned in the previous paragraph. There is, then, a strong suggestion, from 10 of 12 determinable examples, that the manufacture of a Châtelperron point may have started usually with the backing of the end of the blank that was to become the point of the tool. This question is discussed further below, in section VII of this chapter, using information from other artifact classes.

IV. LAMES À DOS

Lames à dos (see Figure 6-9, #496, #365 and #5949) are somewhat more frequent (see Table 6-11) at Les Tambourets than shouldered pieces, but the descriptive study is again based on a pooled sample from all areas of the site. The attribute system used is the same as for shouldered pieces (Appendix B, Section VII). Some important attribute distributions of *lames à dos* are shown in Tables 6-12 and 6-13.

All but one of the 27 *lames à dos* are fragmentary; proximal portions and segments predominate in the collections. The backing is (by definition) complete on the portion available for study, and it is most often heavy and from the ventral surface only. With the object oriented to the bulbar

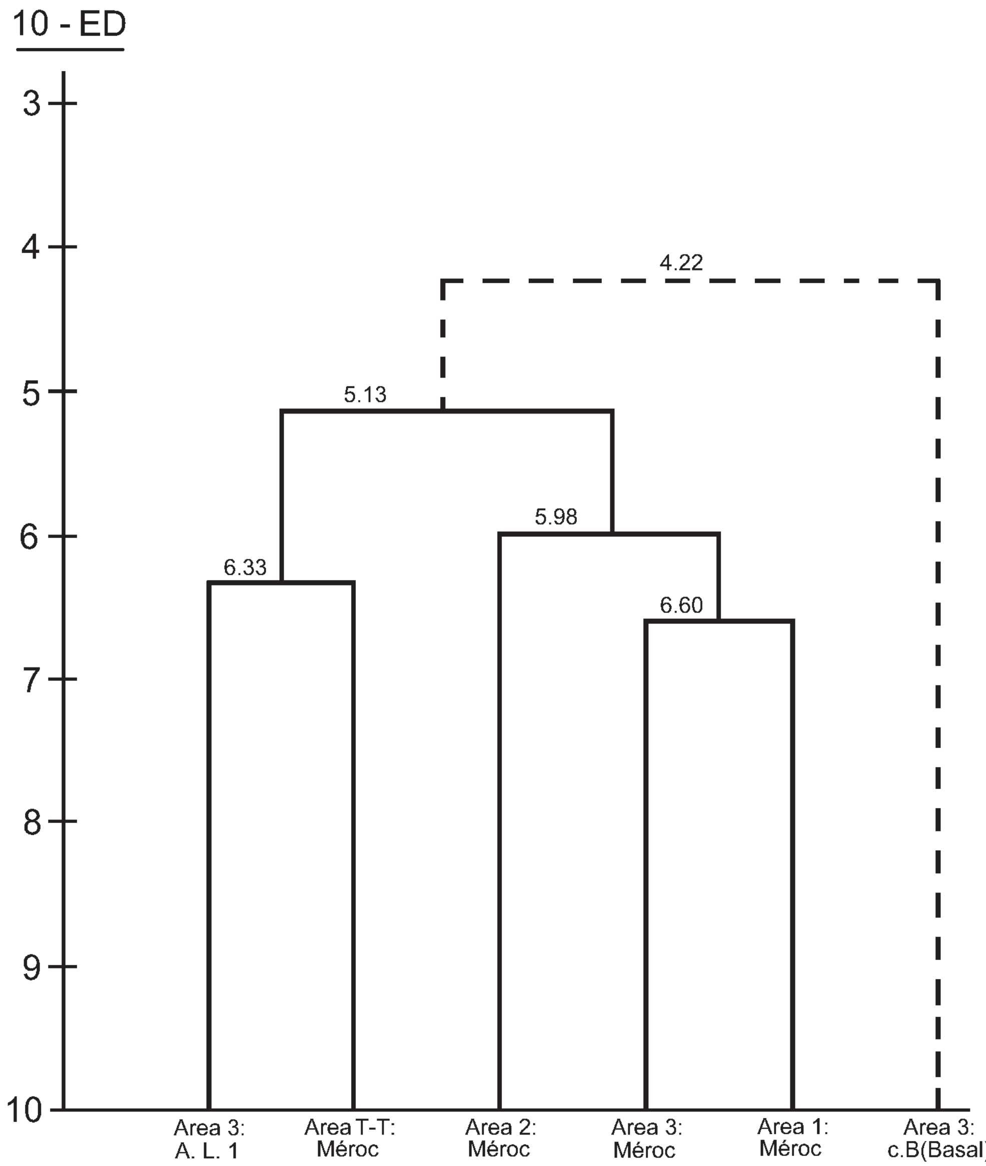

Figure 6-8. Dendrogram showing relationships among Châtelperron point samples at Les Tambourets based on a similarity measure, 10-ED, as discussed in the text.

axis, frequencies of left and right backing are close to being equal. The blanks are all blades, and only five pieces preserve all or part of the original distal extremity. Sharply pointed forms are absent (by definition). On one example, the backing and an obliquely oriented hinge fracture form a very blunt point. The other four pieces are not pointed; the distal extremity is a broad feather edge or steep dorsal facet. Eight of the 11 proximal extremities available for study are unretouched on the edge opposite the backing. On the other three, the backing combines with obverse (or obverse/inverse) retouch on the opposite edge to create a morphology like that of a Châtelperron butt. None of the *lames à dos* is made on a *lame à crête*, and only one is cortical.

The major question about the *lames à dos* is whether they represent a separate class of backed tool—completely backed but not pointed—independent of Châtelperron points or, rather, some unfinished intermediate by-products of Châtelperron point manufacture. The presence of some characteristic Châtelperron butt treatments suggests that the second possibility may be correct for at least some of the *lames à dos*. This question is considered in more detail below, in Section VII of this chapter.

V. PIECES WITH PARTIAL AND/OR IRREGUALR BACKING

The largest sample of backed pieces from Les Tambourets other than Châtelperron points is made up of pieces with partial and/or irregular backing (see Figure 6-9, #194 and #333). The description is based on a pooled sample (see Table 6-11), and the relevant attribute system is, once again, that of Appendix B, Section VII. Attribute distributions for these pieces are shown in Tables 6-12 and 6-13.

Almost all the pieces in the sample are broken, and segments and proximal fragments account for over two-thirds of the sample. Almost 20% of the objects have complete (irregular) backing on the portion represented, but most

TABLE 6-11.--Distribution of backed and naturally backed tools from different areas of Les Tambourets.

	Ar.3: A.L.1	Ar.3: Méroc	Ar.2: Méroc	Ar.1: Méroc	Area T-T: Méroc	General	Ar.3: cB(B)	TOTAL
Abri Audi knives	0	0	0	0	2	0	0	2
Shouldered pieces	2	0	3	3	1	4	0	13
Lames à dos	8	2	5	2	6	4	0	27
Pieces with partial and/or irregular backing	11	3	11	11	7	10	2	55
Eléments tronqués	0	0	1	0	0	0	0	1
Naturally backed knives:								
with Châtelperron point morphology	9	6	3	7	3	3	0	31
with Abri Audi knife morphology	2	0	0	0	0	1	1	4
"regular"	4	2	0	0	0	0	0	6
TOTAL "OTHER BACKED"	36	13	23	23	19	22	3	139
(Châtelperron points)	28	25	33	59	41	40	5	231
Ratio "other backed : Châtelperron points - 1 : n	0.78	1.92	1.43	2.57	2.16	1.82	1.67	1.66

of the pieces, about 80%, are only partially backed. Often this partial backing is itself irregular. These characteristics, in combination with the fact that heavy backing is found on fewer than half of the objects and the fact that very few of the distal extremities present are sharply pointed, suggest strongly that the pieces with partial and/or irregular backing are parts of unfinished objects broken during the course of manufacture. Several of the rare complete examples, with a curving line of partial backing at the distal end, suggest more specifically that the unfinished objects in question were, at least sometimes, Châtelperron points. Indeed, the most satisfactory interpretation of the pieces with partial and/or irregular backing is one that relates them to the sequence of steps used to manufacture a Châtelperron point from an unmodified blade blank, as discussed below in Section VII of this chapter.

VI. NATURALLY BACKED KNIVES

The Châtelperronian assemblages from Les Tambourets contain several different kinds of tools that belong to the general class of naturally backed knives (see Table 6-11). Most of the naturally backed knives occur on blades, and they mimic, in their general morphology, the dominant backed tool in the assemblages, the Châtelperron point. Others, made on flakes, are morphologically somewhat similar to Abri Audi knives (see Figure 6-9, #5591). A few others, morphologically diverse, do not bear a close resemblance to any of the specialized forms of (retouched) backed tools. Each of these kinds of naturally backed knives is described in the paragraphs that follow, beginning with those blade tools that resemble Châtelperron points.

In the view of Louis Méroc (1963a: 67), one of the distinctive characteristics of the Châtelperronian industry of Les Tambourets is the presence of *lames à crête*, generally with utilization damage on the edge opposite the *crête*, whose size and gross morphology are so similar to the dimensions and shape of Châtelperron points that they can be seen as naturally backed versions or mimics of the latter (see Figures 6-9, #2262, #1833, #3864, #8255, 6-10, #153, and 6-11, #1690). This idea receives support from the fact (mentioned above in Section I of this chapter) that some Châtelperron points from Les Tambourets, ca. 11% of the total sample, represent minimal modifications of *lames à crête*, accomplished by backing that is usually only partial (see Table 6-4). Méroc's original suggestion may be phrased more generally as follows (cf. †Méroc and Bricker 1984): At Les Tambourets, the *lame à crête* of a certain size and shape was a blank of choice for the manufacture of backed points (or knives). The natural back formed by the removals that create the *crête* was sometimes modified by steep, backing retouch to produce a true, backed Châtelperron point. More often, however, *lames à crête* in the appropriate size and shape range were not retouched; rather, they were probably used, in unmodified form, for the same range of functions as were Châtelperron points, and, as a result of that use, they bear the same macroscopic traces of utilization damage on the edge opposite the (natural) back.

Although my study of the materials from Les Tambourets did not identify as many Châtelperron-like *lames à crête* as originally reported by Méroc (1963a: 67), there is a series of 31 naturally backed knives on blade blanks (29 of which are *lames à crête*), widely distributed among the

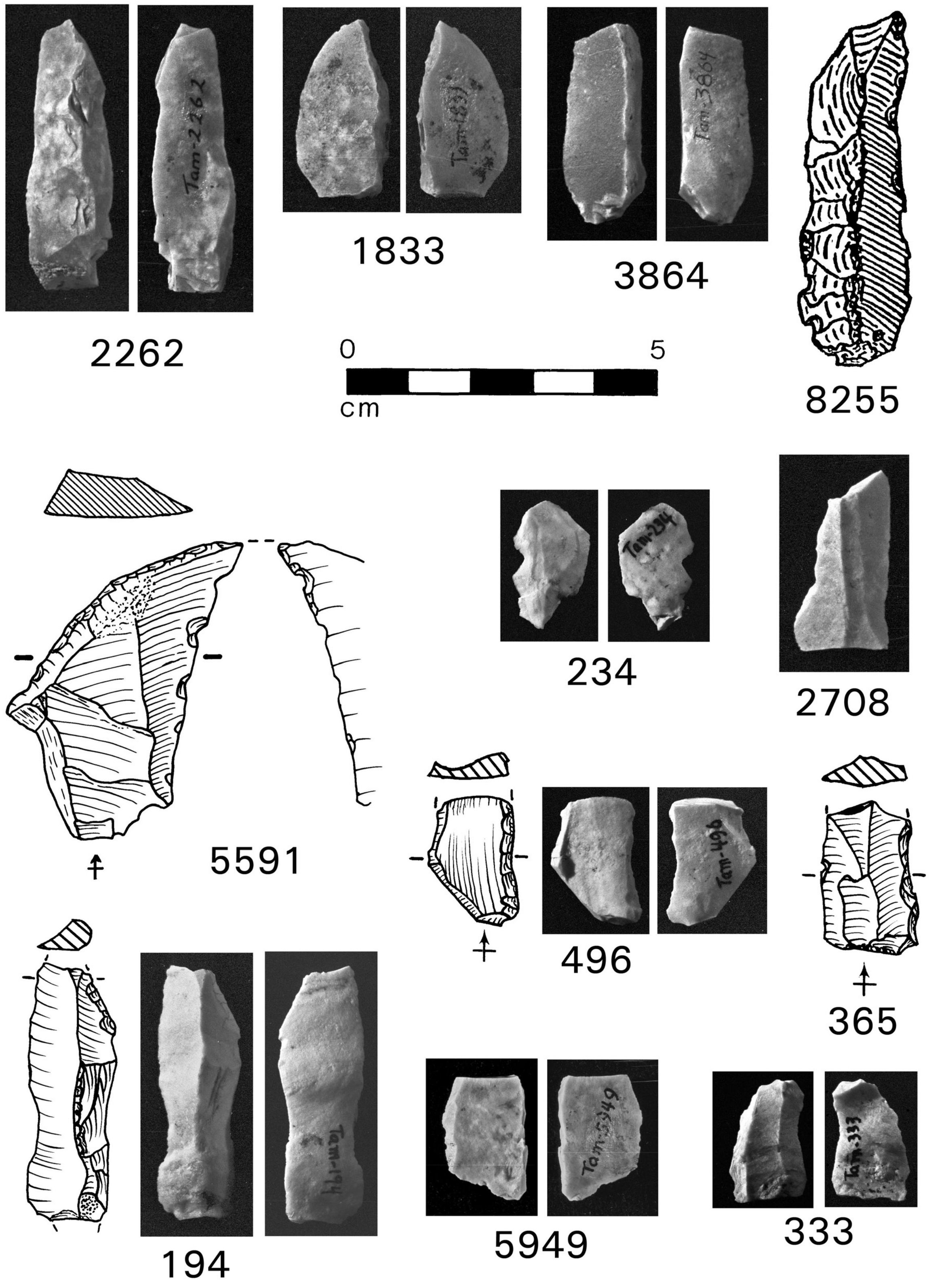

Figure 6-9. Backed tools from Les Tambourets. #2262, #1833, #3864, #8255: naturally backed knives with Châtelperron-point morphology; #5591: naturally backed knife; #234, #2708: shouldered pieces; #496, #365, #5949: lames à dos; #194, #333: blades with partial and/or irregular backing. #8255 is in the Méroc Collection, area unspecified (drawing by L. Méroc); #5591 is from couche B (basal) in Area 3; all other pieces are from Archaeological Level 1 in Area 3.

TABLE 6-12.--Distributions of portion and other attribute sets of shouldered pieces and other classes of backed and naturally backed tools.

	Shouldered Pieces	Lames à dos	Part.and/ or Irreg. Backed Pieces		Nat. Bked. with Chât.Point Morphology
	n	n	n	%	n
Portion (OB1)					
Complete	0	1	4	7.27	*
Distal	3	4	12	21.82	
Segment	5	12	21	38.18	
Proximal	5	10	18	32.73	
TOTAL	13	27	55	100.00	
Completeness of Backing (OB2)					
Complete	0	27	10	18.18	*
Partial	13	0	45	81.82	
TOTAL	13	27	55	100.00	
Priority Backing Direction (OB4)					
Bidirectional	2	7	3	5.45	*
Ventral	11	20	51	92.73	
Dorsal	0	0	1	1.82	
TOTAL	13	27	55	100.00	
Maximum Extent of Backing (OB5 and CH5)					
Heavy	10	19	25	45.45	27
Medium	3	6	23	41.82	2
Light	0	2	7	12.73	2
TOTAL	13	27	55	100.00	31

different areas of the site (see Table 6-11), and this total is indeed slightly greater than the number of (retouched) backed Châtelperron points made on *lame à crête* blanks (n=25; see Table 6-4). Accepting Méroc's suggestion as a working hypothesis, the object of the attribute analysis of these objects is to specify how similar they are in their formal attributes to the full series of Châtelperron points, with which they putatively share a functional identity. In order to make such an analysis possible, the attribute system used to describe the Châtelperron-like naturally backed knives consists of most of the sets of the attribute system for Châtelperron points (Appendix B, Section VI).[16] Some of the important attribute distributions are shown in Tables 6-12 and 6-13; others are discussed in the text that follows.

Within the pooled sample of 31 Châtelperron-like naturally backed knives, 26 are complete or almost complete, and 5 are fragmentary butt portions that are, nevertheless, long enough for the curvature of the natural back to be apparent. On the majority of examples (see Table 6-12), the presence of the natural back creates a cross-section for the blade that is the same as that created by heavy backing on retouched Châtelperron points. In almost all cases (n=29), the natural back is formed by the steep removals of the *crête* of a *lame à crête*. With the pieces in a bulbar orientation,

(Table 6-12--continued)

	Shouldered Pieces	Lames à dos	Part.and/ or Irreg. Backed Pieces		Nat. Bked. with Chât.Point Morphology
	n	n	n	%	n
Minimum Extent of Backing (OB6 and CH6)					
Heavy	0	14	8	14.55	18
Medium	5	9	12	21.82	6
Light	8	4	35	63.64	7
TOTAL	13	27	55	100.01	31
Backing Side (OB8 and CH8)					
Left	4	9	25	45.45	13
Right	8	11	23	41.82	18
Indeterminate	1	7	7	12.73	0
TOTAL	13	27	55	100.00	31
Nature of Edge Opp. the Backing (OB9 and CH10)					
Unmodified	1	7	10	18.18	0
Utilized	11	17	41	74.55	31
Retouched	1	3	4	7.27	0
TOTAL	13	27	55	100.00	31
Shape of Distal End (OB12)					
Sharply pointed	0	0	3		*
Bluntly pointed	1	1	5		
Not pointed	2	4	8		
TOTAL	3	5	16		

the natural back is located on the left side (see Figures 6-9, #8255, 6-10,#153, and 6-11, #1690) approximately as often as on the right (see Figure 6-9, #2262, #1833, and #3864), a parity that one finds also in the pooled sample of true Châtelperron points. All pieces in the sample, including the nine objects excavated from Archaeological Level 1, have macroscopically obvious utilization damage on the edge opposite the backing. Because the naturally backed knives are, by definition, not retouched, all have unretouched point and/or butt types, which are, to be sure, the most frequently occurring extremity types for true Châtelperron points as well. Sample values of width and thickness are shown in Table 6-13; mean length for the complete and almost complete examples is 46.92mm, with a standard deviation of 8.95mm. The naturally backed knives are significantly larger in all dimensions than the true Châtelperron points.[17]

In overall shape, the Châtelperron-like naturally backed knives are very similar to the true, retouched Châtelperron points. In all but three cases, the naturally backed edge diverges markedly (attribute set CH22) toward the anterior end, and the outline of that end is predominantly (n=17) a smooth curve (attribute 1b of set CH21). The divergence of the naturally backed edge is slightly less pronounced (backed side deviation index mean=6.33, with s=6.60)

(Table 6-12--continued)

	Shouldered Pieces	Lames à dos	Part.and/ or Irreg. Backed Pieces		Nat. Bked. with Chât.Point Morphology
	n	n	n	%	n
Distal Termination (OB13)					
Feather/sharp edge	2	3	8		*
Steep dorsal facet	0	1	6		
Hinge fracture	1	1	2		
TOTAL	3	5	16		
Nature of Proximal End (OB14 and CH14)					
Unretouched-1	1	2	2		5
Unretouched-2	3	6	18		23
Obverse	1	2	2		0
Inverse	0	0	0		0
Obverse/Inverse	0	1	0		0
TOTAL	5	11	22		28
Lame à Crête (OB20 and CH26)					
On lame à crête	0	0	6	10.91	29
Gibbosity (OB21 and CH27)					
Gibbous	0	0	2	3.64	0
Occurrence of Cortex (OB22 and NS2)					
Cortical	1	1	4	7.27	1

Note: * This attribute set does not apply to this artifact class.

than that of the retouched back of Châtelperron points (mean=7.87, s=23.72), but this difference is not significant at the 0.05 level.[18] Using the same categories employed for true Châtelperron points, the distribution of gross morphology for the naturally backed knives is as follows: 16 classic Châtelperronoid, 5 parallel Châtelperronoid, 3 subparallel Châtelperronoid, 1 foliate Châtelperronoid, and 1 subfoliate Châtelperronoid. The distribution of gross morphology does not differ significantly from that for Châtelperron points.[19]

The sample of Châtelperron-like naturally backed knives can be seen, then, to be very similar to the sample of true Châtelperron points in some aspects and quite different in others. Further discussion about the general relationship between the two tool classes and about Méroc's specific hypothesis appears in Section VII of this chapter, below.

The second kind of naturally backed knife found at Les Tambourets is a tool on an elongate flake blank, with the natural back curving toward the distal extremity. The morphology resembles somewhat that of an Abri Audi knife (see Figure 6-9, #5591). Because only four such tools

TABLE 6-13.--Distributions of width and other attribute sets of shouldered pieces and other classes of backed and naturally backed tools. Sample values shown are mean ($\bar{X}$) and standard deviation (s).

	Shouldered Pieces	Lames à dos	Part.and/ or Irreg. Backed Pieces	Nat. Bked. with Chât.Point Morphology
N (all portions)	13	27	55	31
Width (OB17 and CH19) in mm				
$\bar{X}$	14.77	13.33	14.51	16.39
s	2.52	2.83	3.49	3.11
Backed Width (OB18) in mm				
$\bar{X}$	9.77	13.33	12.76	*
s	2.28	2.83	4.43	
Thickness (OB19 and CH20) in mm				
$\bar{X}$	5.00	5.44	5.80	8.94
s	0.82	1.05	2.31	2.06

Note: * This attribute set does not apply to this artifact class.

are present in the collections (see Table 6-11), no formal attribute descriptions are presented here. All four objects are complete, and three of them lack any retouch whatsoever. The illustrated piece, from couche B(Basal) in Test Pit 3W5 in Area 3, has a natural back formed by a steep dorsal facet that has been modified very slightly by light obverse retouch along the distal half of this edge. This modification, which has not significantly altered the shape of the naturally backed edge, is too modest to be called backing. The edge opposite the natural back bears extensive utilization damage. As in the case of the Abri Audi knives with true (retouched) backing, these four pieces simply extend the range of Châtelperron-like naturally backed knives at Les Tambourets slightly beyond the formal boundary between blades and flakes.

The third kind of naturally backed knife is represented in the collections by only six objects, all from Area 3 (see Table 6-11). These pieces, which have no close morphological resemblances to either Châtelperron points or Abri Audi knives, may be termed "regular" naturally backed knives of the sort that occur occasionally in a variety of Middle and Upper Palaeolithic contexts. Four of the knives are on flake blanks (see Figure 6-10, #548), one of which is cortical (see Figure 6-10, #2928), and two are on blades (see Figure 6-11, #171), one of which is a cortical *lame à crête* (see Figure 6-11, #5682). The natural back is always one or more steep dorsal facets. They are large objects; sample values (mean ± standard deviation, in mm) of length, width, and thickness for the small sample of six are 68.83±17.75, 41.50±15.55, and 17.67±6.74, respectively. Heavy utilization damage appears on at least part of the edge opposite the natural back on all the pieces.

VII. RELATIONSHIPS AMONG BACKED TOOL CLASSES

Following the analytic model employed for scrapers (Chapter 5, Section V), the relationships among different kinds of backed and naturally backed tools were investigated by means of a discriminant analysis. The tool classes analyzed were pieces with partial and/or irregular backing (n=55), shouldered pieces (n=13), *lames à dos* (n=27), naturally backed knives with Châtelperron-point morphology (n=31), and Châtelperron points. In order to permit the clearest possible comparison between the latter two tool classes, and thus to carry out the clearest test of Louis Méroc's hypothesis about the naturally backed *lames à crête*, the Châtelperron point sample was divided for purposes of this analysis into Châtelperron points made on *lames à crête* (n=25) and "regular" Châtelperron points made on other kinds of blades (n=206). Several of the backed tool classes (e.g., Abri Audi knives) were excluded from the discriminant analysis because of inadequate sample sizes.

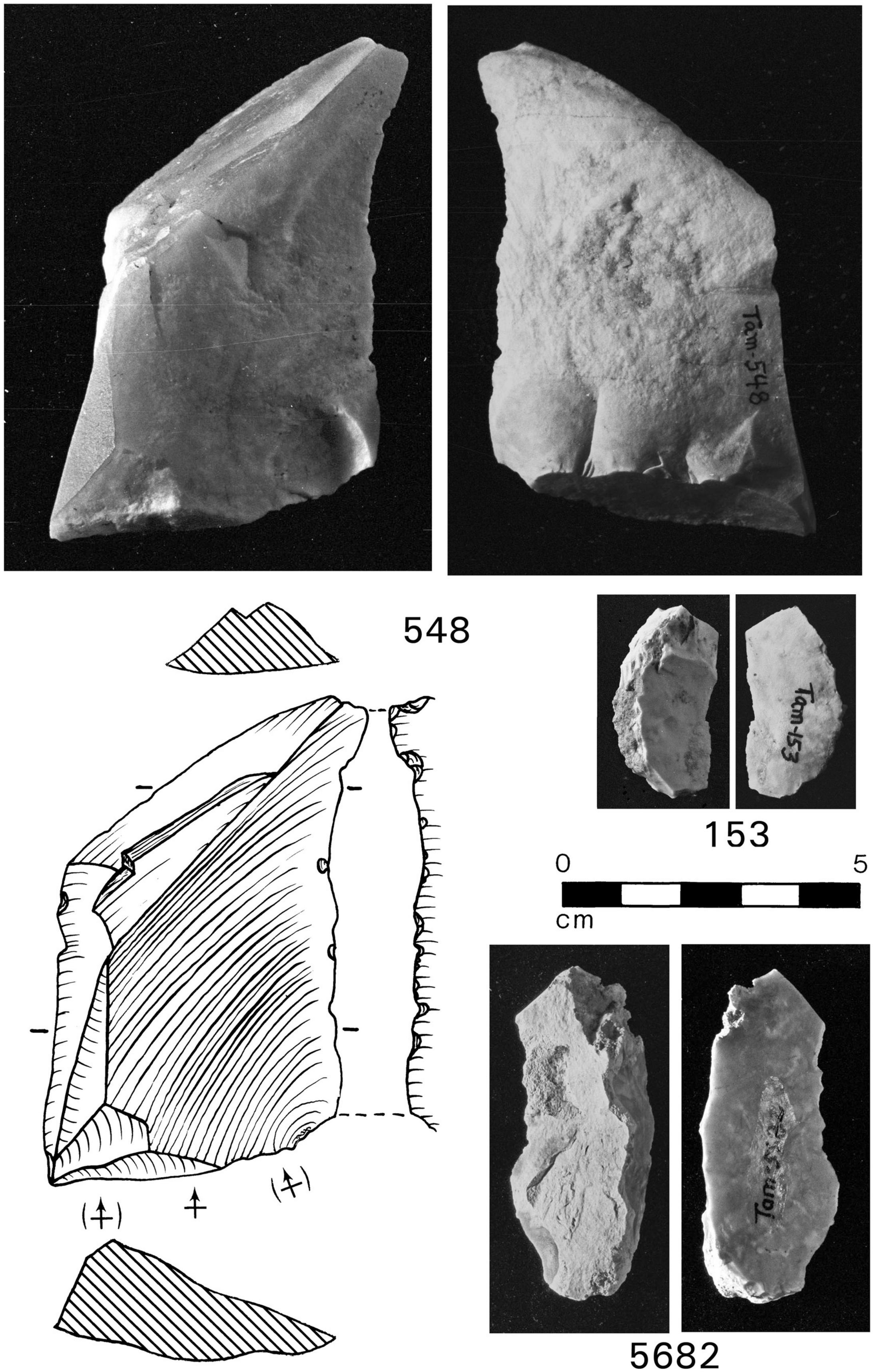

Figure 6-10. Naturally backed knives from Archaeological Level 1 in Area 3 at Les Tambourets. #153 has Châtelperron-point morphology.

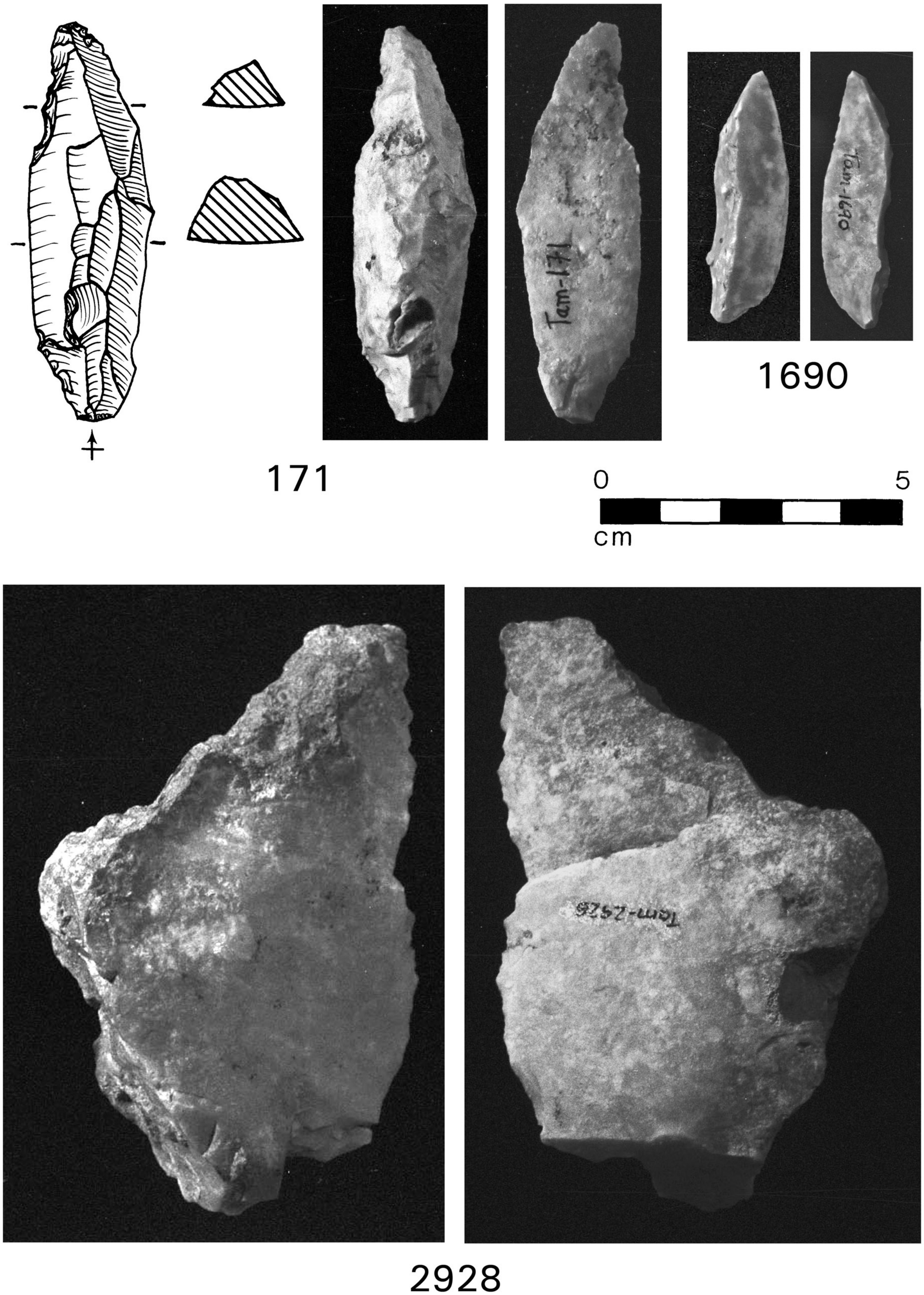

Figure 6-11. Naturally backed knives from Archaeological Level 1 in Area 3 at Les Tambourets. #1690 has Châtelperron-point morphology.

The analysis used four attribute sets that are identical or comparable across all the backed tool classes. Two of the sets concern the backing and are made up of ordinal-scale attributes. These are maximal extent of backing (CH5 and OB5) and minimal extent of backing (CH6 and OB6). The other two sets concern the dimensions of the tool. Maximum width of tool (CH19 and OB17) was used for Châtelperron points, *lames à dos*, and naturally backed knives; in order to maintain comparability, maximum backed width of tool (OB18) was used for shouldered pieces and pieces with partial and/or irregular backing.

The discriminant analysis,[20] the major results of which are shown in Table 6-14, retained all four of the attribute sets supplied and produced four canonical variates. The most useful attribute set for discriminating among the different tool classes was maximum thickness, followed—in decreasing order of utility—by maximum width (or backed width), minimum extent of backing, and maximum extent of backing.

The data of Table 6-14 indicate clearly that the discriminant analysis was not very successful in distinguishing among what the original typological analysis defined as being very different classes of backed tools. The best measure of the "failure" of the original typology is the fact that only 38% of the 357 objects in the sample were correctly reclassified by the analysis. (Correct reclassification means, for example, classifying as a *lame à dos* a piece that I had originally called a *lame à dos*.) This 38% success rate for backed tools contrasts strikingly with the 72% success rate achieved by a similar analysis of scrapers (see Table 5-16). The highest success rate for an individual backed tool class is 77%, for shouldered pieces. Only 33% of "regular" Châtelperron points, the predominant backed tool class at Les Tambourets, were correctly classified; the other two-thirds of this sample were erroneously placed within every one of the other backed tool classes in the analysis.

The failure of the discriminant analysis to discriminate indicates clearly that what were originally defined as different tool classes are in fact very similar, in terms of the attribute sets used in the analysis. The undeniable differences used to define the different classes are differences in nominal-scale attributes not able to be used in the discriminant analysis—for example, natural or true backing, partial or complete backing, presence or absence of a shoulder, or presence or absence of a pointed distal extremity. One measure of the extent of similarity and difference in blank dimensions and cross-sectional shape is provided by another result of the discriminant analysis, a two-dimensional plot (Figure 6-12) of tool-class means on the axes of the first two canonical variates, which together account for ca. 86% of the variation in the concerned attribute sets. All backed tool classes are indeed very similar, but two general groupings can be discerned. The first group contains primarily *lames à crête* (the Châtelperron-like naturally backed knives and Châtelperron points made on *lames à crête*), and the second contains all the other backed tool classes. This situation provides an opportunity for a final consideration of Méroc's hypothesis about the relationship between Châtelperron points and *lame à crête* blanks.

Evidence was presented and discussed earlier (in Section VI of this chapter, above) that the naturally backed knives with Châtelperron point morphology have attribute distributions indistinguishable from those of retouched Châtelperron points except for the attributes of the dimensions of the blank. The discriminant analysis, based in large part on the dimensions of the blank, provides the further useful information that the Châtelperron-like naturally backed knives, most of which are made on *lames à crête*, are most closely related to those retouched (truly backed) Châtelperron points that are made on *lame à crête* blanks (see Figure 6-12). *Lames à crête* are generally thicker and (because they have not been reduced by backing retouch) wider than retouched Châtelperron points made on regular blade blanks. However, as the discriminant analysis makes clear, *lames à crête* with an unmodified, curving, natural back are no more typologically "distant" from regular Châtelperron points than are *lames à crête* on which the curvature of the natural back has been enhanced by (usually partial) backing retouch. In one sense, then, Méroc's hypothesis is firmly supported by all results of the present analysis. Although the data now available do not speak to the question of whether *lames à crête* of a certain size and shape were deliberately produced results of a specialized *débitage* technique, it is almost certainly true that both unmodified and only slightly modified *lames à crête* in the approximate size and shape range were the functional equivalents of regular or classic Châtelperron points. There is ample justification for including the Châtelperron-like naturally backed knives among the formal tools from Les Tambourets.

The second grouping of backed tool classes in Figure 6-12 includes regular Châtelperron points, pieces with partial and/or irregular backing, shouldered pieces, and *lames à dos*. These backed tools are quite similar in their dimensions and cross-sectional shapes, and they differ primarily in completeness of backing and the shape—pointed or not—of the distal end. There is abundant evidence, discussed above in Sections III, IV, and V of this chapter, that many examples of the three major tool classes are by-products of the manufacture of Châtelperron points—pieces that broke during manufacture or were left unfinished for other reasons. The discriminant analysis confirms that the blanks in question are essentially the same as the blanks for finished Châtelperron points. All available evidence suggests that the relationships among the four backed-tool classes in question are processual and sequential. The attempt to explain why certain kinds of partially backed and nonpointed objects occur in the Tambourets assemblages leads to the specification of several models of the manufacturing steps by which blade blanks were transformed into Châtelperron points. Several such models of a Châtelperron point production sequence are discussed in the following paragraphs.

Figure 6-13 shows one sequence of steps by which Châtelperron points were made on nonpointed blade blanks at Les Tambourets. There is more evidence in the samples for the use of nonpointed blanks than of pointed

TABLE 6-14.--Canonical variates and other results of the discriminant analysis of backed and naturally backed tools.

Canonical Variates

	Canonical Variate 1	Canonical Variate 2	Canonical Variate 3	Canonical Variate 4
Coefficient for maximum extent of backing	0.092	-0.216	-1.880	0.588
Coefficient for minimum extent of backing	0.243	-0.915	0.934	0.662
Coefficient for width	-0.010	0.300	0.047	0.214
Coefficient for thickness	-0.555	-0.356	-0.011	-0.069
Constant	2.884	0.175	-0.044	-4.822
Eigenvalue	0.397	0.190	0.059	0.037
Cumulative percentage of total dispersion	58.09	85.92	94.55	100.00
Group means for:				
Châtelperron points (regular)	0.214	0.240	0.122	0.043
Pieces with partial and/or irregular backing	0.300	-0.583	-0.315	0.218
Shouldered pieces	0.765	-1.326	0.484	-0.622
<u>Lames à dos</u>	0.270	0.416	-0.573	-0.415
Nat. bked. knives with Chât. point morphology	-1.704	0.100	-0.027	-0.099
Châtelperron points on <u>lames à crête</u>	-1.003	-0.576	0.089	0.060

Attribute Sets Retained by the Analysis

		CH(R)*	P/I B	SHLRD	LADOS	NATBK	CH(L)
1. Max. extent of backing	$\bar{X}$	1.30	1.67	1.23	1.41	1.19	1.36
	s	0.48	0.70	0.44	0.69	0.54	0.64
2. Min. extent of backing	$\bar{X}$	2.14	2.49	2.62	1.67	1.71	2.24
	s	0.71	0.74	0.51	0.78	0.94	0.83
3. Width	$\bar{X}$	14.41	13.13	9.77	13.33	16.39	14.72
	s	2.99	3.81	2.28	2.83	3.11	2.65
4. Thickness	$\bar{X}$	5.71	5.80	5.00	5.44	8.94	7.96
	s	1.54	2.31	0.82	1.05	2.06	2.03

blanks; whether this corresponds to the real frequencies of the two kinds of blanks produced or whether there was a higher failure rate in the process of making pointed tools from nonpointed blanks cannot be specified. For purposes of consistent graphic representation, Figure 6-13 depicts a blade with a single major dorsal ridge and a sharp, "feather-edge," square, distal extremity. The same model is assumed to apply for square-ended blanks whose distal extremities are steep dorsal facets or hinge fractures, examples of which occur in the collections. In this and the subsequent models discussed, it is assumed that the functional orientation of the tool is concordant with the bulbar axis of the blank—point distal, butt proximal—as is true for over 80% of the finished Châtelperron points from Les Tambourets. By arbitrary convention, all backing is shown on the right margin. Finally, the model depicted in Figure 6-13 shows the manufacture of a Châtelperron point with an unretouched butt, which is the butt treatment found on the majority (ca. 66%) of Châtelperron points.

Modification of the blank (form a of Figure 6-13) begins by starting a line of backing at the distal end of the blank and moving it along toward but not beyond the blank's

(Table 6-14--continued)

Comparison of Initial Classification (rows) and Reclassification (columns)

		CH(R)*	P/I B	SHLRD	LàDOS	NATBK	CH(L)
CH(R)	(n = 206)	68	27	23	56	11	21
P/I B	(n = 55)	10	17	10	8	4	6
SHLRD	(n = 13)	1	2	10	0	0	0
LàDOS	(n = 27)	4	7	1	14	1	0
NATBK	(n = 31)	2	2	0	6	16	5
CH(L)	(n = 25)	0	3	3	3	7	9

Correct reclassification of:
- Châtelperron points (regular): 68 of 206, 33.01%
- Pieces with partial and/or irregular backing: 17 of 55, 30.91%
- Shouldered pieces: 10 of 13, 76.92%
- Lames à dos: 14 of 27, 51.85%
- Naturally backed knives with Châtelperron point morphology: 16 of 31, 51.61%
- Châtelperron points on lames à crête: 9 of 25, 36.00%
- All tools in the sample: 134 of 357, 37.54%

Note: * CH(R) = Châtelperron points (regular)
P/I B = Pieces with partial and/or irreg. backing
SHLRD = Shouldered pieces
LàDOS = Lames à dos
NATBK = Naturally backed knives with Châtelperron point morphology
CH(L) = Châtelperron points on lames à crête

midsection (form b). Another "pass" or series of passes backs the distal half of the blank more heavily, resulting in the creation of a shouldered piece (form d). At this stage, additional backing removals transgress even farther into the distal end of the blank, beginning but not yet fully achieving the curving or angulation of the line of backing toward the opposite edge (form h). The continuation of this backing process at the distal end (frequently with the use of bidirectional backing) results in the intersection of the backing with the opposite edge, the removal of the last traces of the original distal extremity, and the final pointed morphology characteristic of the Châtelperron point. Only at this stage, when the point of the tool has been successfully created, is the backing of the proximal half of the blank performed, either partially (form l) or completely (form m).

Failure by breakage (or a decision to abandon the task, for reasons unknown to us) may occur at any point in this process. The uppermost row of forms in Figure 6-13, forms c, c′,...k, k′, are characteristic breakage products, most of which occur in the collections from Les Tambourets (Table 6-15). It is, of course, also the case that completed Châtelperron points may break in a variety of ways (forms n, n′,...q, q′, q″), and, depending on exactly when the fracture occurs, some of these breakage products may be indistinguishable from forms produced by fracture during manufacture (see Table 6-15, forms n′, p″, q′, q″).

The statement made earlier, that the relationships among several of the backed-tool classes are processual and sequential, may now be illustrated specifically. Form d, for example, which the typology employed classifies as a shouldered piece, is a form that results from the process of Châtelperron point manufacture. The correct interpretation of its presence in the assemblages derives from its position in a sequence of manufacturing steps, approximately midway between the unmodified blank (form a) and the finished product (form l or m). If form d were to break into three parts corresponding to forms f, f′, and f″, such parts would be treated by the typology employed as belonging to three separate artifact classes—*lame à dos* (form f), shouldered piece (form f′), and unmodified *débitage* product (form f″)—despite the fact that the only meaningful artifact class is that of Châtelperron point. The artifact class assignments of all the forms shown in Figure 6-13 are listed in Table 6-15.

A similar but less complicated series of steps seems to have been employed for the manufacture of Châtelperron points on blanks that were originally at least roughly pointed (Figure 6-14). The major difference between this model and the previous one is that the line of backing was curved from the start of the backing process. As in the other model, backing starts at the distal end (form s), and the point of the tool (which may, as in the illustration, be formed in part by

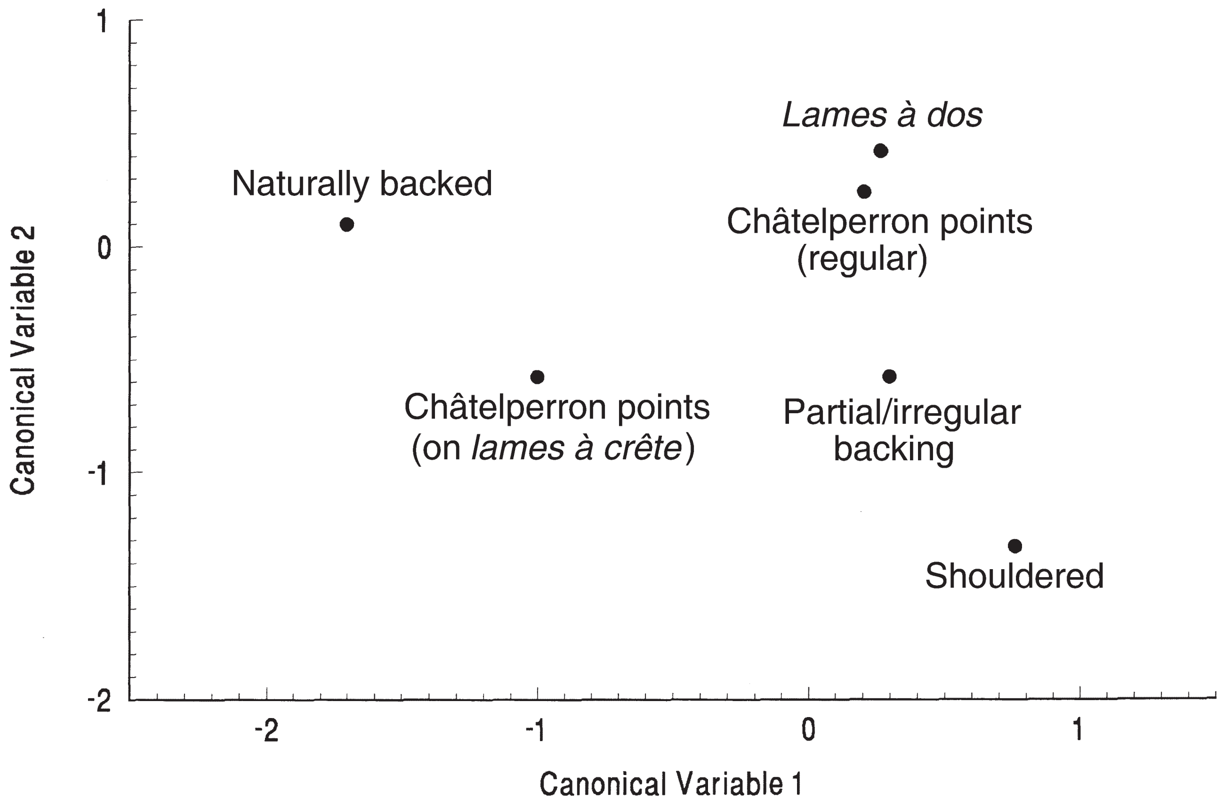

Figure 6-12. Scatterplot of backed and naturally backed tools at Les Tambourets plotted along the axes of the first two canonical variates resulting from a discriminant analysis, as discussed in the text.

retouch of the opposite edge) is brought to its final form before the proximal part of the blank is backed (form t). Intermediate products of this manufacturing sequence are rare at Les Tambourets, and only those forms actually recovered are shown (see Table 6-15). The breakage products of completed Châtelperron points, which would be very similar to those shown in Figure 6-13, are not repeated here.

Some Châtelperron points have retouched butt treatments, and the study of the fragmentary by-products strongly suggests that a somewhat different sequence of manufacturing steps was employed. Figure 6-15, which uses the same conventions specified above for Figure 6-13, shows a model for the manufacture of such tools. It is apparently the case that if the butt was to be shaped in part by retouch of the opposite edge, the proximal end of the blank was finished first rather than last. According to this model, then, a line of backing is started at the proximal end and continued to but not beyond the midregion (form y). The next two steps, the order of which cannot be determined from the data available, continue the backing deeper into the piece, creating a shouldered piece, and bring the butt to its final form by the application of retouch to the opposite edge (form bb). The line of backing is then extended, in an essentially straight line, to the distal extremity of the blank (form ee). Continued backing at the distal end begins to create the curved or angulated line of backing (form gg), which finally intersects the opposite edge to produce the finished Châtelperron point (form ii). Characteristic breakage products of this manufacturing process are once again shown in the top row of the figure, but the breakage products of finished Châtelperron points are not repeated. The tool class assignments of the forms shown in Figure 6-15 and their occurrence in the Tambourets assemblages are specified in Table 6-15.

The three models discussed above are unlikely to represent the only sequences of steps used to manufacture Châtelperron points at Les Tambourets, but the existence of these three is well documented by broken and otherwise unfinished by-products assigned to one or another class of "other backed tool." One can say, in general terms, that if the Châtelperron point manufacturing process was interrupted by failure, the results varied primarily as a function of where in the sequence of manufacturing steps the failure occurred (see Table 6-15). If the failure occurred early in the sequence, the retouched result was most likely to be a piece with partial and/or irregular backing. If the failure occurred later in the manufacturing sequence, the retouched results were very likely to be a shouldered piece, a *lame à dos*, or both, depending on the location(s) of the fracture(s).

The contrast between the manufacturing models shown in Figures 6-13 and 6-14 suggests the practice of a certain economy of effort on the part of the Châtelperronian artificers of Les Tambourets. If the butt of the Châtelperron point was to be left unretouched, the most difficult task was curving or angling the line of backing across the full width of the distal end, often with the help of bidirectional removals, to create the point. It is probable that this task carried a higher risk of failure through breakage than the less heavy

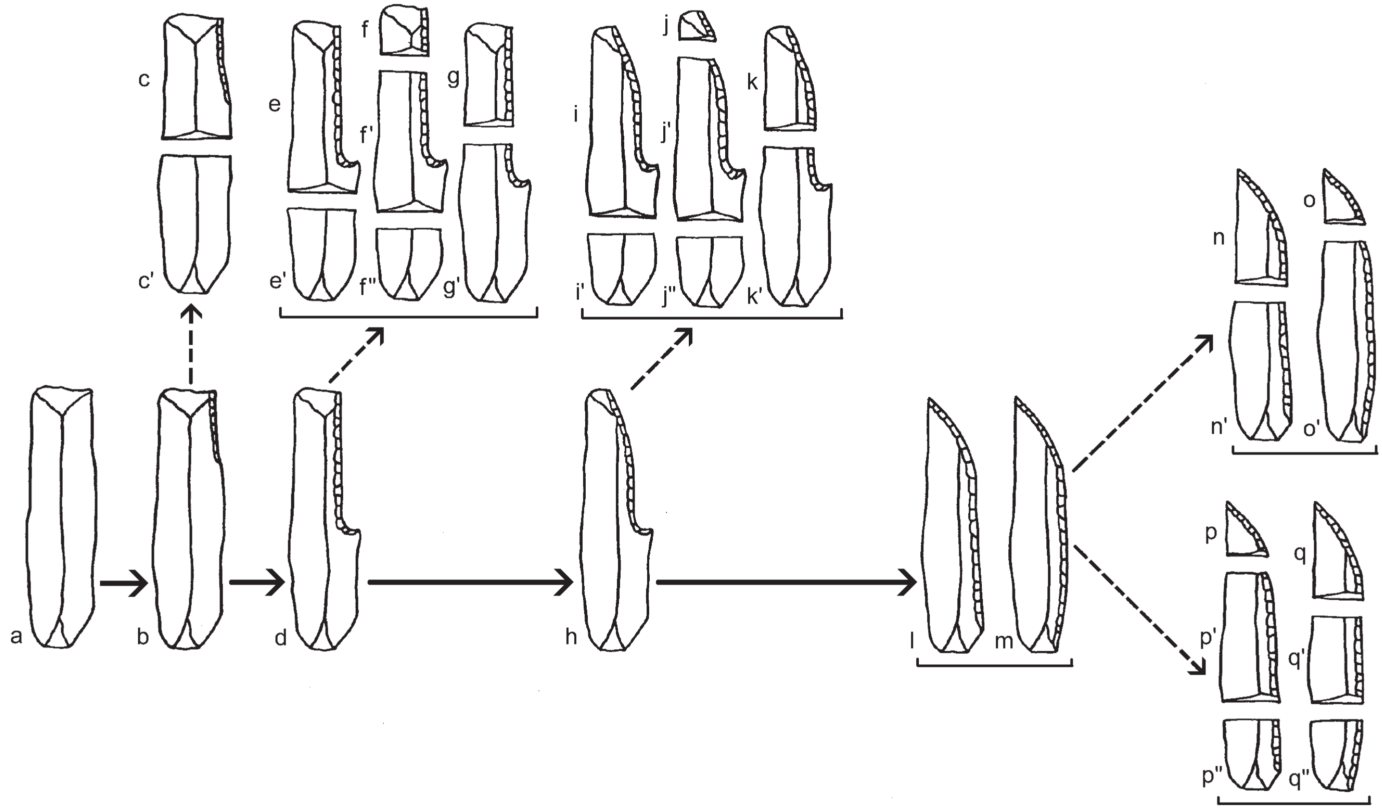

Figure 6-13. Hypothetical sequence of steps by which Châtelperron points were made on nonpointed blade blanks at Les Tambourets, plus the various objects resulting from breakage during or after manufacture.

backing of the proximal region, and it appears than only when the more "dangerous" task had been completed successfully was time and effort expended on the less dangerous task. The model of Figure 6-15 suggests, however, that if the creation of the butt required retouch of the opposite edge, the risk of failure through breakage was significantly increased (perhaps because the bulbar region was thicker than the distal region) to the point that the artificer waited until the butt had been successfully formed before undertaking the still risky task of finishing the distal end. If the suggestions from the Tambourets backed tools have been correctly interpreted, the principle employed may be stated as follows: "If the piece is going to break, let it break sooner rather than later, when a minimal amount of time has been invested." Such economy of effort is well documented in the early Gravettian of Pataud:5, where *both* extremities of Gravette points, almost always involving retouch of the opposite edge, were finished before the backing of the midregion of the blank was completed (Bricker 1973: 262–265).

In conclusion, almost all backed (and naturally backed) tools at Les Tambourets are very closely related to Châtelperron points. Only the single *élément tronqué* and the six "regular" naturally backed knives are not demonstrably part of the morphological and functional domain of the Châtelperron point. With these quantitatively insignificant exceptions, the story of backed tools at Les Tambourets *is* the story of Châtelperron points.

ENDNOTES

1. The occurrence by chance alone of four correlation coefficients significant at the 0.05 level has a probability of 0.001. Bartlett's test of significance for the matrix produces a Chi-squared value of 80.72 with 10 degrees of freedom, P<0.0001.
2. The method of initial factor extraction was "principal components,, and a "direct oblimin" method of oblique rotation was employed. The BMDP4M program (Frane et al. 1981) was run on a DEC-20 computer at the Tulane Computing Laboratory.
3. r=0.199, 0.05>P>0.02.
4. The analysis was performed using the BMDP8M program (Mickey et al. 1981), run on a DEC-20 computer at the Tulane Computing Laboratory.
5. "In Boolean factor analysis the success of the technique is measured by comparing the observed binary responses with those estimated by multiplying the loadings times the scores. ...the *positive discrepancy* is the number of times the observed score is one and the analysis estimates it to be zero and the negative discrepancy is the number of times the observed score is zero and the estimated value is one. A useful measure of agreement between the original data ... and the estimated values ... is the *total number of discrepancies*..." (Mickey et al. 1981: 538).
6. There are three exceptions to this statement. The fragmentary portions are significantly thinner in Area 2:Méroc (t=2.02, df=31, and P[1-tailed]=0.026) and Area 3:couche B(Basal) (t=3.39, df=3, and P[1-tailed]=0.021) and significantly narrower in Area 3:Méroc (t=2.08, f=23, and P[1-tailed]=0.024).
7. t=2.49, df=10, P(1-tailed)=0.007.
8. For length and backed edge divergence index, r=0.199, 0.05 >P>0.02.
9. F=5.03, df=4 and 226, P(1-tailed)<0.005).
10. Chi-squared=35.02, df=4, P<0.0001.
11. Chi-squared=6.44, df=2, P=0.040.
12. Chi-squared=50.43, df=1, P<0.0001.
13. Chi-squared=5.97, df=1, P=0.015.

TABLE 6-15.--Artifact class assignments of the forms resulting from the manufacture of Châtelperron points according to the models shown in Figures 6-13, 6-14, and 6-15. Parentheses indicate retouched forms not present in the assemblage samples from Les Tambourets.

Form	Artifact Class				
	Débitage Products	Part.and/ or Irreg. Backed Pieces	Shouldered Pieces	Lames à dos	Châtelperron Points
a	X				
(b)		X			
c		X			
c'	X				
(d)			X		
e			X		
e'	X				
f				X	
f'			X		
f"	X				
g				X	
g'			X		
(h)			X		
i			X		
(i')	X				
(j)				X	
j'			X		
j"	X				
k				X	
k'			X		
l					X
m					X
n					X
n'		X*			X
o					X
o'					X
p					X
p'					X
p"		X*			X
q					X
q'				X*	X
q"				X*	X
r	X				
s		X			
t			X		
u			X		

14. Fisher's Exact Test, P=0.035.
15. The Euclidean distances were calculated using the BMDP2M program (Engelman 1981), run on a DEC-20 computer at the Tulane Computing Laboratory.
16. The Châtelperron point attribute sets used in the study of the Châtelperron-like naturally backed knives are CH1, CH5-CH6, CH8-CH10, CH13-CH14, CH16-CH30, and CH31.
17. Sample values for the dimensions of Châtelperron points are shown in Table 6-6. Significance of the differences in means was tested against the t distribution with the following results: for maximum width of all portions, t=3.41, df=260, P(1-tailed)=0.0008; for maximum thickness of all portions, t=8.75, df=260, P(1-tailed)<0.0001; for length of complete and almost complete examples, t=1.91, df=126, P(1-tailed)=0.029.
18. t=1.53, df=126, P[1-tailed]=0.065.
19. Chi-squared=1.40, df=2, P=0.50.
20. The analysis was performed using the "Stepwise Discriminant Analysis" program, BMDP7M (Jennrich and Sampson 1981), run on a DEC-20 computer at the Tulane Computing Laboratory.

(Table 6-15--continued)

Form	Artifact Class				
	Débitage Products	Part.and/ or Irreg. Backed Pieces	Shouldered Pieces	Lames à dos	Châtelperron Points
u'	X				
v					X
w					X
x	X				
(y)		X			
z	X				
z'		X			
aa		X			
aa'				X*	X
(bb)			X		
cc	X				
cc'			X		
dd			X		
dd'				X*	X
ee				X	
ff				X	
ff'				X*	X
(gg)				X	
hh				X	
hh'				X*	X
ii					X

Note: * If curvature of back is not apparent

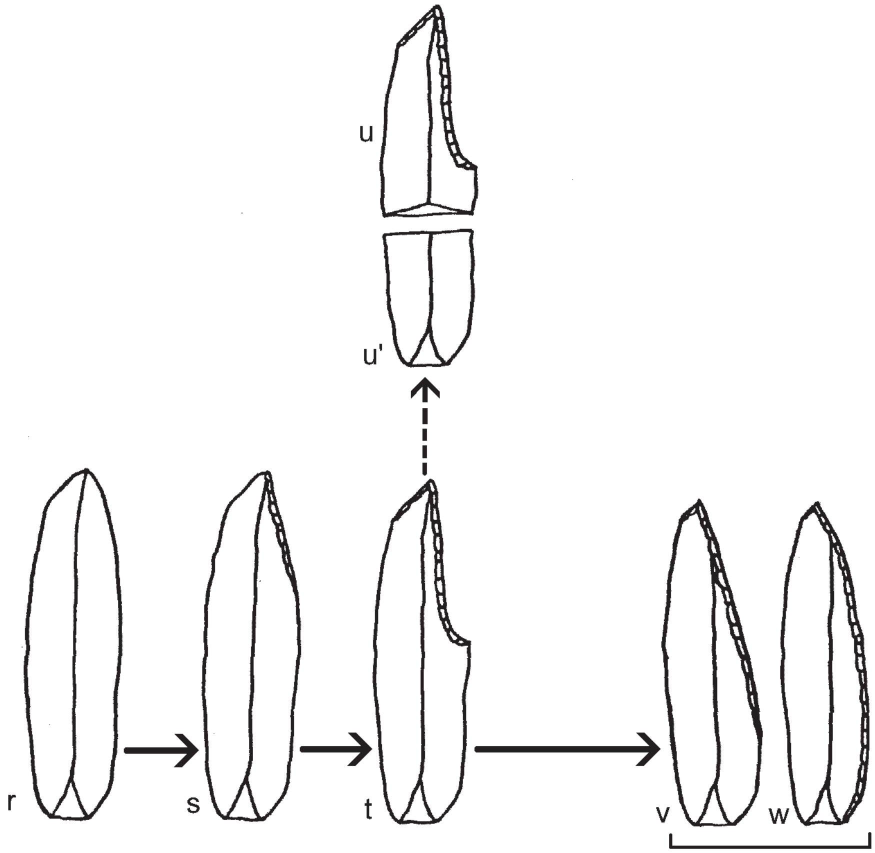

Figure 6-14. Hypothetical sequence of steps by which Châtelperron points were made on pointed blade blanks at Les Tambourets (most objects resulting from breakage are the same as in Figure 6-13).

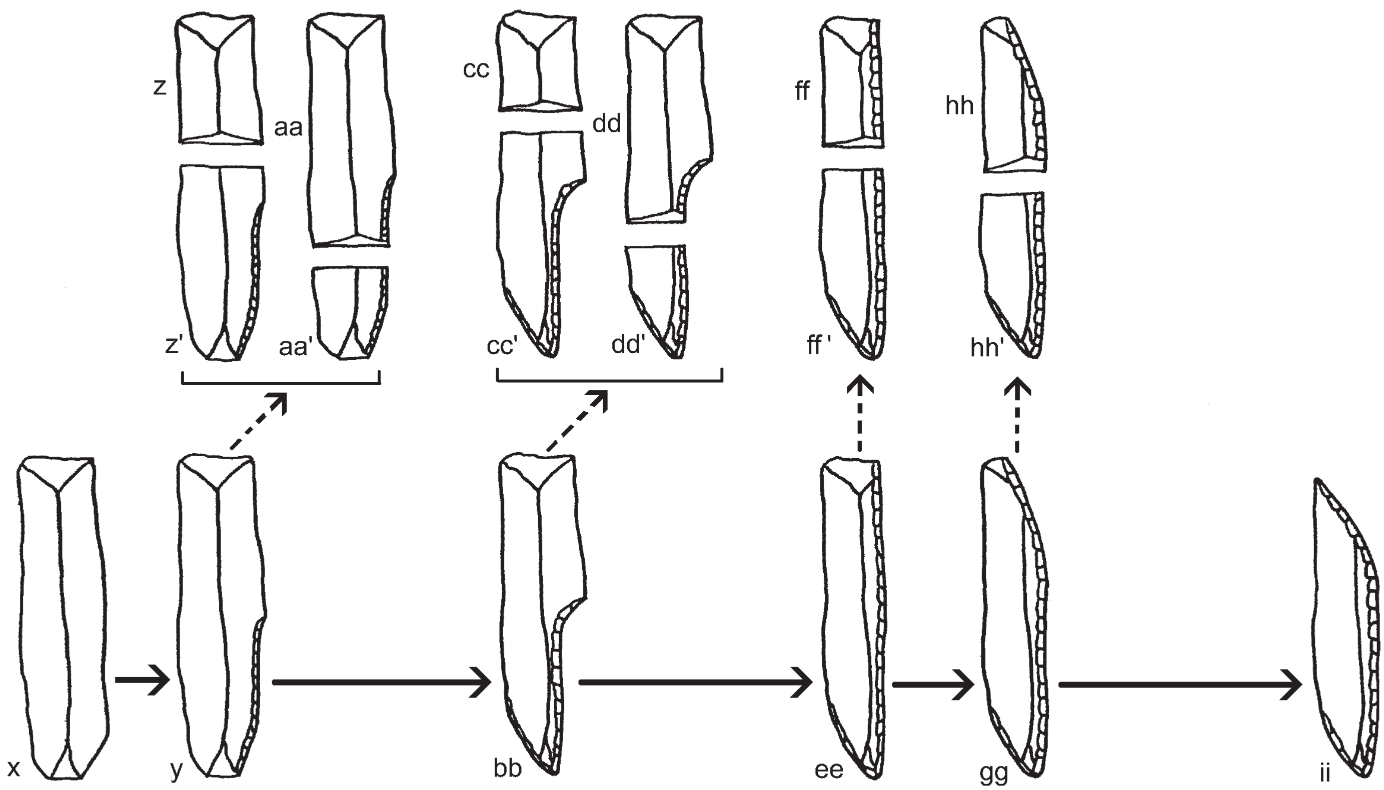

Figure 6-15. Hypothetical sequence of steps by which Châtelperron points with retouched butts were made at Les Tambourets, plus the various objects resulting from breakage during manufacture.

CHAPTER 7
BURINS

INTRODUCTION

For over a century, the burin has been recognized as one of the major classes of Upper Palaeolithic tools. The history of the recognition of burins as tools and early classification schemes for them have been usefully reviewed by Movius (1966, 1968) and Brézillon (1971). It has been understood for nearly as long that variation within this tool class is so great that some formal subdivision of the class—the recognition of different kinds or types of burins—is a virtual necessity for the fruitful typological study of burin series. What has not been agreed upon, however, is the primary principle of subclassification—which of the many aspects of variation is to be chosen as most important in recognizing and defining the major kinds of burins? During the 20th century, two major approaches were used by typologists of the French Upper Palaeolithic (Brézillon 1971: 165–173). For some workers (e.g., Bourlon 1911; Burkitt 1920; Pradel 1966), the first principle of classification was the shape of the burin edge, whereas for others (e.g., Noone 1934; de Sonneville-Bordes and Perrot 1956a), the first principle was "...the method of production rather than the form of the burin produced, i.e., ...the techniques employed in producing the burin's essential feature, a *restricted* working edge" (Noone 1934: 81). The present study of the burins from Les Tambourets uses this second approach, as revised and codified by the group working at the abri Pataud in the 1960s (Movius et al. 1968). The primary principle for the subdivision of the burin class into different major kinds of burins is the nature of the "spall removal surface" (SRS), the surface from which the burin spall (or spalls) was struck in order to create the burin edge (see Appendix B, attribute set BU1, SRS type). Although much of the analysis of the Tambourets burin series is carried out *within* the resultant SRS types (dihedral burins [for example, Figures 7-1 and 7-2], truncation burins [for example, Figure 7-3], etc.), the analysis is concerned as well with burins as a unified class, in recognition of the fact that the choice of any single aspect of variation as primary is arbitrary and that its true typological significance, if any, is to be demonstrated, not assumed.

The attribute analysis of burins from Les Tambourets is based on six samples: the excavated sample from Archaeological Level 1 in Area 3, three surface samples collected by Méroc in Areas 1, 2, and 3, and two very small excavated samples from couche B(Basal) and couche C in Area 3. The samples from Area 3:Archaeological Level 1, Area 3:Méroc, and Area 2:Méroc are large enough to be analyzed separately. The other three samples are so small that they are used only in the analysis of a pooled sample of Tambourets burins comprised of 275 burin edges.

Presentation of the results of the analysis of burins follows the now familiar sequence of preliminary factor analysis, univariate and bivariate distributional data, and, finally, the relationships within and among samples.

I. THE FACTORS OF BURINS

As a preliminary study of the variation within the burin tool class, a factor analysis was performed on a sample comprised of all complete burins from Area 3:Archaeological Level 1 (n=74 burin edges). The analysis is based on all the major burin attribute sets (see Appendix B for descriptions and definitions) that are measured on ratio, interval, or ordinal scales, as follows: burin angle (BU5), burin edge width (BU6), number of burin removals (BU8), maximum ventral canting (BU12), SRS shape (BU14), SRS angle (BU15), lateral position of the burin edge (BU16), length, width, and thickness of the blank (BU24, BU25, BU26), and near-burin-edge thickness (BU27). For purposes of this analysis, maximum ventral canting is coded as an ordinal variable, from least canting (dorsal oblique = -1) to most canting (flat-faced = +3). Similarly, SRS shape is coded from very concave (-2) through straight (0) to very convex (+2), and lateral position is coded from left lateral (-2) through median (0) to right lateral (+2). The correlation matrix on which the factor analysis is based (Table 7-1) shows that 15 of the 55 coefficients not located on the diagonal are significant at the 0.05 level. The probability of this number of significant correlations occurring by chance alone is 4.67×10^{-8}; Bartlett's test of significance for the matrix yields a Chi-squared value of 272.95 with 55 degrees of freedom, $P<0.0001$. These characteristics of the matrix suggest the appropriateness of factor analysis (Vierra and Carlson 1981: 276–278).

The major results of the factor analysis[1] are shown in Table 7-2. Four factors with eigenvalues greater than 1.0 were extracted, accounting for approximately 66% of the total variance. The five highest loadings on the unrotated first factor are, in order of decreasing strength, for the variables near-burin-edge thickness, blank thickness, burin edge width, blank length, and blank width. Among the 11 attribute sets used in the analysis, the most important determinants of variation in the burin sample are the variables having to do with the dimensions of the piece, especially the thickness of the blank.

Examination of the factor loadings after oblique rotation (see Table 7-2) permits further interpretation of burin variability. Rotated Factor 1, which is very similar to the first unrotated factor, is clearly a factor of gross size of the blank, especially blank thickness (which is itself a partial determinant of burin edge width). Rotated Factor 2 documents a relationship among the number of burin removals, burin edge width, and the extent of ventral canting. The nature of the relationship is specified by the correlation matrix (see Table 7-1)—as burin edge width increases, so does the number of removals, and as these increase, so does the extent of ventral canting. Rotated Factor 3 has a high loading for only one variable, SRS shape. A very tenuous suggestion of a relationship between SRS shape and burin angle is not sufficiently documented by this analysis of burins of all SRS types, but the situation is clarified by the later analyses of different kinds of burins considered separately. Rotated Factor 4 documents an expected, if rather weak, relationship between SRS angle and burin angle. Even though the

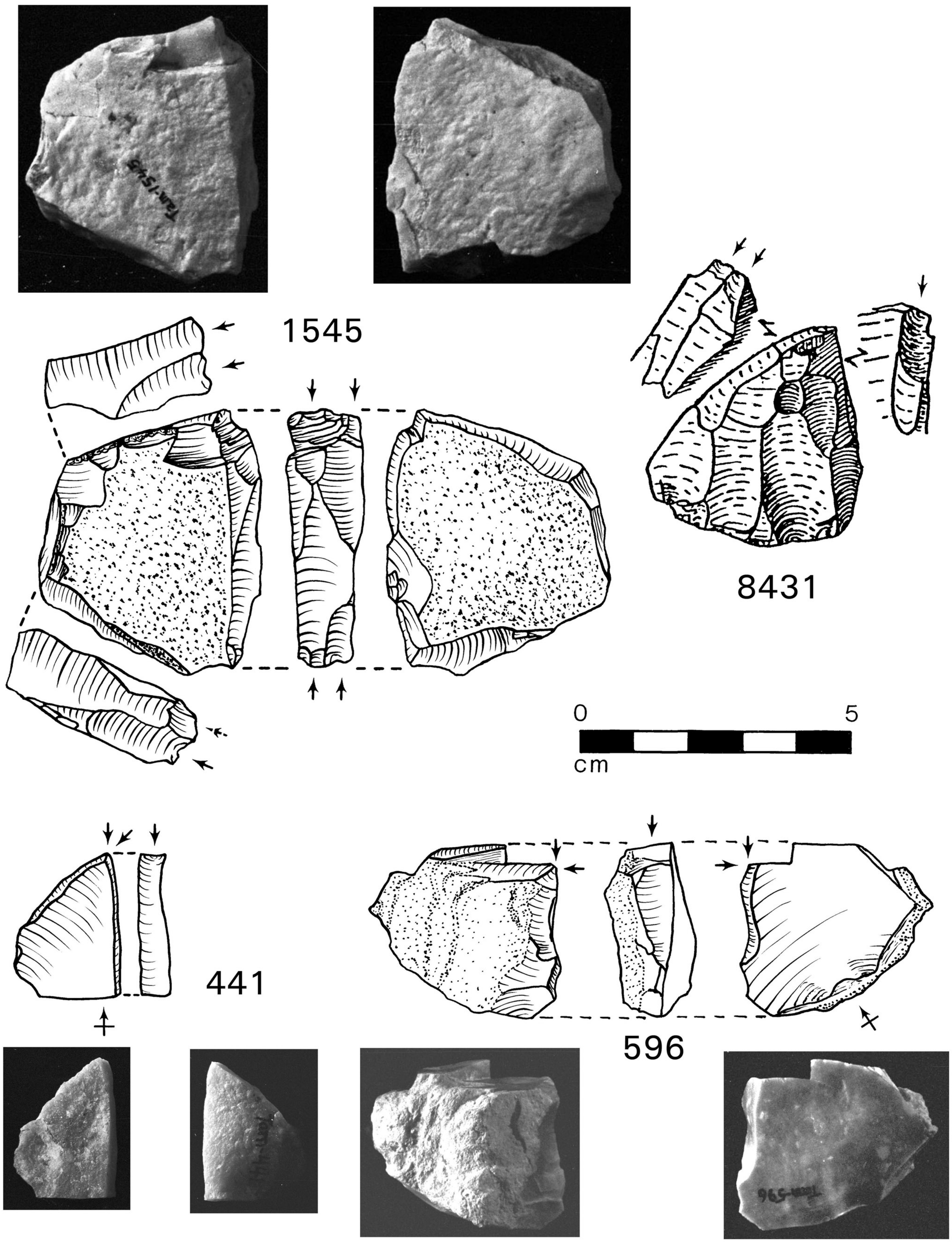

Figure 7-1. Dihedral burins from Area 3 at Les Tambourets. #8431 is in the Méroc Collection (drawing by L. Méroc); all other pieces are from Archaeological Level 1.

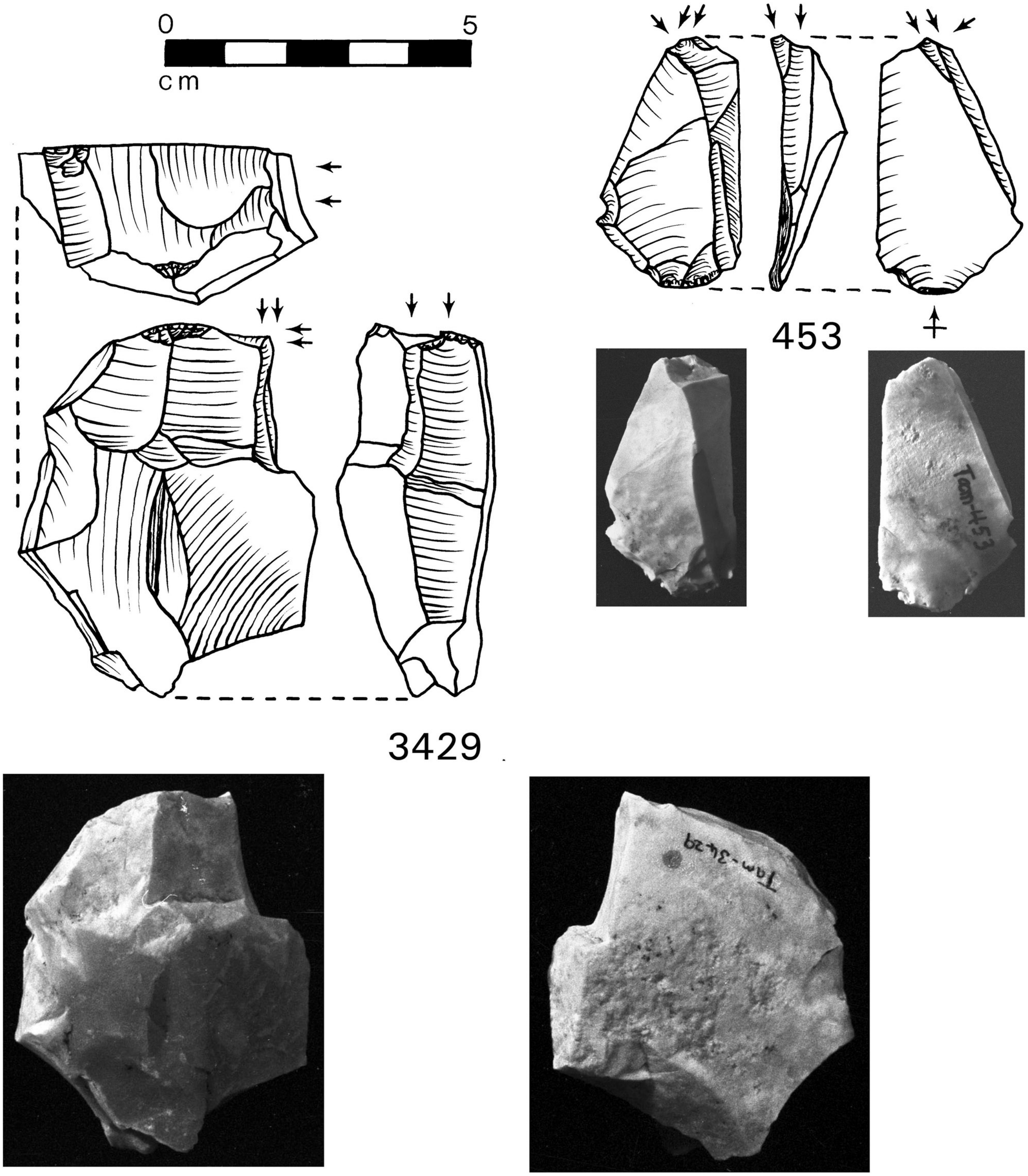

Figure 7-2. Dihedral burins from Archaeological Level 1 in Area 3 at Les Tambourets.

method of rotation employed did not force orthogonality, the four factors are essentially uncorrelated.

Identical factor analyses were performed on samples of all complete burins from Area 3:Méroc and Area 2:Méroc, and the results (not presented here in detail) are similar. In both analyses, four major factors were extracted, and the first factor is a factor of gross size of the blank, especially blank thickness. The other three rotated factors for Area 3:Méroc are identical to those for Area 3:Archaeological Level 1 except that the order of the third and fourth factors is reversed. In the analysis of the Area 2:Méroc burins, rotated Factor 2 associates lateral position of the burin edge (loading = 0.697) with number of removals (0.786) and burin edge width (0.624). Rotated Factor 3 suggests a relationship between SRS angle (loading = 0.692) and SRS shape (0.617). Rotated Factor 4 has two high loadings, one positive (0.812,

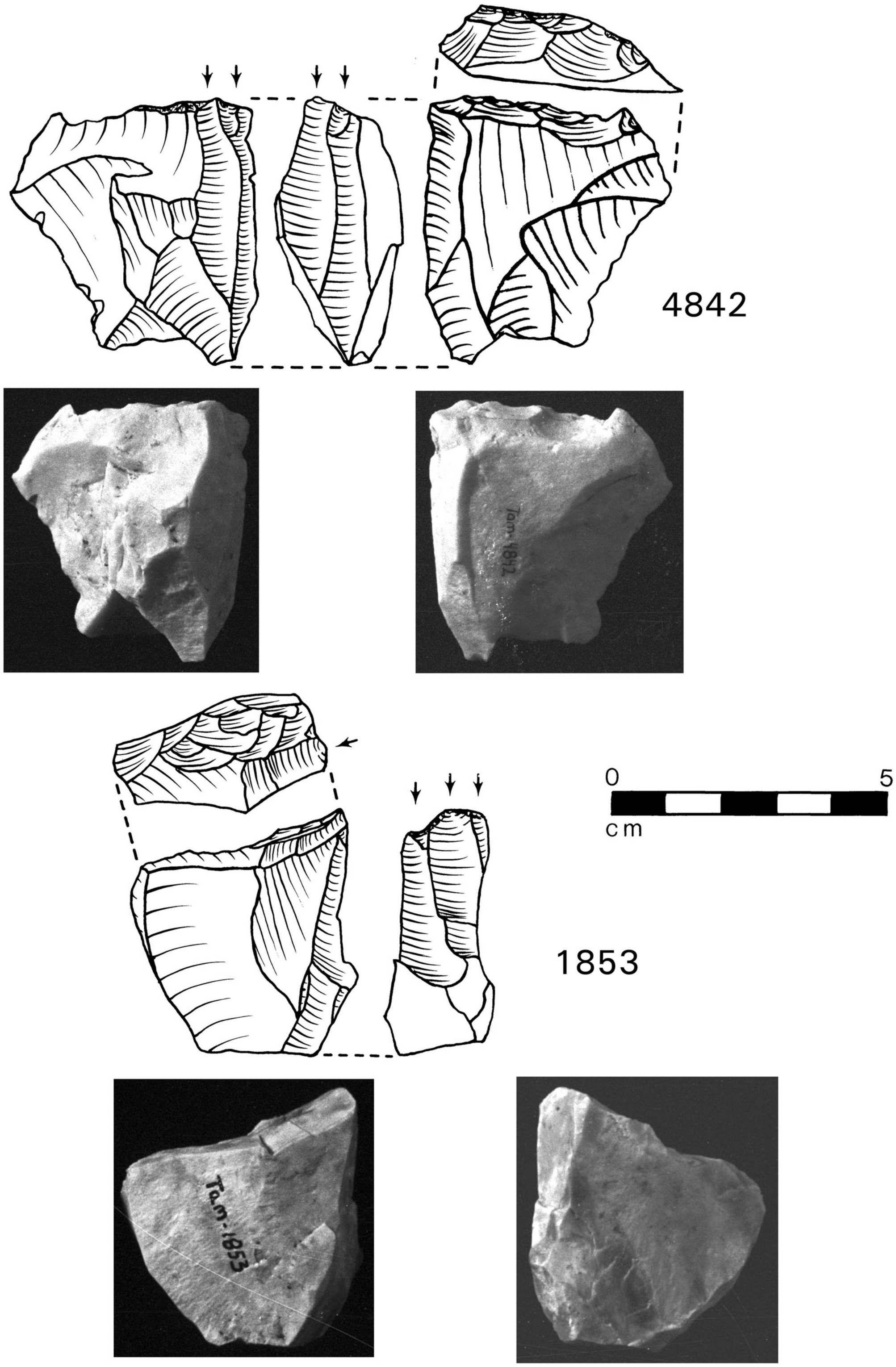

Figure 7-3. Truncation burins from Archaeological Level 1 in Area 3 at Les Tambourets.

for maximum ventral canting) and one negative (-0.654, for burin angle); this suggests an inverse relationship whereby burins with greater ventral canting are sharper than those with less. Clearly, then, the pattern of variation within the burin series from Area 2 differs in some details from that of the Area 3 burins.

The factor analyses discussed above treat burins as a unitary tool class; neither variable traditionally used for burin classification (technique of manufacture or edge shape) is used in analysis because both are measured on a nominal scale. The result of analysis is the identification of *general factors of burins* at Les Tambourets. Comparison of

Table 7-1.--Correlation matrix of burin attributes for all complete burins in Area 3:Archaeological Level 1. Values of "r" followed by an asterisk are significant at the .05 level.

	BU5	BU6	BU8	BU12	BU15	BU14	BU16	BU24	BU25	BU26	BU27
BU 5	1.000										
BU 6	0.051	1.000									
BU 8	0.175	0.503*	1.000								
BU12	0.148	0.221	0.297*	1.000							
BU15	0.164	0.134	0.127	0.078	1.000						
BU14	0.054	-0.028	-0.069	-0.072	-0.116	1.000					
BU16	-0.165	-0.032	-0.223	-0.119	-0.047	-0.008	1.000				
BU24	0.040	0.435*	0.173	0.200	0.043	-0.026	-0.032	1.000			
BU25	-0.040	0.324*	0.054	0.026	0.286*	-0.213	0.056	0.482*	1.000		
BU26	0.042	0.501*	0.028	0.279*	0.189	0.059	0.116	0.595*	0.538*	1.000	
BU27	0.128	0.609*	0.068	0.184	0.288*	0.055	0.088	0.504*	0.522*	0.866*	1.000

BU 5: Burin angle
BU 6: Burin edge width
BU 8: Number of burin removals
BU12: Maximum ventral canting
BU15: SRS angle
BU14: SRS shape
BU16: Lateral position of the burin edge
BU24: Length (W) of blank
BU25: Maximum width (W) of blank
BU26: Maximum thickness of blank
BU27: Near-burin-edge thickness

these results with the results of some early attribute analyses of other French Upper Palaeolithic burin series (Bricker 1973, 1995; Bricker and David 1984, 1995; Brooks 1979, 1995; Clay 1976, 1995; David 1966, 1985, 1995) suggested that some patterns of burin attribute interaction are specific to burins of different SRS types and that, therefore, a unitary analysis of all burins should be supplemented by separate multivariate analyses of samples defined by manufacturing technique (SRS type). Because the several burin series from Les Tambourets are relatively small, only two such analyses were performed. One pooled sample is composed of all the dihedral burin edges (n=101) on complete, unbroken burins from all six of the provenience units previously mentioned; the other pooled sample includes all truncation burin edges (n=65) on complete, unbroken blanks in the six units.

The factor analysis of dihedral burins (Tables 7-3 and 7-4), performed identically to those reported above, extracted four major factors, three of which are essentially identical to general factors of burins already discussed. Rotated Factor 1 is a factor of blank size, rotated Factor 2 clusters variation in numbers of removals, extent of ventral canting, and burin edge width, and rotated Factor 3 documents a relationship between SRS angle and burin angle. Rotated Factor 4 for dihedral burins has a high loading only for lateral position of the burin edge; a suggested weak relationship between lateral position and SRS shape is not readily interpreted.

An identical factor analysis of truncation burins (Tables 7-5 and 7-6) extracted five factors with eigenvalues greater than 1.0. The first factor is the familiar factor of gross size. Rotated Factor 2 has a high positive loading only for SRS angle, but the relatively high negative loading for SRS shape appears to reflect the finding of other studies (e.g., Bricker 1973: 791–800; Bricker and David 1984: 74; David 1966: 223–224 and Table 45) that concavity of the SRS tends to appear preferentially on truncation burins with high SRS angles. Rotated Factor 3 shows a strong clustering of number of removals and burin edge width. Rotated Factor 4 loads strongly on burin angle, and there is the further suggestion of a relationship between burin angle and SRS shape (sharper burin edges associated with concavity of the SRS). This influence of SRS shape upon the resultant burin angle was hinted at in the factor analysis of all burins (Factor 3 in the analysis for Area 3:Archaeological Level 1), but it is now shown to be specific to truncation burins.

Table 7-2.--Factor loadings and other results of the factor analysis of all complete burins in Area 3:Archaeological Level 1.

Unrotated Factor Loadings (Pattern) for Principal Components

	Factor 1	Factor 2	Factor 3	Factor 4	Communal-ities
Burin angle	0.145	0.483	0.099	0.624	0.652
Burin edge width	0.742	0.217	0.113	-0.266	0.680
Number of removals	0.329	0.716	-0.038	-0.304	0.715
Maximum ventral canting	0.362	0.462	0.095	-0.158	0.379
SRS angle	0.346	0.117	-0.504	0.572	0.715
SRS shape	-0.068	-0.054	0.834	0.304	0.795
Lateral position	0.005	-0.610	0.013	-0.067	0.377
Blank length	0.723	-0.084	0.118	-0.199	0.583
Blank width	0.677	-0.297	-0.363	0.015	0.680
Blank thickness	0.865	-0.268	0.180	0.071	0.858
Near-burin-edge thickness	0.874	-0.206	0.133	0.181	0.857

Eigenvalues & Cumulative Percentage of Total Variance Explained by Factors

Factor	Eigenvalue	Cum. %
1	3.429144	31.17
2	1.604892	45.76
3	1.178107	56.47
4	1.078817	66.28
5	0.868840	74.18
6	0.844525	81.86
7	0.729020	88.49
8	0.525052	93.26
9	0.396727	96.86
10	0.249329	99.13
11	0.095546	100.00

Rotated Factor 5, loading heavily on lateral position of the burin edge, is essentially the same as the fourth rotated factor of dihedral burins.

The technique of factor analysis is used here as a preliminary screening device in order to identify clusters of attribute covariation that can be investigated more specifically using other techniques. The results of the five analyses performed may be summarized as follows. The most important contributor to variation among Tambourets burins—of all kinds and from all provenience units—is the size of the blank. Another major contributor to variation, ubiquitous in its effect, is a factor of size and shape of the burin edge. In all samples, this factor includes the variables of edge width and number of removals; for dihedral burins, but not for truncation burins, it includes variation in the obliquity of the edge. No other factors of burin variation are as generally applicable. Contribution to variation in burin angle differs in the different provenience units and SRS types tested. One such factor ("A"), clustering burin angle and SRS angle, is operative in both samples from Area 3 and in the pooled sample of all dihedral burins. Another burin angle factor ("B"), applying only to Area 3 and to the pooled sample of truncation burins, clusters burin angle with SRS shape. This difference strongly suggests that the artificers used different techniques to achieve their desired ends when manufacturing burins of different SRS types. A third burin angle factor ("C"), occurring only in the burin series from Area 2:Méroc, identifies a negative

(Table 7-2, continued)

Rotated Factor Loadings (Pattern)

	Factor 1	Factor 2	Factor 3	Factor 4
Burin angle	-0.029	0.227	0.315	0.678
Burin edge width	0.629	0.474	-0.026	-0.120
Number of removals	0.034	0.840	-0.143	-0.040
Maximum ventral canting	0.183	0.568	0.024	-0.007
SRS angle	0.172	-0.078	-0.294	0.762
SRS shape	0.121	-0.131	0.896	-0.013
Lateral position	0.233	-0.524	-0.028	-0.218
Blank length	0.723	0.172	-0.005	-0.138
Blank width	0.662	-0.148	-0.388	0.151
Blank thickness	0.932	-0.067	0.134	0.062
Near-burin-edge thickness	0.908	-0.055	0.129	0.193

Factor Correlations for Rotated Factors

	Factor 1	Factor 2	Factor 3	Factor 4
Factor 1	1.000			
Factor 2	0.108	1.000		
Factor 3	-0.110	0.052	1.000	
Factor 4	0.048	0.126	-0.010	1.000

or inverse relationship between burin angle and obliquity. Finally, two additional factors deal with several characteristics of the SRS. The first such factor, present only in the Area 2:Méroc sample, clusters SRS angle with SRS shape in a positive or direct relationship. The second, occurring only in the pooled sample of truncation burins, clusters the same attributes in a negative or inverse way, emphasizing again the use of different manufacturing techniques for burins of different SRS types. In a later section of this chapter, the attribute relationships identified by the factor analyses of dihedral and truncation burins are examined in more detail in light of their interaction with important nominal-scale attribute sets, such as burin edge shape, that could not be included in the factor analyses.

II. BURIN ATTRIBUTE DISTRIBUTIONS

In this section, distributions of single attribute sets are discussed briefly as comments on Tables 7-7, 7-8, 7-9, and 7-10. Except for noting cases in which distributions differ significantly between or among different SRS types, discussion of attribute combinations is deferred until section III of this chapter, below.

Dihedral burins (see Figures 7-1 and 7-2) are the most frequently occurring SRS types (see Table 7-7) in most of the samples studied, followed usually by truncation burins (see Figures 7-3 and 7-4, #265) and break burins (Figures 7-4, #8434, and 7-5, #1387 and #5688 [proximal]), but—as is true for most burin attribute sets at Les Tambourets—there is great variation among samples. The best represented of the minor SRS types are unretouched edge burins (see Figure 7-5, #4572) and unretouched end burins (see Figure 7-5, #2186), which together account for more than 10% of most samples. The retouch forming the SRS of truncation and retouched edge/end burins (see Figure 7-5, #1805 and #3394) is almost always "normal" or obverse retouch (see Table 7-8), but inverse truncation burins do occur (see Figure 7-3, #4842). Both dihedral and truncation modification occur rarely. Tertiary modification affects between 5% and 10% of the burin edges. In about half the cases, its only effect is to thin the burin edge; in the other cases, it has changed the

Table 7-3.--Correlation matrix of burin attributes for all complete dihedral burins. Values of "r" followed by an asterisk are significant at the .05 level.

	BU5	BU6	BU8	BU12	BU15	BU14	BU16	BU24	BU25	BU26	BU27
BU 5	1.000										
BU 6	0.097	1.000									
BU 8	0.205*	0.585*	1.000								
BU12	0.143	0.301*	0.405*	1.000							
BU15	0.322*	0.079	0.003	0.048	1.000						
BU14	-0.075	0.017	0.026	-0.016	-0.208*	1.000					
BU16	0.020	0.184	-0.007	-0.020	-0.032	0.105	1.000				
BU24	-0.040	0.428*	0.230*	0.080	-0.134	0.059	0.045	1.000			
BU25	-0.001	0.327*	0.089	0.018	0.200*	-0.169	0.018	0.505*	1.000		
BU26	0.109	0.457*	0.210*	0.167	0.176	-0.048	0.191	0.517*	0.572*	1.000	
BU27	0.199*	0.586*	0.273*	0.202*	0.233*	-0.055	0.196*	0.410*	0.513*	0.872*	1.000

BU 5: Burin angle
BU 6: Burin edge width
BU 8: Number of burin removals
BU12: Maximum ventral canting
BU15: SRS angle
BU14: SRS shape
BU16: Lateral position of the burin edge
BU24: Length (W) of blank
BU25: Maximum width (W) of blank
BU26: Maximum thickness of blank
BU27: Near-burin-edge thickness

shape of the edge, making it more regular than it would have otherwise been or, sometimes, bevelling it. Thinning removals, which are very infrequent, occur most often on the ventral surface.

Mean values of burin angle are most frequently between 75 and 80 degrees (see Tables 7-9 and 7-10), and there is no consistent pattern of variation among the different SRS types. The kind of functional specialization documented for some Gravettian burin series (Bricker and David 1984: 66 and 68, Figure 19)—for example, sharp burins (retouched edge/end), medium-angle burins (dihedral, truncation), and dull burins (break, unretouched edge/end)—is not found at Les Tambourets. When allowance is made for small samples sizes, it is clear that the Tambourets burin series is completely generalized, with burins of all kinds covering all parts of the range of burin angles. For burin edge width, however, there is a difference. Break burin edges tend to be narrower than those of dihedral and truncation burins, and in the two samples from Area 3, this difference is significant at the 0.05 level.[2] This may be evidence for a weak expression of the kind of functional specialization more strongly developed in some Gravettian burin series (Bricker and David 1984: 70 and 71, Figure 20), but it is more likely a simple reflection of the fact that the blanks that have broken are thinner than the blanks that have not (see below).

The majority of edges on burins other than dihedral burins are straight or bevelled (see Figures 7-3, #4842, and 7-4, #3870), whereas those of dihedral burins are most often of more complex shapes (see Table 7-8).[3] The most frequent edge shape for dihedral burins is usually angulated (see Figure 7-2, #453). The majority of burins in all samples are polyhedric, having most often two or three significant removals; mean values do not differ significantly among SRS types (see Tables 7-9 and 7-10). In most of the dihedral burin samples, the SRS removals are located on the left side of the edge approximately as frequently as on the right (see Table 7-8). The SRS side tends, in general, to be a single removal whereas the non-SRS side is polyhedric.[4] The dihedral burin series from Area 3:Archaeological Level 1 is distinctive in that a left-side location for the SRS is clearly predominant. Furthermore, these burins with a left SRS are significantly less often polyhedric (11 of 23 cases) than those with a right SRS (11 of 13).[5] Because the edges of dihedral burins are less often straight, dihedrals tend to have higher frequencies of complex obliquity than do other SRS types.[6] Maximum ventral canting does not, however, differ significantly among SRS types. The majority of burin edges (ca. 55% to 65%, varying by sample) have some ventral canting (see Figures 7-1, #1853, 7-2, #453, 7-4, #265,

Table 7-4.--Factor loadings and other results of the factor analysis of complete dihedral burins.

Unrotated Factor Loadings (Pattern) for Principal Components

	Factor 1	Factor 2	Factor 3	Factor 4	Communal-ities
Burin angle	0.225	0.669	0.037	0.282	0.580
Burin edge width	0.763	-0.012	0.339	0.003	0.697
Number of removals	0.512	0.223	0.635	-0.171	0.744
Maximum ventral canting	0.350	0.329	0.544	-0.172	0.557
SRS angle	0.229	0.657	-0.416	0.155	0.681
SRS shape	-0.076	-0.405	0.427	0.392	0.506
Lateral position	0.201	-0.217	0.038	0.800	0.729
Blank length	0.640	-0.453	-0.015	-0.243	0.674
Blank width	0.661	-0.168	-0.453	-0.230	0.723
Blank thickness	0.853	-0.129	-0.246	0.098	0.814
Near-burin-edge thickness	0.874	0.003	-0.165	0.159	0.816

Eigenvalues & Cumulative Percentage of Total Variance Explained by Factors

Factor	Eigenvalue	Cum. %
1	3.454000	31.40
2	1.498556	45.02
3	1.464695	58.34
4	1.102640	68.36
5	0.835793	75.96
6	0.700970	82.33
7	0.638979	88.14
8	0.520822	92.88
9	0.374549	96.28
10	0.316305	99.16
11	0.092691	100.00

and 7-5, #1805), most frequently the "oblique" attribute. A "lateral" edge occurs on only about one-third of the burins (see Figures 7-1, #441, and 7-5, #1387 [top]). Both dorsal canting (dorsal oblique) (see Figures 7-3, #4842, and 7-5, #5688 [proximal]) and extreme ventral canting (flat-faced) are very infrequent.

The burin spalls that result from the creation of the burin edge are a distinctive component of the lithic industry. Burin spalls from Archaeological Level 1 are discussed briefly and illustrated in Chapter 12, along with other unretouched *débitage* products.

The predominant SRS shape for dihedral burins is straight (see Figure 7-1, #596), and almost all the non-straight examples are convex (see Figure 7-1, #8431 and #441). The most frequent SRS shape for truncation burins is concave (see Figure 7-3, #1853), and that for break burins is straight (see Figures 7-4, #8434, and 7-5, #5688 [proximal]). These differences are significant at the 0.05 level.[7] In the very small samples of the minor SRS types, retouched edge/end burins resemble truncation burins in their distributions, and unretouched edge/end burins resemble dihedral burins. In all samples, the mean SRS angle (see Tables 7-9 and 7-10) is lowest for dihedral burins; means for truncation and break burins are always larger. The differences are, however, small, and they are significant at the 0.05 level in only one sample.[8] Mean values for the very small samples of the minor SRS types are extremely varied.

The distribution of lateral position of the burin edge

(Table 7-4, continued)

Rotated Factor Loadings (Pattern)

	Factor 1	Factor 2	Factor 3	Factor 4
Burin angle	-0.107	0.262	0.703	0.101
Burin edge width	0.475	0.566	-0.012	0.154
Number of removals	0.065	0.852	-0.013	-0.035
Maximum ventral canting	-0.065	0.751	0.084	-0.103
SRS angle	0.127	-0.095	0.792	-0.115
SRS shape	-0.161	0.100	-0.344	0.571
Lateral position	0.133	-0.178	0.145	0.840
Blank length	0.728	0.136	-0.387	-0.040
Blank width	0.845	-0.141	0.010	-0.204
Blank thickness	0.854	0.033	0.131	0.156
Near-burin-edge thickness	0.778	0.138	0.244	0.195

Factor Correlations for Rotated Factors

	Factor 1	Factor 2	Factor 3	Factor 4
Factor 1	1.000			
Factor 2	0.188	1.000		
Factor 3	0.090	0.057	1.000	
Factor 4	0.045	0.119	-0.052	1.000

(see Table 7-8) does not vary significantly among SRS types. Left and right orientations occur in approximately equal frequencies, and a median orientation (see Figure 7-4, #3870) is always rare. A lateral orientation (see Figure 7-3, #1853 and #4842) is somewhat more frequent than an asymmetrical orientation (see Figure 7-4, #265) in all samples. The bulbar position of the burin edges varies appreciably among samples. A distal position is more frequent than a proximal one in all samples except Area 2:Méroc, where the two frequencies are approximately equal. The sample from Area 3:Archaeological Level 1 is differentiated from the others by its relatively high frequency of burin edges on the side of the blank. In Area 2:Méroc, dihedral and break burins occur significantly more often at the proximal end of the blank than do truncation burins.[9] Frequencies of transversality vary, according to sample, between about 10% and 25%; although the highest frequencies are usually for dihedral burins, transversality is well represented among the other SRS types as well.

Approximately half the studied burin edges in Area 2:Méroc and Area 3:Méroc occur on single tools; in Area 3:Archaeological Level 1 and Area 1:Méroc, over three-quarters of the burin edges are on single tools. Of the nonsingle burin forms, double burins (see Figures 7-1, #1545, and 7-5, #1387) and occasionally multiple or triple burins (see Figure 7-5, #4572), of the same SRS type, usually outnumber mixed burins. All but two of the mixed burins (a dihedral + dihedral + truncation in Area 3:Méroc and a dihedral + dihedral + unretouched end in Area 2:Méroc) have only two burins on a given blank. Frequencies of single vs nonsingle burins do not differ significantly among SRS types. In a pooled sample of all studied burin edges from Les Tambourets, burins combine with end-scrapers (n=12) (see Figure 7-5, #5688), end-and-side-scrapers (n=4), side-scrapers (n=8) (see Figure 7-4, #8354), *becs* (n=2), truncated pieces (n=8), and splintered pieces (n=2) to form combination tools. All SRS types are represented on combination tools. There is a suggestion in the data that truncation, retouched edge, and retouched end burins are preferentially associated with scrapers, whereas dihedral burins are associated with oth-

Table 7-5.--Correlation matrix of burin attributes for all complete truncation burins. Values of "r" followed by an asterisk are significant at the .05 level.

	BU5	BU6	BU8	BU12	BU15	BU14	BU16	BU24	BU25	BU26	BU27
BU 5	1.000										
BU 6	-0.033	1.000									
BU 8	-0.006	0.427*	1.000								
BU12	-0.259*	0.125	0.223	1.000							
BU15	0.100	-0.064	-0.160	-0.335*	1.000						
BU14	0.162	0.064	0.145	0.161	-0.345*	1.000					
BU16	-0.187	-0.092	-0.054	-0.043	0.141	0.009	1.000				
BU24	0.071	0.186	-0.082	-0.113	-0.072	-0.206	0.013	1.000			
BU25	0.011	0.164	-0.064	-0.049	0.135	-0.174	0.243*	0.404*	1.000		
BU26	0.149	0.202	-0.101	-0.250*	0.191	-0.093	0.142	0.533*	0.406*	1.000	
BU27	0.171	0.388*	0.008	-0.187	0.220	-0.084	0.157	0.388*	0.478*	0.708*	1.000

BU 5: Burin angle
BU 6: Burin edge width
BU 8: Number of burin removals
BU12: Maximum ventral canting
BU15: SRS angle
BU14: SRS shape
BU16: Lateral position of the burin edge
BU24: Length (W) of blank
BU25: Maximum width (W) of blank
BU26: Maximum thickness of blank
BU27: Near-burin-edge thickness

er tools, but these differences fail to achieve significance at the 0.05 level in the small sample.[10] For the investigation of corner position of the burin edge (see Table 7-7), unstudied burin edges are tabulated if at least one edge on the blank in question is part of the studied sample. By far the most frequent pattern of co-occurrence is AC (= BD)—two burin edges at opposite ends of the same margin (see Figure 7-5, #1387). Approximately three-quarters of all burins in the Tambourets samples are made on flake blanks; chunks are numerous, and blades are very infrequent. About one-third of all burin blanks are cortical. Nature of the blank does not differ significantly among the SRS types.

Sample values of blank length, maximum width, and maximum thickness are tabulated for complete, single burins only (see Tables 7-9 and 7-10). In some samples,[11] break burins are significantly shorter and/or thinner than other major SRS types and truncation burins are wider then dihedral burins. Mean values of near-burin-edge thickness, tabulated for all burin edges, do not differ significantly among the major SRS types.

Utilization damage on the margins of burin blanks was recorded only for the excavated samples. In Area 3:Archaeological Level 1, only 8 of the 82 blanks bear such damage. Fewer than one-quarter of the single burins have marginal retouch (see Table 7-7). The retouch is almost always obverse and partial, appearing on one margin only. Retouch on the left margin is slightly more frequent than retouch on the right. The predominant retouch type, accounting for a majority of occurrences, is heavy. Marginal retouch frequencies do not differ significantly among SRS types in a pooled sample of all single burins. Marginal notches, which were recorded for the excavated materials only, are virtually absent in the Tambourets burin series. In the Area 3:Archaeological Level 1 sample of single burins, marginal notching occurs on only four tools. Among all the Tambourets burins, only one has what could be interpreted as a stop-notch. Burin attribute sets BU38 through BU43—concerning flint variety, double patination, heat alteration, and several characteristics of the striking platform—are discussed elsewhere in this report as part of analyses concerning more than a single artifact class.

III. BURIN ATTRIBUTE INTERACTIONS

Among the principal functional characteristics of all burins, regardless of SRS type, are the shape of the burin edge, its width, and its angle. Starting from the attribute interactions identified by the factor analyses but including the nominal-scale attributes that were there excluded, further analysis of the Tambourets burins attempted to specify more clearly the principal determinants of these three important

Table 7-6.--Factor loadings and other results of the factor analysis of all complete truncation burins.

Unrotated Factor Loadings (Pattern) for Principal Components

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Communalities
Burin angle	0.192	-0.081	0.816	-0.088	0.134	0.735
Burin edge width	0.298	0.719	0.048	0.393	-0.004	0.762
Number of removals	-0.135	0.677	0.061	0.455	0.176	0.719
Maximum ventral canting	-0.378	0.524	-0.390	-0.125	-0.107	0.597
SRS angle	0.365	-0.530	0.002	0.569	0.237	0.794
SRS shape	-0.301	0.394	0.345	-0.462	0.513	0.843
Lateral position	0.238	-0.131	-0.545	-0.177	0.665	0.844
Blank length	0.654	0.173	-0.032	-0.306	-0.455	0.759
Blank width	0.673	0.104	-0.291	-0.139	0.020	0.569
Blank thickness	0.836	0.083	0.093	-0.155	0.020	0.739
Near-burin-edge thickness	0.832	0.219	0.076	0.039	0.163	0.774

Eigenvalues & Cumulative Percentage of Total Variance Explained by Factors

Factor	Eigenvalue	Cum. %
1	2.839678	25.82
2	1.806017	42.23
3	1.340675	54.42
4	1.092310	64.35
5	1.056194	73.95
6	0.674072	80.08
7	0.638432	85.89
8	0.518802	90.60
9	0.417877	94.40
10	0.395121	97.99
11	0.220822	100.00

functional characteristics. In order to work with adequate sample sizes, the analysis was limited to dihedral burins and truncation burins.

The analysis of dihedral burins is based on a pooled sample from all the units studied. The most informative results of a series of bivariate tests[12] are discussed here in an order intended to correspond, in general terms, to the processual steps of burin manufacture. The first determining factor of the characteristics of the finished dihedral burin is the nature of the blank on which it is made. The nature of the blank is a specific determinant of the blank's dimensions. What is most important for the Tambourets dihedrals is the fact that most of the blanks are flakes or chunks; both are wide and thick, and the chunks are both wider and thicker than flakes.[13] The blank dimensions, most importantly thickness and near-burin thickness, are significant determinants of burin edge width. The successful creation of a wide burin edge favors the use of several burin removals rather than just one. Polyhedric removals tend to be associated with nonstraight edge shapes,[14] and a nonstraight edge tends, obviously, to have a greater degree of ventral canting than a straight one. In addition, burins with nonstraight edges have significantly duller burin angles than those with straight edges.[15] Blank width and near-burin thickness are significant determinants of SRS angle, which is, in turn, one of the major determinants of burin angle. In summary, then, the detailed characteristics of the Tambourets dihedral burins are partially but signifi-

Rotated Factor Loadings (Pattern)

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Burin angle	0.071	0.036	-0.018	0.827	-0.196
Burin edge width	0.273	0.016	0.815	-0.033	-0.113
Number of removals	-0.187	-0.025	0.832	-0.012	-0.014
Maximum ventral canting	-0.092	-0.509	0.232	-0.437	0.037
SRS angle	-0.092	0.886	0.050	0.053	0.154
SRS shape	-0.153	-0.650	0.086	0.541	0.343
Lateral position	0.125	0.050	-0.123	-0.167	0.883
Blank length	0.853	-0.186	-0.119	-0.079	-0.268
Blank width	0.689	0.032	0.008	-0.155	0.231
Blank thickness	0.796	0.077	0.022	0.213	0.085
Near-burin-edge thickness	0.713	0.171	0.275	0.209	0.171

Factor Correlations for Rotated Factors

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Factor 1	1.000				
Factor 2	0.194	1.000			
Factor 3	0.053	-0.146	1.000		
Factor 4	0.034	0.071	0.005	1.000	
Factor 5	0.045	0.042	0.040	0.005	1.000

cantly determined by the wide, thick, crude blanks chosen by the artificers.

Attribute interaction patterns are somewhat different for the truncation burins at Les Tambourets (analyzed again as a pooled sample from all the units studied). With blades virtually absent from the sample, nature of the blank is *not* a significant determinant of blank dimensions; unlike the situation for dihedral burins, chunk blanks for truncation burins are not wider or thicker than flake blanks. Of the four linear dimensions of the blank measured, only near-burin thickness is significantly correlated with burin edge width (see Table 7-5). The correlation between maximum blank thickness and near-burin thickness is significant at the 0.05 level for truncation burins, as it is for dihedral burins, but the strength of the correlation is significantly less among the former.[16] This difference apparently reflects some greater irregularity in truncation burin blanks that is not controlled by the attribute system employed. As is true for dihedral burins, wider edges tend to be made with a greater number of removals and to have nonstraight edge shapes.[17] There is, however, no significant correlation between edge width and degree of ventral canting.

Another principal determinant of the functional characteristics of truncation burins is the SRS angle, but its patterns of interaction with other attributes are not simple. It is not the case, for example, that SRS angle of truncation burins is significantly correlated with the dimensions of the blank. Nor is it the case that SRS angle is a significant determinant of burin angle; the low value of the correlation coefficient, r=0.162, means that less than 3% of the variation in burin angle is explained by variation in SRS angle. These are major differences between truncation and dihedral burins at Les Tambourets. SRS angle does, however, interact significantly with both SRS shape and maximum ventral canting. The greater (duller) the SRS angle, the more concavity is used,[18] and truncation burins with a concave SRS are more likely to have a straight or bevelled edge.[19] The smaller (sharper) the SRS angle, the more ventral canting is present,[20] and burin edges with pronounced ventral canting have significantly sharper burin angles than others.[21]

This brief examination of burin attribute interaction patterns strongly suggests that in the Tambourets series truncation burins are technologically more complex than dihedral burins. The principal functional properties of dihedral burins are largely determined by the metric characteristics of the blank, whereas those of truncation burins

Table 7-7.--Distributions of SRS type and other attributes of burins.

	Area 3: A.L.1		Area 3: Méroc		Area 2: Méroc		Ar.1: Méroc	Ar.3: cB(B)	Ar.3: c.C
	n	%	n	%	n	%	n	n	n
SRS Type (BU1)									
Dihedral	49	55.68	23	29.11	31	36.47	7	3	1
Truncation	14	15.91	33	41.77	22	25.88	4	1	0
Break	10	11.36	8	10.13	12	14.12	3	0	1
Ret. Edge	0	0	3	3.80	7	8.24	1	0	0
Ret. End	3	3.41	2	2.53	3	3.53	0	0	1
Unret. Edge	7	7.95	1	1.27	4	4.71	0	0	0
Unret. End	5	5.68	9	11.39	6	7.06	0	1	0
TOTAL	88	99.99	79	100.00	85	100.01	15	5	3
Corner Position (BU20)									
AB	1		0		5		0	0	0
AC(=BD)	7		10		5		0	0	0
AD	0		3		2		0	0	0
BC	2		2		0		0	0	0
ABC	0		1		1		0	0	0
ABD	0		0		1		0	0	0
TOTAL*	10		16		14		0	0	0
Occurrence of Marginal Retouch (BU29)									
N (singles)	68		41		43		12	3	2
n with marg. retouch	10	14.71	8	(19.51)	10	(23.26)	2	1	1

vary far more independently of the constraints imposed by the blank. It seems clear that this greater degree of independence follows from the increased geometric precision achieved when the SRS, the specialized striking platform for final spall removal, was created by truncating retouch rather than by (preliminary) spall removal. Later tool-making traditions of the French Upper Palaeolithic provide eloquent evidence that the dihedral technique for burin manufacture could provide great geometric precision in the hands of skilled artificers, but we do not find that degree of technological sophistication in the Châtelperronian burin series from Les Tambourets. To the (limited) extent that the makers of the Tambourets burins were able to transcend the primary restraints of the crude blanks they used, they did so by employing the truncation technique.

IV. DISCRIMINANT ANALYSIS OF BURINS

Much of the analysis reported in earlier sections of this chapter has been done *within* technologically defined subsamples of the burin series—i.e., within the different SRS types. One kind of check on the utility of such an approach to burins is the sort of discriminant analysis used in previous chapters for the study of scrapers and backed tools. A pooled sample of all burins (n=275) in the studied units was

(Table 7-7--continued)

	Area 3: A.L.1 n	Area 3: A.L.1 %	Area 3: Méroc n	Area 3: Méroc %	Area 2: Méroc n	Area 2: Méroc %	Ar.1: Méroc n	Ar.3: cB(B) n	Ar.3: c.C n
Marginal Ret. Type (BU30)									
Fine	2		1		1		0	1	0
Heavy	7		5		6		1	0	0
Scaled	0		0		1		1	0	0
Stepped	1		2		2		0	0	1
Aurignacian	0		0		0		0	0	0
Mixed	0		0		0		0	0	0
TOTAL	10		8		10		2	1	1
Extent of Marg. Ret. (BU32)									
Continuous	1		2		0		0	0	0
Partial	9		6		10		2	1	1
TOTAL	10		8		10		2	1	1
Marginal Ret. Side (BU33)									
Left	8		4		5		2	1	0
Right	2		4		5		0	0	1
Both	0		0		0		0	0	0
TOTAL	10		8		10		2	1	1

Note: * For double, multiple, triple, and mixed burins, each blank is counted only once.

analyzed in terms of ten attribute sets: burin angle (BU5), burin edge width (BU6), number of burin removals (BU8), maximum ventral canting (BU12), SRS shape (BU14), SRS angle (BU15), lateral position of the burin edge (BU16), maximum width (BU25) and thickness (BU26) of the blank, and near-burin-edge thickness (BU27). Length of the blank was omitted so that burins on broken blanks could be included.

The major results of the discriminant analysis[22] are shown in Table 7-11. Only four of the ten attribute sets supplied were retained by the analysis. The most important set for discriminating among the SRS types is SRS angle, followed in order of decreasing importance by SRS shape, blank width, and burin angle. Four canonical variates were defined, of which the first is by far the most important, accounting for ca. 86% of the total dispersion in the sample. The overall success of the analysis in its ability to discriminate among SRS types (i.e., to reclassify examples correctly on the basis of the four relevant attribute sets) is low, 45.09% correctly reclassified, but the pattern of correct and erroneous reclassifications is itself very informative.

Of the 151 reclassification errors, 112 (74.17%) involve confounding one of the major SRS types with a minor one or one minor SRS type with another. In light of the fact that

Table 7-8.--Distributions of burin edge shape and other attributes of burins.

	Area 3:Arch. Level 1							Area 3:Méroc									Area 2:Méroc									Area 1: Méroc				Ar.3: cB(B)			Ar.3: c.C		
	Dihedral n	%	T n	B n	RN n	UD n	UN n	Dihedral n	%	Truncation n	%	B n	RD n	RN n	UD n	UN n	Dihedral n	%	Truncation n	%	B n	RD n	RN n	UD n	UN n	D n	T n	B n	RD n	D n	T n	UN n	D n	B n	RN n
Burin Edge Shape (BU7)																																			
Straight	18	(36.73)	4	6	3	3	2	8	(34.78)	14	(42.42)	4	0	1	0	2	6	(19.35)	10	(45.45)	5	3	0	0	2	3	3	1	1	1	1	0	0	0	0
Bevelled	1	(2.04)	3	0	0	0	1	0	(0)	7	(21.21)	0	2	0	0	0	1	(3.23)	3	(13.64)	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Angulated	12	(24.49)	3	3	0	2	1	9	(39.13)	7	(21.21)	1	1	1	0	2	10	(32.26)	4	(18.18)	2	1	3	1	1	4	0	1	0	2	0	0	1	1	0
Curved	3	(6.12)	1	0	0	0	0	2	(8.70)	0	(0)	1	0	0	0	0	3	(9.68)	0	(0)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Rounded	3	(6.12)	1	0	0	0	0	1	(4.35)	1	(3.03)	1	0	0	1	1	4	(12.90)	1	(4.55)	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Irregular	12	(24.49)	2	1	0	2	1	3	(13.04)	4	(12.12)	1	0	0	0	4	7	(22.58)	4	(18.18)	2	0	0	2	2	0	1	1	0	0	0	1	0	0	1
TOTAL	49	(99.99)	14	10	3	7	5	23	(100.00)	33	(99.99)	8	3	2	1	9	31	(100.00)	22	(100.00)	12	7	3	4	6	7	4	3	1	3	1	1	1	1	1
Dir. of SRS Retouch (BU2)																																			
Inverse	0	(0)	2	0	0	0	0	0	(0)	4	(12.12)	0	0	0	0	0	0	(0)	1	(4.55)	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Secondary Modification (BU3)																																			
Dihedral	-*		2	0	0	1	0	-		3	(9.09)	0	1	0	0	2	-		1	(4.55)	0	1	0	0	0	-	0	0	0	-	0	0	-	0	0
Truncation	1	(2.04)	-	0	-	0	0	1	(4.35)	-		1	-	-	0	0	2	(6.45)	-		1	-	-	0	0	0	-	1	-	0	-	0	0	0	-
Tertiary Modification (BU4)																																			
(present)	2	(4.08)	2	0	1	0	0	0	(0)	5	(15.15)	0	1	0	0	0	2	(6.45)	3	(13.64)	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Thinning Removals (BU10)																																			
(present)	1	(2.04)	0	2	0	0	1	0	(0)	1	(3.03)	0	0	0	0	1	0	(0)	1	(4.55)	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0

(Table 7-8--continued)

	Area 3:Arch. Level 1							Area 3:Méroc								
	Dihedral n	%	T n	B n	RN n	UD n	UN n	Dihedral n	%	Truncation n	%	B n	RD n	RN n	UD n	UN n
Pattern of Dihed. Rems. (BU9)																
SRS Left	23	(46.94)	-	-	-	-	-	6	(26.09)	-		-	-	-	-	-
SRS Right	13	(26.53)	-	-	-	-	-	9	(39.13)	-		-	-	-	-	-
Alternate	7	(14.29)	-	-	-	-	-	5	(21.74)	-		-	-	-	-	-
Indeterm.	6	(12.24)	-	-	-	-	-	3	(13.04)	-		-	-	-	-	-
TOTAL	49	(100.00)						23	(100.00)							
Obliquity (BU11/BU12)																
Simple																
Dors.Obl.	0	(0)	1	2	0	1	2	1	(4.35)	2	(6.06)	0	0	0	0	0
Lateral	16	(32.65)	2	3	1	3	1	4	(17.39)	10	(30.30)	2	1	0	0	3
Oblique	8	(16.33)	2	1	1	1	0	3	(13.04)	5	(15.15)	2	1	1	0	0
High Obl.	1	(2.04)	1	0	1	0	0	0	(0)	3	(9.09)	0	0	0	0	0
Flat-faced	0	(0)	1	0	0	0	0	1	(4.35)	1	(3.03)	0	0	0	0	0
Complex																
Max.= Lat.	4	(8.16)	1	0	0	0	1	3	(13.04)	0	(0)	1	0	0	0	2
Max.= Obl.	12	(24.49)	3	3	0	2	1	9	(39.13)	7	(21.21)	2	0	1	1	4
Max.= H.O.	4	(8.16)	3	1	0	0	0	1	(4.35)	4	(12.12)	1	1	0	0	0
Max.= F.F.	4	(8.16)	0	0	0	0	0	1	(4.35)	1	(3.03)	0	0	0	0	0
TOTAL	49	(99.99)	14	10	3	7	5	23	(100.00)	33	(99.99)	8	3	2	1	9
SRS Shape (BU14)																
Concave ++	0	(0)	3	0	0	0	0	0	(0)	7	(21.21)	1	2	0	0	0
Concave +	3	(6.12)	6	1	0	2	1	1	(4.35)	15	(45.45)	3	0	0	0	1
Straight	29	(59.18)	4	8	2	5	4	17	(73.91)	5	(15.15)	4	1	2	1	8
Convex +	16	(32.65)	0	1	1	0	0	3	(13.04)	1	(3.03)	0	0	0	0	0
Convex ++	1	(2.04)	1	0	0	0	0	2	(8.70)	5	(15.15)	0	0	0	0	0
TOTAL	49	(99.99)	14	10	3	7	5	23	(100.00)	33	(99.99)	8	3	2	1	9

	Area 2:Méroc									Area 1: Méroc				Ar.3: cB(B)			Ar.3: c.C		
	Dihedral n	%	Truncation n	%	B n	RD n	RN n	UD n	UN n	D n	T n	B n	RD n	D n	T n	UN n	D n	B n	RN n
Pattern of Dihed. Rems. (BU9)																			
SRS Left	12	(38.71)	-		-	-	-	-	-	2	-	-	-	2	-	-	1	-	-
SRS Right	10	(32.26)	-		-	-	-	-	-	2	-	-	-	1	-	-	0	-	-
Alternate	7	(22.58)	-		-	-	-	-	-	1	-	-	-	0	-	-	0	-	-
Indeterm.	2	(6.45)	-		-	-	-	-	-	2	-	-	-	0	-	-	0	-	-
TOTAL	31	(100.00)								7				3			1		
Obliquity (BU11/BU12)																			
Simple																			
Dors.Obl.	0	(0)	0	(0)	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lateral	6	(19.35)	8	(36.36)	5	1	0	0	2	1	0	1	0	2	0	0	0	0	0
Oblique	2	(6.45)	7	(31.82)	2	5	1	0	0	2	2	0	0	0	1	0	0	0	0
High Obl.	1	(3.23)	0	(0)	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
Flat-faced	0	(0)	0	(0)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Complex																			
Max.= Lat.	3	(9.68)	1	(4.55)	1	0	1	1	2	2	0	1	0	1	0	0	0	1	0
Max.= Obl.	16	(51.62)	2	(9.09)	1	1	1	2	1	2	1	1	0	0	0	1	1	0	0
Max.= H.O.	2	(6.45)	4	(18.18)	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Max.= F.F.	1	(3.23)	0	(0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
TOTAL	31	(100.01)	22	(100.00)	12	7	3	4	6	7	4	3	1	3	1	1	1	1	1
SRS Shape (BU14)																			
Concave ++	0	(0)	3	(13.64)	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0
Concave +	2	(6.45)	7	(31.82)	0	2	0	0	0	1	2	1	1	0	1	0	0	1	1
Straight	26	(83.87)	7	(31.82)	11	3	2	4	5	4	0	2	0	3	0	1	1	0	0
Convex +	2	(6.45)	3	(13.64)	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Convex ++	1	(3.23)	2	(9.09)	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0
TOTAL	31	(100.00)	22	(100.01)	12	7	3	4	6	7	4	3	1	3	1	1	1	1	1

(Table 7-8--continued)

	Area 3:Arch. Level 1							Area 3:Méroc										Area 2:Méroc										Area 1: Méroc				Ar.3: cB(B)			Ar.3: c.C		
	Dihedral n	%	T n	B n	RN n	UD n	UN n	Dihedral n	%	Truncation n	%	B n	RD n	RN n	UD n	UN n	Dihedral n	%	Truncation n	%	B n	RD n	RN n	UD n	UN n	D n	T n	B n	RD n	D n	T n	UN n	D n	B n	RN n
Lateral Position (BU16)																																					
Left Lateral	13	(26.53)	0	1	2	1	2	5	(21.74)	8	(24.24)	4	1	0	0	2	6	(19.35)	6	(27.27)	4	2	1	1	4	3	0	2	0	1	0	0	1	0	0
Left Asymm.	8	(16.33)	4	2	0	1	1	2	(8.70)	6	(18.18)	1	0	0	0	3	5	(16.13)	5	(22.73)	3	0	0	0	0	0	3	0	0	1	0	0	0	0	0
Median	6	(12.24)	0	1	0	1	0	3	(13.04)	6	(18.18)	1	0	0	1	1	5	(16.13)	0	(0)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Right Asymm.	8	(16.33)	5	1	0	0	0	8	(34.78)	7	(21.21)	0	0	1	0	2	4	(12.90)	1	(4.55)	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0
Right Lat.	14	(28.57)	5	5	1	4	2	5	(21.74)	6	(18.18)	2	2	1	0	1	11	(35.48)	10	(45.45)	4	4	2	3	2	3	1	1	1	0	1	1	0	1	1
TOTAL	49	(100.00)	14	10	3	7	5	23	(100.00)	33	(99.99)	8	3	2	1	9	31	(99.99)	22	(100.00)	12	7	3	4	6	7	4	3	1	3	1	1	1	1	1
Bulbar Position (BU17)																																					
Distal	16	(32.65)	3	3	1	5	4	2	(8.70)	8	(24.24)	3	2	0	1	3	11	(35.48)	12	(54.55)	1	2	2	1	1	4	1	1	1	0	0	0	1	1	0
Proximal	9	(18.37)	2	1	0	1	0	5	(21.74)	7	(21.21)	1	1	1	0	4	9	(29.03)	2	(9.09)	4	3	0	1	1	0	0	1	0	1	0	1	0	0	0
Side	7	(14.29)	5	0	0	1	0	2	(8.70)	0	(0)	1	0	0	0	0	0	(0)	0	(0)	1	1	0	1	0	0	0	0	0	1	0	0	0	0	0
Indeterm.	17	(34.69)	4	6	2	0	1	14	(60.87)	18	(54.55)	3	0	1	0	2	11	(35.48)	8	(36.36)	6	1	1	1	4	3	3	1	0	1	1	0	0	0	1
TOTAL	49	(100.00)	14	10	3	7	5	23	(100.01)	33	(100.00)	8	3	2	1	9	31	(99.99)	22	(100.00)	12	7	3	4	6	7	4	3	1	3	1	1	1	1	1
Transversal-ity (BU18)																																					
(present)	14	(28.57)	4	0	0	2	0	6	(26.09)	1	(3.03)	1	3	0	0	4	2	(6.45)	0	(0)	0	5	0	2	0	1	0	0	1	3	0	0	1	0	0
Tool Disposition (BU19)																																					
Single	39	(79.59)	11	6	3	4	5	11	(47.83)	15	(45.45)	5	1	1	1	7	13	(41.94)	13	(59.09)	8	1	3	1	4	5	4	3	0	1	1	1	1	0	1
Double	7	(14.29)	1	2	0	0	0	6	(26.09)	6	(18.18)	0	0	0	0	0	2	(6.45)	2	(9.09)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Multiple	0	(0)	0	0	0	2	0	0	(0)	0	(0)	0	0	0	0	0	0	(0)	0	(0)	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Triple	0	(0)	0	0	0	0	0	0	(0)	0	(0)	0	0	0	0	0	0	(0)	3	(13.64)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mixed	2	(4.08)	1	0	0	1	0	4	(17.39)	7	(21.21)	0	0	0	0	1	6	(19.35)	4	(18.18)	3	4	0	1	1	0	0	0	0	0	0	0	0	0	0
Comb. Tool	1	(2.04)	1	2	0	0	0	2	(8.70)	5	(15.15)	3	2	1	0	1	10	(32.26)	0	(0)	1	0	0	2	1	2	0	0	1	2	0	0	0	1	0
TOTAL	49	(100.00)	14	10	3	7	5	23	(100.01)	33	(99.99)	8	3	2	1	9	31	(100.00)	22	(100.00)	12	7	3	4	6	7	4	3	1	3	1	1	1	1	1

(Table 7-8--continued)

	Area 3:Arch. Level 1							Area 3:Méroc									Area 2:Méroc									Area 1: Méroc				Ar.3: cB(B)			Ar.3: c.C		
	Dihedral n	%	T n	B n	RN n	UD n	UN n	Dihedral n	%	Truncation n	%	B n	RD n	RN n	UD n	UN n	Dihedral n	%	Truncation n	%	B n	RD n	RN n	UD n	UN n	D n	T n	B n	RD n	D n	T n	UN n	D n	B n	RN n
Nature of Blank (for singles only) (BU21)																																			
Blade	3		0	0	1	2	2	0		1		1	0	0	0	1	2		0		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Flake	32		9	5	1	2	3	6		11		3	1	0	1	4	8		10		6	1	2	0	2	4	3	1	0	1	0	1	1	0	1
Chunk	4		2	1	1	0	0	5		3		1	0	1	0	2	3		3		2	0	1	1	2	1	1	1	0	0	1	0	0	0	0
TOTAL	39		11	6	3	4	5	11		15		5	1	1	1	7	13		13		8	1	3	1	4	5	4	3	0	1	1	1	1	0	1
includ. n with cortex	17		4	1	2	1	3	7		7		2	0	1	0	2	5		4		4	1	2	0	2	1	2	2	0	1	0	0	1	0	1
Positive Hinge Spall (BU28)																																			
(present)	2	(4.08)	0	0	1	0	0	0	(0)	0	(0)	0	0	0	0	0	0	(0)	0	(0)	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0

* NOTE: "-" = not applicable

Table 7-9.--Distributions of burin angle and other attributes of burins in Area 3.

	Area 3:Archaeological Level 1						Area 3:Méroc						
	Dihed.	Trunc.	Break	R.End	R.Edg.	U.End	Dihed.	Trunc.	Break	R.Edg.	R.End	U.Edg.	U.End
N burin edges	49	14	10	3	7	5	23	33	8	3	2	1	9
Burin Angle (BU5)													
$\bar{X}$	76.02	73.57	71.50	66.67	75.71	78.00	76.52	74.55	76.25	68.33	67.50		81.11
s	9.57	10.08	8.51	20.21	10.58	14.40	9.82	7.00	11.57	11.55	3.54		7.82
Burin Edge Width (BU6) in mm													
$\bar{X}$	9.16	10.71	6.40	6.67	6.43	6.20	11.13	11.55	7.13	10.67	10.00		11.44
s	4.02	4.70	2.41	1.15	2.37	2.59	4.76	4.15	4.70	5.03	2.83		5.20
Number of Burin Removals (BU8)													
$\bar{X}$	1.94	2.14	1.60	1.00	1.43	1.60	2.35	1.79	2.13	1.33	2.50		2.78
s	0.90	1.23	0.52	0	0.53	0.55	0.94	0.82	0.83	0.58	0.71		1.30
SRS Angle (BU15)													
$\bar{X}$	66.94	76.43	69.00	73.33	10.00	80.00	66.09	73.33	75.00	6.67	60.00		74.44
s	17.58	8.42	21.32	20.82	15.28	14.14	19.71	16.33	16.04	5.77	14.14		11.30
Near-Burin-Edge Th.(BU27) in mm													
$\bar{X}$	12.88	16.00	12.40	13.67	9.71	11.60	16.74	17.24	13.38	17.00	14.50		15.44
s	4.31	5.01	4.84	7.23	3.82	3.91	5.64	4.15	5.88	5.29	0.71		4.13
N comp.singles	30	9	4	2	4	5	11	11	5	1	0	1	7
Blank Length (BU24) in mm													
$\bar{X}$	41.73	49.89	31.50	51.00	40.00	42.20	56.46	48.00	43.20				43.57
s	10.26	7.01	9.88	9.90	10.80	14.25	11.16	8.05	12.05				5.32

(Table 7-9--continued)

Blank Width (BU25) in mm										
$\bar{X}$	28.67	40.78	32.25	37.00	32.25	30.60	35.55	31.91	30.80	33.71
s	9.97	10.47	13.50	21.21	17.56	13.18	6.28	7.46	14.89	8.98
Blank Thickn. (BU26) in mm										
$\bar{X}$	14.80	19.33	10.50	24.00	13.00	12.80	18.00	18.91	16.80	15.29
s	5.96	4.06	2.65	7.07	4.08	4.87	5.62	4.30	5.54	4.42

only about 19% of the burin edges in the sample are minor SRS types, it is clear that these minor types are the principal locus of problems in discrimination. Most of the reclassification errors of this kind are quite explicable, and they suggest that the burin typology used here has overemphasized some technical details that do not exert a large influence on the overall characteristics of the tools in question. For example, the most frequent error for truncation burins is their reclassification as retouched end burins. The difference between a "true" truncation, which significantly alters the shape of the end of the blank, and "retouch" of the end, which does not, is a matter of degree. For the Tambourets burin series, the use of this criterion frequently places into different subclasses burins that are otherwise very similar. Another such example is provided by the fact that the most frequently occurring error for unretouched end burins is their reclassification as break burins. Although a processually oriented study of burins quite usefully distinguishes between a spall removal surface that antedated the detachment of the blank and one that was created later, this distinction may often be irrelevant to the resulting morphology.

The other major kind of reclassification error (n=39, 25.83% of all errors) involves confusion *among* the major SRS types. The majority of these (n=25) involve break burins, the least adequately discriminated SRS type in the Tambourets series. Fewer than one-quarter of the break burins are correctly reclassified by the analysis, and the errors are spread throughout almost all the other SRS types. Despite the unambiguous nature of its technological definition, the break burin is a taxon of very low morphological integrity within the Tambourets burin series.

Erroneous reclassification of dihedral burins as truncation burins or vice-versa are very infrequent (n=14, 9.27% of all errors). The fact that the one is very rarely confused with the other, even in the absence of the defining technological criteria, is obviously related to the different patterns of attribute interactions discussed in the preceding section of this chapter. The different manufacturing techniques produce different products.

In summary, the discriminant analysis suggests that the burin classification employed is somewhat too detailed for the Tambourets burin series. In particular, the taxonomic reality of break burins and the minor SRS types is suspect. However, the distinction between dihedral and truncation burins corresponds in large measure to real differences that have clear multivariate expression.

V. RELATIONSHIPS AMONG BURIN SAMPLES

The same ten attribute sets used for the discriminant analysis (see above) were used in an investigation of the morphological "distances" separating five studied samples of burins from Les Tambourets—the excavated samples from Area 3:Archaeological Level 1 and couche B(Basal) and the surface samples from Méroc's Areas 1, 2, and 3. Following procedures previously discussed in detail for end-scrapers (see Chapter 5), Mahalanobis' generalized distance statistic (D^2) was calculated for each sample pair (Table 7-12); these distance measures were then transformed to measures of similarity, which were used in a cluster analysis the results of which are shown in Figure 7-6. The two large burin samples from Area 3, one excavated and one surface-collected, are very significantly different (P=0.004). This difference emphasizes once again the great intersample variation that has been commented on frequently at the level of single attribute sets. It is apparently the case for burins, as for Châtelperron points, that morphological attributes are strongly localized within the site and that the excavated sample from the extreme southern margin of Area 3 (Archaeological Level 1) is not representative of that area as a whole.

VI. CONCLUDING REMARKS

The extensive attribute analyses reported in this chapter suggest that the Châtelperronian burin series from Les Tambourets can be characterized as very generalized. Although all the technologically defined subclasses of burins (SRS types) are formally present in the series, there is very little internal differentiation, either within or between SRS types. Burin blanks are generally crude (amorphous, thick), and except in the case of truncation burins little effort has been made to transcend the more obvious limitations of the blank. The extreme complexity of burins that one finds in the later Upper Palaeolithic is simply not present in the

Table 7-10.--Distributions of burin angle and other attributes of burins in Areas 2 and 1.

	Area 2:Méroc							Area 1:Méroc			
	Dihed.	Trunc.	Break	R.Edg.	R.End	U.Edg.	U.End	Dihed.	Trunc.	Break	R.Edg.
N burin edges	31	22	12	7	3	4	6	7	4	3	1
Burin Angle (BU5)											
$\bar{X}$	78.55	80.91	77.08	80.71	76.67	85.00	80.00	75.71	76 25	73.33	
s	8.58	8.54	10.33	9.32	7.64	7.07	11.40	14.56	14.36	14.43	
Burin Edge Width (BU6) in mm											
$\bar{X}$	11.07	9.95	9.25	8.71	12.67	9.25	12.67	9.86	11.00	6.67	
s	4.07	3.53	4.27	3.40	3.06	1.26	6.31	6.04	4.08	4.16	
Number of Burin Removals (BU8)											
$\bar{X}$	2.42	1.77	2.17	1.57	2.33	2.50	2.33	1.71	2.00	2.00	
s	0.81	0.81	1.47	0.79	0.58	0.58	1.03	0.76	0.82	1.00	
SRS Angle (BU15)											
$\bar{X}$	65.16	80.46	73.33	8.57	80.00	7.50	81.67	67.14	77.50	80.00	
s	19.13	9.50	16.14	10.69	10.00	15.00	7.53	14.96	12.58	10.00	
Near-Burin-Edge Th.(BU27) in mm											
$\bar{X}$	16.65	16.96	14.67	18.29	14.67	16.25	20.67	11.86	15.00	11.00	
s	4.81	4.46	3.65	3.35	4.16	5.56	6.86	4.60	4.69	5.29	
N comp.singles	11	11	7	1	2	1	4	3	4	3	0
Blank Length (BU24) in mm											
$\bar{X}$	46.18	46.18	44.29		37.50		43.75	44.00	46.50	32.33	
s	12.51	5.25	10.42		0.71		7.97	12.49	11.96	5.51	

(Table 7-10--continued)

Blank Width (BU25) in mm								
$\bar{X}$	28.73	39.09	28.86	35.00	35.50	29.33	32.25	28.00
s	8.73	11.45	8.24	9.90	6.61	7.57	11.47	11.79
Blank Thickn. (BU26) in mm								
$\bar{X}$	18.09	20.09	15.00	16.00	20.50	13.00	16.00	11.33
s	4.09	4.57	3.70	8.49	2.89	6.25	6.00	5.69

Tambourets series. The Tambourets artificers were not unskilled at flint-working, and the flint sources at their disposal did not force the production of thick, chunky blanks. Their achievements in the manufacture of Châtelperron points leave no doubts about their abilities. Such data as these suggest that the Tambourets burin series is a good illustration of an early stage in the process of developing, from a Mousterian base, the full technological potential of the burin as an effective tool-class, a potential realized with such diversity in later traditions within the European Upper Palaeolithic . To the extent that this may be true, the detailed attribute analysis of the Tambourets burin series is of value in providing something close to base-line data with which these later, more complex developments may be compared.

ENDNOTES

1. The method of initial factor extraction was "principal components," and a "direct oblimin" method of oblique rotation was employed. The BMDP4M program (Frane et al. 1981) was run on a DEC-20 computer at the Tulane Computing Services.
2. For Area 3:Archaeological Level 1, F=3.44, df=2 and 70, P(1-tailed)=0.036. For Area 3:Méroc, F=3.26, df=2 and 61, P(1-tailed)=0.044. A series of Scheffe tests (Downie and Heath 1974: 211–213) shows that in both samples, the sample-pair probabilities less than 0.05 are between break and truncation burins.
3. For Area 2:Méroc, this difference is significant: Chi-squared=8.77, df=1, P=0.012.
4. In Area 2:Méroc, this difference is significant: Chi-squared= 0.84, df=1, P<0.0001.
5. Chi-squared=4.73, df=1, P=0.030.
6. In Area 2:Méroc, this difference is significant: Chi-squared=9.68, df=1, P=0.008.
7. With truncation and break burins grouped to eliminate small cell values, test results for Area 3:Archaeological Level 1, Area 3:Méroc, and Area 2:Méroc are, respectively: Chi-squared=28.39, 26.00, and 21.63; df=1, 1, and 1; P=0.0001, 0.00003, and 0.0002.
8. For Area 2:Méroc, F=5.99, df=2 and 62, P=0.005. The significant sample-pair difference is between dihedral and truncation burins.
9. Chi-squared=12.84, df=1, P=0.012.
10. Fisher's exact test, P=0.081.
11. The significance of the differences was tested by analysis of variance and Scheffe tests. In Area 3:Archaeological Level 1, break burins are shorter than truncation burins (F=5.31, df=2 and 40, P=0.009) and thinner than truncation burins (F=4.16, df=2 and 40, P=0.022), and truncation burins are wider than dihedral burins (F=4.73, df=2 and 40, P=0.014). In Area 3:Méroc, break burins are shorter than dihedral burins (F=3.57, df=2 and 24, P=0.045). In Area 2:Méroc, truncation burins are wider than dihedral burins (F=3.81, df=2 and 26, P=0.035).
12. Information on most of the bivariate relationships at issue is provided by the correlation matrix (see Table 7-3) on which the factor analysis is based. Only data not available in the matrix are presented here.
13. One-factor analysis of variance: for maximum width, F=5.09, df=2 and 111, 0.01>P(1-tailed)>0.005; for blank thickness, F=5.27, df=2 and 111, 0.01>P(1-tailed)>0.005; for near-burin thickness, F=3.19, df=2 and 111, 0.05>P(1-tailed)>0.025.
14. F=24.78, df=5 and 108, P[1-tailed]<0.005.
15. t=3.04, df=112, 0.005>P[1-tailed]>0.0005.
16. tau=2.55, P[1-tailed]=0.005.
17. t=5.74, df=72, P[1-tailed]<0.0005.
18. F=3.43, df=3 and 70, P[1-tailed]=0.021.
19. t=1.84, df=72, P[1-tailed]>0.025.
20. F=4.25, df=2 and 71, P[1-tailed]=0.018.
21. F=3.02, df=3 and 70, P[1-tailed]=0.035.
22. The analysis was performed using the "Stepwise Discriminant Analysis" program, BMDP7M (Jennrich and Sampson 1981), run on a DEC-20 computer at the Tulane Computing Services.

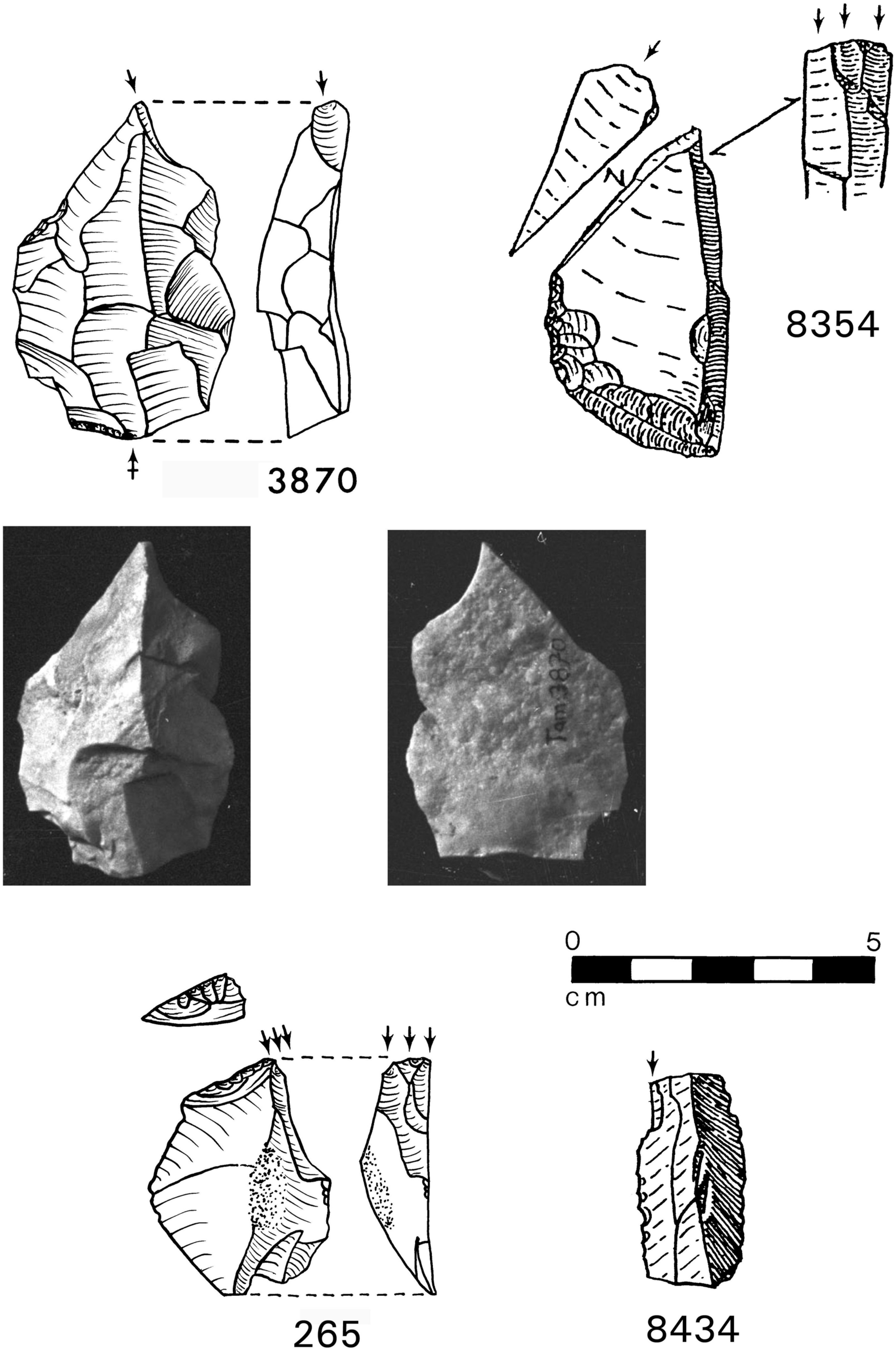

Figure 7-4. Burins and combination tool from Les Tambourets. #3870: unretouched edge burin; #8354: double dihedral burin on a side-scraper; #265: truncation burin; #8434: break burin. #3870, #265: from Archaeological Level 1 in Area 3; #8354: in the Méroc Collection from Area 2 (drawing by L. Méroc); #8434: in the Méroc Collection from Area 3 (drawing by L. Méroc).

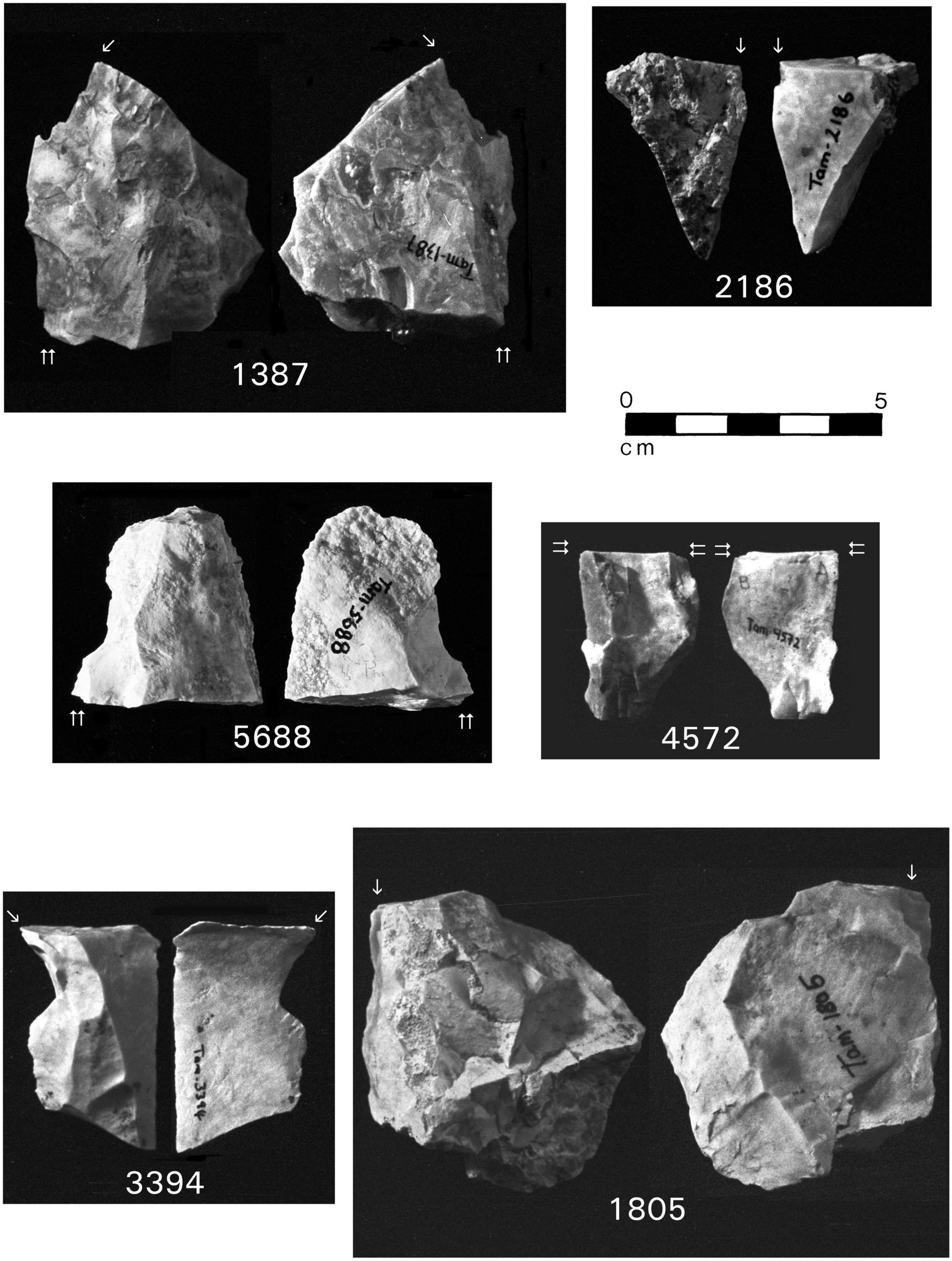

Figure 7-5. Burins and combination tool from Archaeological Level 1 at Les Tambourets. #1387: double break burin; #2186: unretouched end burin; #5688: break burin + end-scraper; #4572: multiple unretouched edge burin; #3394, #1805: retouched end burins.

Table 7-11.--Canonical variates and other results of the discriminant analysis of burins.

Canonical Variates

	Canon. Var. 1	Canon. Var. 2	Canon. Var. 3	Canon. Var. 4
Coefficient for SRS angle	0.067	0.005	0.001	-0.006
Coefficient for SRS shape	0.335	-0.225	0.620	0.495
Coefficient for blank width	-0.027	0.051	0.080	0.015
Coefficient for burin angle	-0.035	-0.007	-0.057	-0.087
Constant	-0.882	-1.511	1.759	6.678
Eigenvalue	1.708	0.236	0.028	0.019
Cumulative percentage of total dispersion	85.79	97.64	99.07	100.00
Group means for:				
Dihedral burins	0.185	-0.171	0.058	0.128
Truncation burins	0.470	0.265	-0.067	-0.229
Break burins	0.561	-0.039	-0.076	0.066
Retouched edge burins	-4.591	0.515	0.399	0.163
Retouched end burins	0.720	0.005	0.490	0.501
Unretouched edge burins	-3.862	-0.421	-0.459	0.024
Unretouched end burins	0.736	0.029	-0.112	-0.308

Attribute Sets Retained by the Analysis

		Dihed.	Trunc.	Break	R.Edg.	R.End	U.Edg.	U.End
1. SRS angle	$\bar{x}$	66.75	76.35	73.24	7.27	73.33	10.00	78.57
	s	18.07	13.09	16.83	9.05	15.00	14.14	11.08
2. SRS shape	$\bar{x}$	0.23	-0.55	-0.18	-1.00	0.22	-0.17	-0.05
	s	0.64	1.20	0.58	0.89	0.83	0.39	0.38
3. Blank width	$\bar{x}$	31.03	35.15	30.91	45.09	33.22	30.50	32.95
	s	9.10	8.90	11.07	6.61	9.76	10.62	9.91
4. Burin angle	$\bar{x}$	76.62	76.28	74.56	75.91	72.22	79.58	79.52
	s	9.83	8.88	10.25	11.14	12.77	9.88	10.24

(Table 7-11--continued)

Comparison of Initial Classification (rows) and Reclassification (columns)

		Dihed.	Trunc.	Break	R.Edg.	R.End	U.Edg.	U.End
Dihedral	(n = 114)	41	6	9	0	26	6	26
Trunc.	(n = 74)	8	41	7	0	10	1	7
Break	(n = 34)	4	5	8	0	4	1	12
R. Edge	(n = 11)	0	0	0	9	0	2	0
R. End	(n = 9)	1	1	0	0	5	0	2
U. Edge	(n = 12)	0	0	0	1	1	10	0
U. End	(n = 21)	2	0	5	0	4	0	10

Correct reclassifications of:
- Dihedrals: 41 of 114, 35.96%
- Truncations: 41 of 74, 55.41%
- Breaks: 8 of 34, 23.53%
- Retouched edges: 9 of 11, 81.82%
- Retouched ends: 5 of 9, 55.56%
- Unretouched edges: 10 of 12, 83.33%
- Unretouched ends: 10 of 21, 47.62%

All burins in the sample: 124 of 275, 45.09%

Table 7-12.--Relationships among five samples of burins, based on variation in ten attribute sets (BU5, BU6, BU8, BU12, BU14, BU15, BU16, BU25-BU27). Lower half-matrix contains values of the Mahalanobis generalized distance statistic (D^2). Upper half-matrix contains probability values for the distance measures.

	1	2	3	4	5
1		.004	<.0001	>.20	>.20
2	.76		>.20	>.20	>.20
3	1.14	.39		.045	>.20
4	.58	.96	1.93		>.20
5	1.98	3.04	3.96	7.80	

Sample 1.	Area 3:A.L.1	N = 88
Sample 2.	Area 3:Méroc	N = 79
Sample 3.	Area 2:Méroc	N = 85
Sample 4.	Area 1:Méroc	N = 15
Sample 5.	Area 3:c.B(Basal)	N = 5

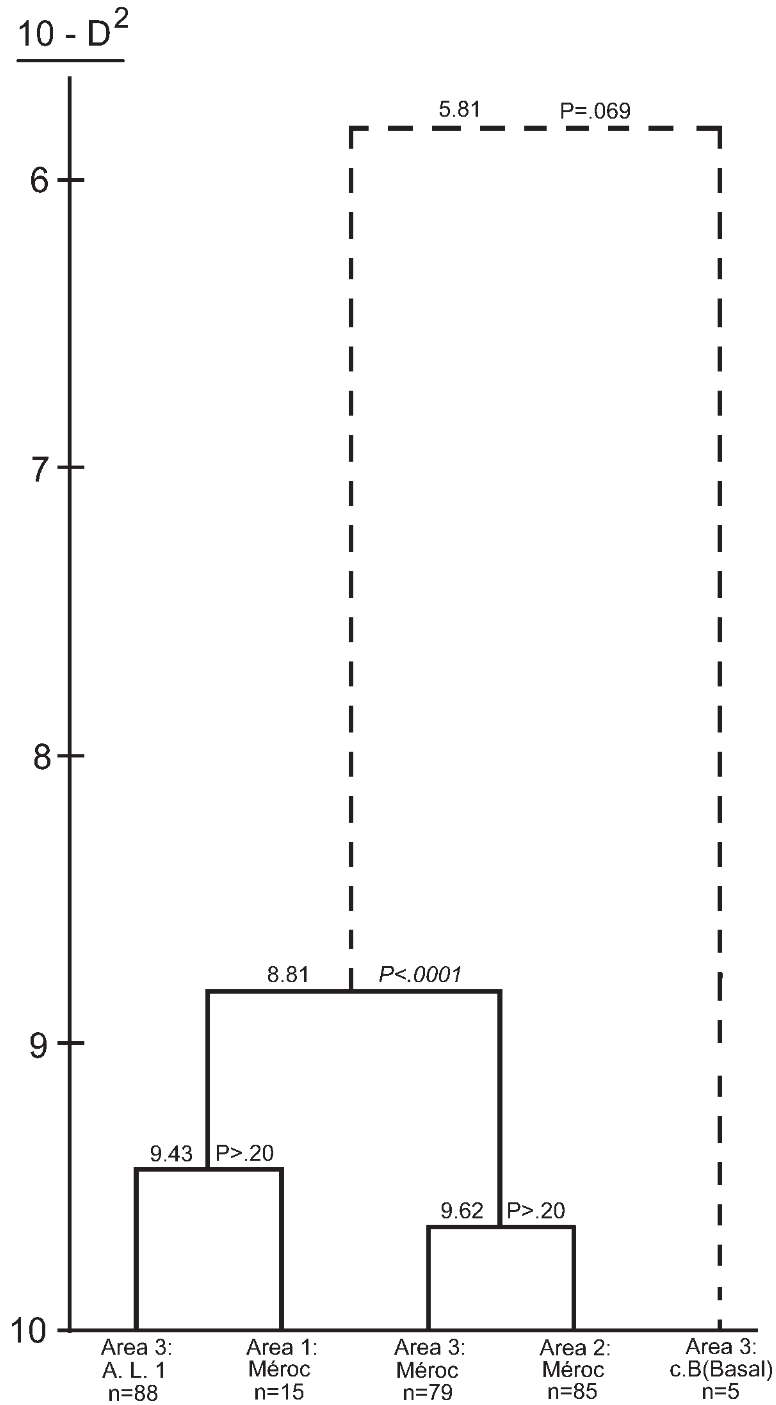

Figure 7-6. Dendrogram showing relationships among burin samples at Les Tambourets based on a similarity measure, 10-D2, as discussed in the text.

CHAPTER 8
TRUNCATED PIECES

INTRODUCTION

Truncated pieces (Figures 8-1 and 8-2, #1586, #2026, #4843) are easily defined morphologically, but understanding the variation within the tool class is greatly hindered by the functional heterogeneity that is masked by the use of the term. Common usage, codified in the typological lexicon of de Sonneville-Bordes and Perrot (1956b: 548) recognizes as a "truncated piece" a blade or flake that has a "truncation" at one or both extremities. A "truncation" is understood to mean a line of regular retouch removals, usually continuous and almost always abrupt, that has had the effect of reducing the length of the blank and that meets both margins of the blank to form clear angular corners or breaks in line (Tixier 1963: 124). There are at least four different demonstrated or alleged reasons why truncations would have been applied to blade or flake blanks (Brézillon 1971: 121–122):

- to reshape the blank by shortening it or removing a fragile extremity in order to create a tool the working part of which is one sharp, unretouched margin (a knife, for example);
- to create a scraping tool on which the scraping edge was essentially rectilinear or even concave (a "spokeshave" scraper) rather than markedly convex, as is the case with an end-scraper;
- to create a tool for perforating or engraving, of which the working part is the intersection of the "high" or most anterior corner of an oblique truncation and the adjacent margin of the blank; and
- to prepare a platform for the removal of a burin spall or spalls in order to create a truncation burin (absent the final step in this process, the "truncated piece" would be, functionally, an unstruck burin).

It is apparent, then, that only by an object-by-object study of use wear could one attempt to achieve an accurate functional sorting of truncated pieces. Most typological studies have made no such attempt and have, rather, treated truncated pieces as a uniform and functionally undefined morphological class.

In addition to truncated pieces proper, the assemblage samples from Les Tambourets contain two other tool classes that are regarded, on morphological grounds, as pieces related to truncated pieces. These classes, which are designated "**pieces with partial and/or irregular truncated ends**" (see Figure 8-2, #4559, #6289, #6692) and "**pieces lightly retouched across an extremity**" (see Figures 8-1, #5527, and 8-2, #6696 and #1998) are discussed briefly at the end of this chapter, in Section V.

The attribute analysis of truncated pieces from Les Tambourets is based on only four samples: the excavated sample from Archaeological Level 1 in Area 3[1] and the three surface samples collected by Méroc in Areas 1, 2, and 3. Because the truncated pieces are neither numerous nor tightly patterned in a typological sense, a rather simple attribute system (see Appendix B) was defined for their analysis.

I. THE FACTORS OF TRUNCATED PIECES

Only four or five of the attribute sets employed for the study of truncated pieces lend themselves to factor analysis. Orientation angle (TP3), detailed truncation shape (TP7) coded as an ordinal variable, maximum width (TP15), and maximum thickness (TP16) of the blank can be used for all single truncated pieces. Blank length (TP14) may be added if one restricts the sample to complete pieces only. Several factor analyses were performed on a combined sample from all four studied units, but they were so uninformative (beyond isolating the normal first factor of gross size) that the results need not be discussed here.

II. TRUNCATED PIECE ATTRIBUTE DISTRIBUTIONS

Distributions of single attribute sets are discussed here briefly as comments on Tables 8-1, 8-2, and 8-3. On the majority of objects, the truncating retouch extends completely across the end of the blank (see Table 8-1), and in almost all cases the truncation is formed by obverse removals only (for example, the pieces shown in Figure 8-1). In the sample from Area 2:Méroc, however, approximately 20% of the truncations are formed by either inverse or obverse/inverse removals. Few of the truncations are mounted squarely on the blank (with an orientation angle of 90º and an absence of asymmetry direction) (see Figure 8-1, #2970); most are tilted to either the right (see Figure 8-1, #1595 and #3706) or the left (see Figure 8-1, #1500). Asymmetry to the left and right are nearly equally distributed in all samples except that from Area 1:Méroc, where a right asymmetry is clearly predominant. Orientation angle, sample values of which are shown in Table 8-3, is distributed bimodally in all samples except that from Area 2:Méroc (Figure 8-3); these bimodalities are related to the nature of the blank, as discussed further in Section III of this chapter.

The truncations are predominantly of simple shape (see Figure 8-1, #1595 and #3706) (see Table 8-1). The detailed shape of the "high" side of complex truncations (for example, Figures 8-1, #1500, and 8-2, #4843)—or the only side of simple ones—is modally concave in all samples except that from Area 2:Méroc, where the modal shape category is straight. The "low" side of complex truncations is predominantly concave in all samples (see Figure 8-1, #1500). While there is some tendency for the two sides of a complex truncation to be of different shapes (for example, concave on the high side and convex on the low side), there are no patterns of association in the small samples that are significant at the 0.05 level. Truncations appear most often at the distal end of the blank (see Table 8-2). Most truncated pieces from Les Tambourets are single tools; bitruncated pieces occur only in the sample from Area 2:Méroc (see Table 8-1). Truncated pieces occurring as parts of combination tools are combined most frequently with burins (n=3 in Area 3:Méroc; n=5 in Area 2:Méroc; n=1 in Area 1:Méroc). Other combinations include four with end-scrapers (in Area 2:Méroc) and one with a double side-scraper (in Area 3:Méroc).

The blanks on which truncated pieces are made are ap-

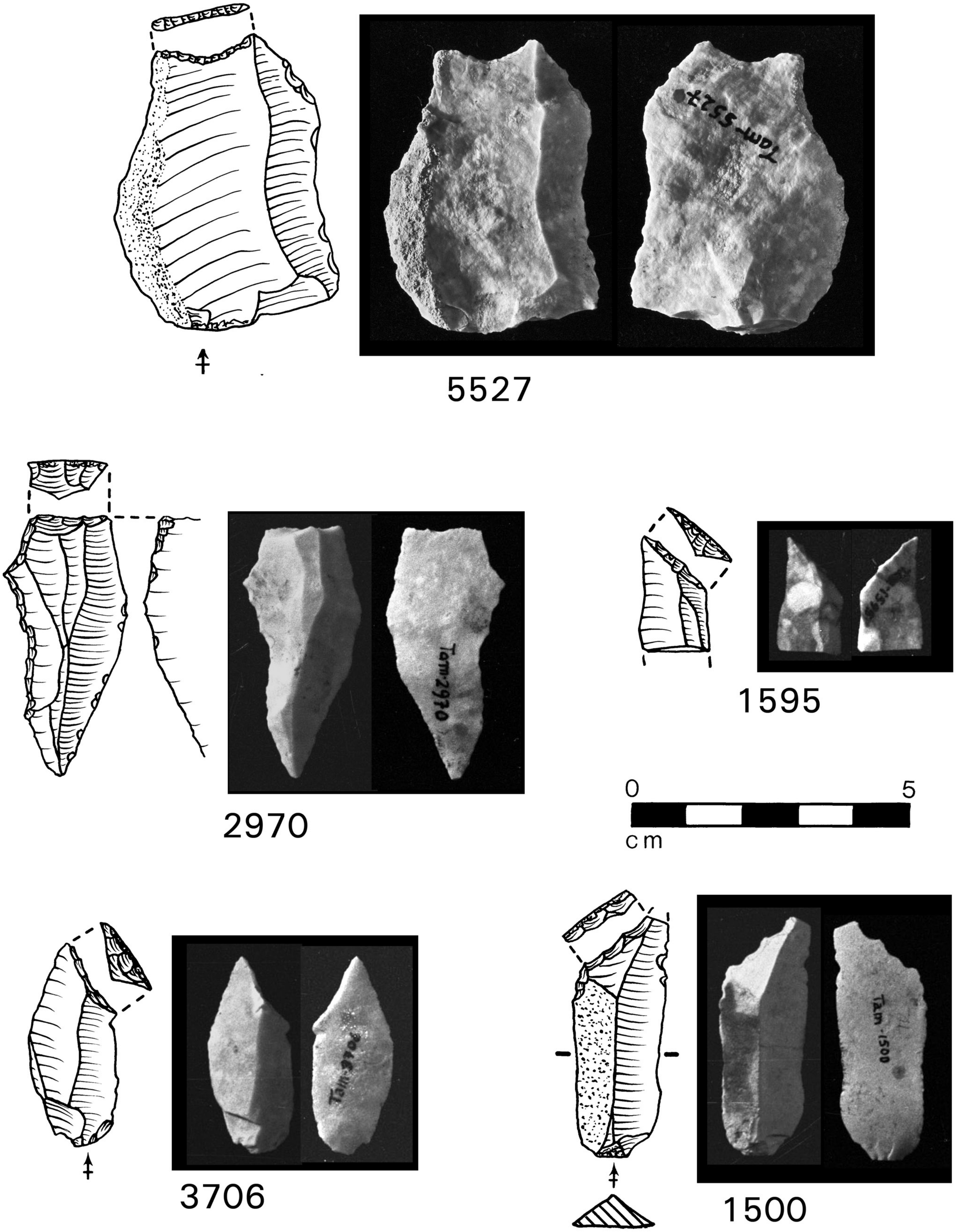

Figure 8-1. Truncated pieces and piece lightly retouched across an extremity in Area 3 at Les Tambourets. #5527: piece lightly retouched across an extremity, from couche B (basal); all others: truncated pieces from Archaeological Level 1.

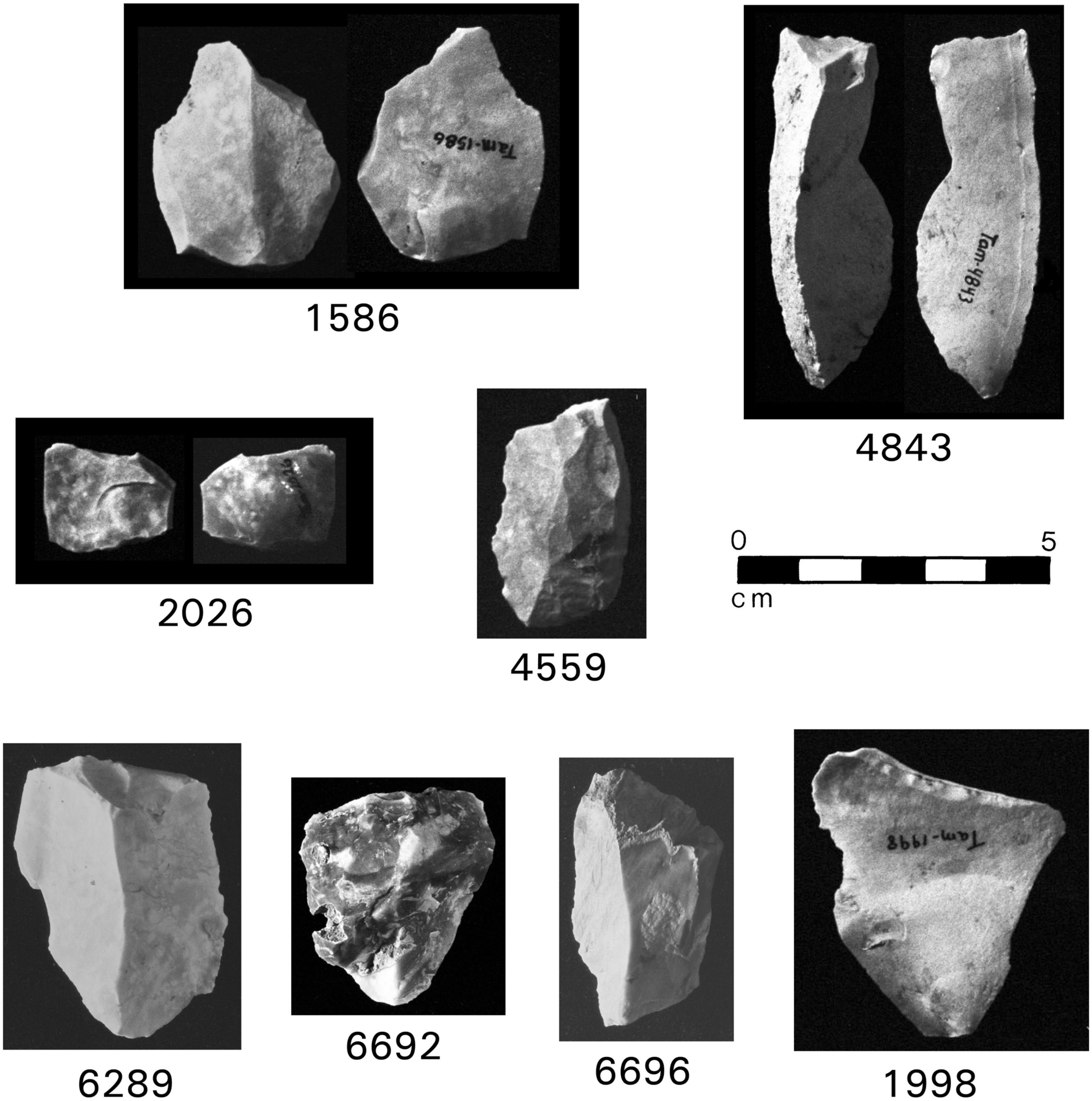

Figure 8-2. Truncated pieces and pieces related to truncated pieces from Archaeological Level 1 in Area 3 at Les Tambourets. #1586, #4843, #2026: truncated pieces; #4559, #6289, #6692: pieces with partial and/or irregular truncated ends; #6696, #1998: pieces lightly retouched across an extremity.

proximately equally divided between blades (see Figures 8-1, #1500, #1595, #3706, and 8-2, #4843) and flakes (see Figure 8-2, #1586, #2026) except in the Area 1:Méroc sample, where blades are predominant (see Table 8-2). Sample values of blank length, width, and thickness for complete, single truncated pieces are shown in Table 8-3. Frequencies of marginal retouch (see Figure 8-1, #2970) vary greatly among the four samples (see Table 8-2). The retouch is predominantly partial, and, except for the sample from Area 2:Méroc, fine retouch is almost the only type represented. The attribute sets of truncated pieces that concern flint variety, double patination, heat alteration, and several characteristics of the striking platform (TP22 through TP27) are discussed elsewhere in this report as part of analyses concerning more than a single tool class.

III. TRUNCATED PIECE ATTRIBUTE INTERACTIONS

A correlation matrix for the continuous variates of the attribute system of truncated pieces is shown in Table 8-4. Ori-

Table 8-1.--Distributions of extent of truncating retouch and other attribute sets of truncated pieces.

	Area 3: A.L.1		Area 3: Méroc		Area 2: Méroc		Area 1: Méroc	
	n	%	n	%	n	%	n	%
Extent of Truncating Retouch (TP1)								
Partial	5	(21.74)	2	(8.70)	9	10.84	8	(32.00)
Complete	18	(78.26)	21	(91.30)	74	89.16	17	(68.00)
TOTAL	23	(100.00)	23	(100.00)	83	100.00	25	(100.00)
Dir. of Truncating Retouch (TP2)								
Obverse	21	(91.30)	21	(91.30)	67	80.72	24	(96.00)
Inverse	1	(4.35)	1	(4.35)	11	13.25	0	0
Obverse/Inverse	1	(4.35)	1	(4.35)	5	6.02	1	(4.00)
TOTAL	23	(100.00)	23	(100.00)	83	99.99	25	(100.00)
Asymmetry Direction (TP4)								
Left	7	(30.43)	11	(47.83)	31	37.35	3	(12.00)
None	6	(26.09)	2	(8.70)	16	19.28	5	(20.00)
Right	10	(43.48)	10	(43.48)	36	43.37	17	(68.00)
TOTAL	23	(100.00)	23	(100.01)	83	100.00	25	(100.00)
Truncation Shape (General) (TP5)								
Simple	13	(56.52)	15	(65.22)	56	67.47	18	(72.00)
Complex	10	(43.48)	8	(34.78)	27	32.53	7	(28.00)
TOTAL	23	(100.00)	23	(100.00)	83	100.00	25	(100.00)
Truncation Shape (Detailed--High or Only Side) (TP7)								
Very Concave	3	(13.04)	2	(8.70)	12	14.46	11	(44.00)
Concave	9	(39.13)	10	(43.48)	20	24.10	5	(20.00)
Straight	9	(39.13)	5	(21.74)	40	48.19	6	(24.00)
Convex	2	(8.70)	3	(13.04)	6	7.23	0	0
Very Convex	0	0	3	(13.04)	5	6.02	3	(12.00)
TOTAL	23	(100.00)	23	(100.00)	83	100.00	25	(100.00)

entation angle is significantly correlated with blank width in the Area 1:Méroc sample only, and the three dimensions of the blank are significantly correlated in all samples except that from Area 1:Méroc. Although it might be expected that truncations applied to wider blanks might be more often partial than complete or more often of complex rather than simple shape, such is not the case in any sample.

An interesting pattern of attribute interaction within the series of truncated pieces from Les Tambourets stems from variation in the nature of the blanks used for their manufacture. Unlike the major tool classes from Les Tambourets—for example, end-scrapers and burins, which are made predominantly on flakes, or Châtelperron points, which are made almost exclusively on blades—the blanks used for truncated pieces are almost equally divided between blades and flakes in most of the samples. This technological heterogeneity is directly reflected in the bimodal distributions of orientation angle mentioned in the previous section. The bimodalities are most obvious in the two samples from Area 3 (see Figure 8-3), with modes at 50°

(Table 8-1--continued)

	Area 3: A.L.1 n	%	Area 3: Méroc n	%	Area 2: Méroc n	%	Area 1: Méroc n	%
Truncation Shape (Detailed--Low Side) (TP8)								
Very Concave	2		4		13		1	
Concave	3		1		2		3	
Straight	1		1		7		1	
Convex	3		2		2		1	
Very Convex	1		0		3		1	
TOTAL*	10		8		27		7	
Tool Disposition (TP10)								
Single	23	(100.00)	19	(82.61)	56	67.47	24	(96.00)
Double	0	0	0	0	18•	21.69	0	0
Combination	0	0	4	(17.39)	9	10.84	1	(4.00)
TOTAL	23	(100.00)	23	(100.00)	83	100.00	25	(100.00)

NOTES: * Tabulated for pieces with complex truncations only
• Includes two pieces on which only one end is studied

and 90° in Area 3:Archaeological Level 1 and 40° and 80° in Area 3:Méroc. When combined into a pooled Area 3 sample (n=46), there are strong modes at 50° (n=8) and 80° (n=14), with the intermodal low frequency at 60° (n=4). Excluding the pieces with orientation angles of 60°, the low-mode sample of "sharp", oblique truncations is seen to contain predominantly blades (10 of 13 objects), whereas the high-mode sample of "duller" truncations contains predominantly flakes and chunks (23 of 31). This is a significant difference in the nature of the blank.[2] In light of this finding, a series of analyses of variance was used to investigate the relationship between the nature of the blank and the orientation angle of truncated pieces. Nature of the blank has a significant effect on variation in orientation angle in Area 3:Archaeological Level 1, Area 3:Méroc, and Area 1:Méroc, which are the three samples in which orientation angle is bimodally distributed; there is no such effect in Area 2:Méroc, in which orientation angle has only one mode, at 80°.[3]

The suggestion that some areas of Les Tambourets contain two different kinds of truncated pieces does not lead to any clarification of functional difference. A similar bimodality in the sample of late Gravettian truncated pieces from Pataud:3 led to the definition of a kind of tool for perforating called a "truncation borer" (Bricker and David 1984: 80–81, 1995: 102). However, the distinctive traces of polishing and use damage that defined truncation borers at Pataud have not been observed on the low-mode truncated pieces from Les Tambourets. Nor is there any close similarity in blank size between truncated pieces and truncation burins at Les Tambourets. Truncated pieces (even high-mode samples made predominantly on flakes) are much smaller in all dimensions than truncation burins (compare Tables 8-3 and 7-9). No significant number of truncated pieces can be seen as unstruck truncation burins.

IV. RELATIONSHIPS AMONG TRUNCATED PIECE SAMPLES

The typological and technological relationships among the four studied samples of truncated pieces from Les Tambourets was investigated through the use of cluster analysis. As was done for other tool classes, the principal non-nominal-scale attribute sets were used to derive the Mahalanobis generalized distance (D^2) between each pair of samples (shown in the lower half-matrix of Table 8-5). This distance measure, which was based on only the dimensions of the blank (TP14-TP16), the orientation angle (TP3), and the detailed shape of the high or only side of the truncation (TP7), leads to the relationship shown in the dendrogram (Figure 8-4) that results from the cluster analysis.[4]

A second cluster analysis based on the Euclidean distance permits the use of a greater number of attribute sets, including those whose variation is measured on a nominal scale. As explained previously in greater detail in Chap-

Table 8-2.--Distributions of bulbar position of truncation and other attribute sets of single truncated pieces.

	Area 3: A.L.1		Area 3: Méroc	Area 2: Méroc		Area 1: Méroc	
	n	%	n	n	%	n	%
Bulbar Position of Truncation (TP9)							
Distal	12	(52.17)	18	34	60.71	15	(62.50)
Proximal	6	(26.09)	1	15	26.79	8	(33.33)
Indeterminate	5	(21.74)	0	7	12.50	1	(4.17)
TOTAL	23	(100.00)	19	56	100.00	24	(100.00)
Nature of Blank (TP11)							
Blade	12	(52.17)	9	26	46.43	17	(70.83)
Flake	10	(43.48)	10	30	53.57	7	(29.17)
Chunk	1	(4.35)	0	0	0	0	0
TOTAL	23	(100.00)	19	56	100.00	24	(100.00)
including n with cortex (TP12)	5	(21.74)	4	6	10.71	5	(20.83)
Occurrence of Marginal Retouch (TP17)							
N (singles)	23		19	56		24	
n with marg. ret.	4		2	14		2	
% with marg. ret.	(17.39)		(10.53)	25.00		(8.33)	
Extent of Marginal Retouch (TP20)							
Continuous	1		1	3		1	
Partial	3		1	11		1	
TOTAL (singles)	4		2	14		2	
Marginal Retouch Type (TP18)							
Fine	2		2	8*		2	
Heavy	0		0	3		0	
Scaled	1		0	1		0	
Stepped	0		0	2*		0	
Aurignacian	0		0	0		0	
Mixed	1		0	0		0	
TOTAL (singles)	4		2	14		2	

NOTE: * Includes one example with inverse retouch

Table 8-3.--Distributions of orientation angle and other attribute sets of truncated pieces. Sample values shown are mean ($\bar{x}$) and standard deviation (s).

	Area 3: A.L.1	Area 3: Méroc	Area 2: Méroc	Area 1: Méroc
N (all truncations)	23	23	83	25
Orientation Angle (TP3) in degrees				
$\bar{x}$	67.83	69.57	72.53	70.00
s	18.82	15.81	13.69	14.14
N (complete singles)	11	14	34	18
Blank Length (TP14) in mm				
$\bar{x}$	41.91	40.29	37.59	33.39
s	19.67	13.65	13.40	8.98
Blank Width (TP15) in mm				
$\bar{x}$	23.91	24.79	23.38	18.83
s	11.88	8.66	8.86	6.29
Blank Thickness (TP16) in mm				
$\bar{x}$	7.73	11.21	9.29	7.00
s	4.13	7.54	4.36	2.89

ter 6, determination of the Euclidean distance between samples assumes the independence of attributes. For this reason, blank width (TP15) was the only one of the three intercorrelated dimensions of the blank used in the analysis, and orientation angle (TP3), which is significantly correlated with blank width in one sample (see Table 8-4), was excluded. The ten attributes used in the determination of Euclidean distance were the percentages in each sample of complete truncations (TP1), inverse truncations (TP2), right asymmetry (TP4), complex truncations (TP5), straight truncation shape on the high or only side (TP7), distal location (TP9, with indeterminate pieces excluded), bitruncated pieces (TP10), blade blanks (TP11), and pieces with marginal retouch (TP12), and the mean value of blank width (TP15). The matrix of Euclidean distance coefficients is shown in Table 8-6, and the dendrogram resulting from the cluster analysis is shown in Figure 8-5.[5]

The two different cluster analyses have quite different results. The analysis based primarily on blank dimensions (see Figure 8-4) associates the excavated sample most closely with the materials collected from the surface in Area 1:Méroc. The more broadly based analysis (see Figure 8-5), which includes nine of the nominal-scale attribute sets, shows the closest similarities to be between the two samples from Area 3, one excavated and one collected from the surface. These latter results repeat, in a multivariate idiom, the data of Tables 8-1 and 8-2, which show that Area 2:Méroc and Area 1:Méroc are frequently divergent from other areas in univariate distributions. Both sets of results, stemming from different techniques of treating different data sets, are informative about the interareal relationships among the truncated pieces from Les Tambourets.

V. PIECES RELATED TO TRUNCATED PIECES

On truncated pieces proper, a line of usually steep, heavy retouch extends completely or nearly completely across the width of the extremity in such a fashion as to truncate (significantly diminish) the original end of the blank. If the line of truncating retouch does not extend absolutely completely across the extremity, as it does in the great majority of cases at Les Tambourets (see Table 8-1), there is at least very little of the extremity that is not clearly truncated by retouch. On two other category of tools, technologically related to truncated pieces, the modification of the blank is less patterned or less extreme. **Pieces with partial and/or irregular truncated ends** are blades or flakes with miscel-

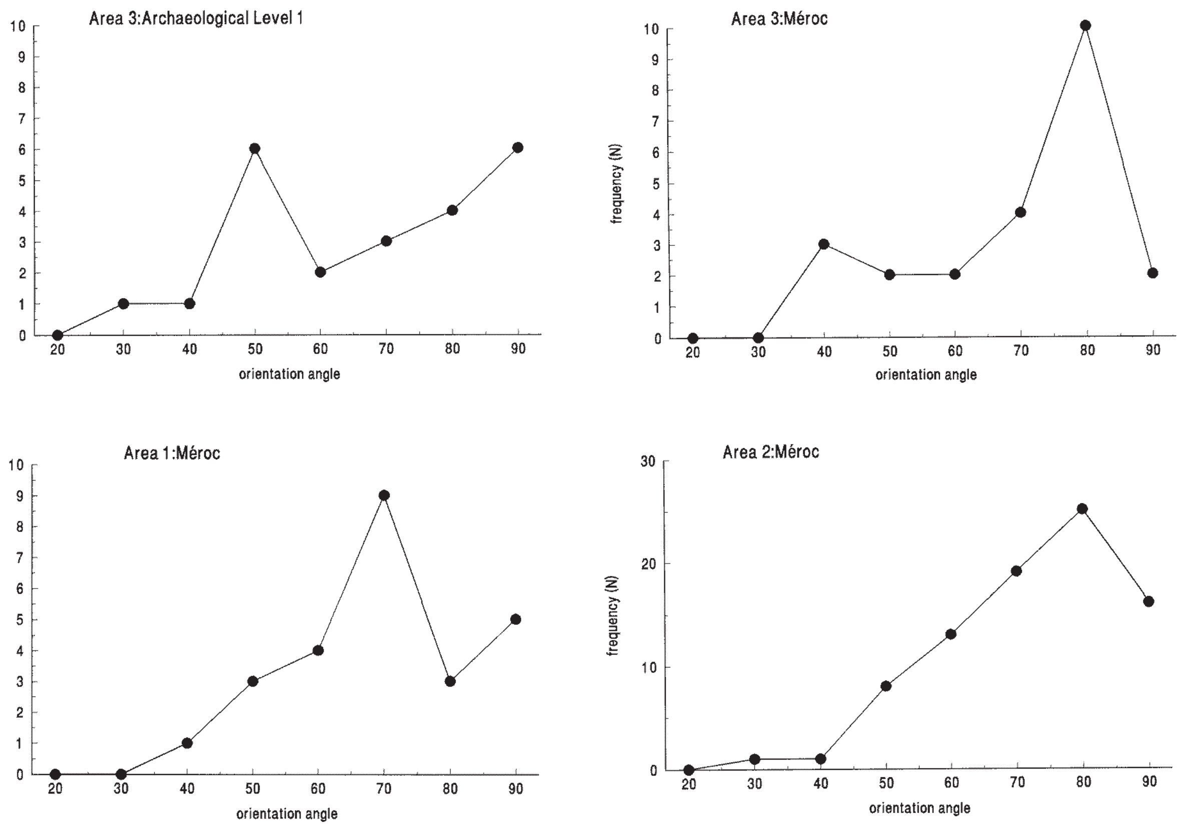

Figure 8-3. Frequency polygons of orientation angle in four samples of truncated pieces from Les Tambourets.

laneous retouch at the extremity. Most often, a very partial, sometimes inverse truncation extends for a short distance across a broken surface; in such cases, the truncation of the blank has been accomplished by fracture (see Figure 8-2, #6289 and #6692), and the partial retouch has probably had the effect of simply making more regular the shape of the resulting extremity. On some pieces, the retouch covers a small part of a steep pre-existing dorsal facet or a blunt hinge surface; in such cases, it is not clear to what extent the blank has really been truncated or reduced in length. There are, finally, a very few pieces on which a complete line of undoubtedly truncating retouch is present but very irregular—for example, forming large denticulations. On **pieces lightly retouched across an extremity**, the retouch is regular and most often continuous, but it is very fine—like fine marginal retouch, but located instead at the end of the piece (see Figures 8-1, #5527, and 8-2, #6696). Very rarely the retouch is inverse (see Figure 8-2, #1998). Such retouch has not really truncated the blank; at best, it has effected a minor regularization of the shape of the extremity.

Although both pieces with partial and/or irregular truncated ends and pieces lightly retouched across an extremity are included in the 92-type inventories as truncated pieces in Chapter 3, neither is included in the attribute study of truncated pieces reported above in previous sections of this chapter. A very abbreviated attribute study of these tool classes was performed, the results of which are summarized here. For both tool classes, variation is described in terms of several of the attribute sets of truncated pieces (Appendix B).

The studied samples of pieces with partial and/or irregular truncated ends include 86 modified extremities on 83 blanks (Table 8-7). On all but one, the line of truncating retouch is partial; the exception, from Area 3:Méroc, is a blade with a complete but irregularly denticulate obverse/inverse truncation. In the great majority of cases, the truncating retouch is obverse. Flake blanks slightly outnumber other kinds in all units except Area 1:Méroc, where blade blanks predominate. All tools are single except for three double-ended tools in Area 2:Méroc and one combination tool (combined with a break burin) in Area 3:Méroc. Marginal retouch is virtually absent except for the sample from Area 2:Méroc; the retouch present is predominantly scaled (5 of 7 occurrences). Sample values of blank length, width, and thickness are shown in Table 8-8; the heterogeneity in the small samples is indicated by the general lack of significant intercorrelation among the dimensions of the blank (Table 8-9).

The studied samples of pieces lightly retouched across an extremity include 38 modified ends on 37 blanks (one tool from Area 3:Archaeological Level 1 is double-ended). The line of retouch is predominantly complete and almost exclusively obverse (Table 8-10). Most of the tools appear on flake blanks, which are often cortical. The dimensions of the blank are almost never significantly intercorrelated in the small samples studied (Tables 8-11 and 8-12).

A comparison of truncated pieces proper and pieces related to them cannot be based on the details of the trun-

Table 8-4.--Relationships among orientation angle, blank length, blank width, and blank thickness of complete, single truncated pieces. The lower half-matrix tabulates correlation coefficients (r); the upper half-matrix tabulates probability values (P). The first listing for each group of four is for Area 3:Archaeological Level 1, N = 11. The second listing is for Area 3:Méroc, N = 14. The third listing is for Area 2:Méroc, N = 34. The fourth listing is for Area 1:Méroc, N = 18.

	Orientation Angle	Blank Length	Blank Width	Blank Thickness
Orientation Angle		>.10 >.10 >.10 >.10	>.10 >.10 >.10 .01>P>.001	>.10 >.10 >.10 >.10
Blank Length	-.228 .149 -.164 -.183		.05>P>.02 <.001 .05>P>.02 >.10	.01>P>.001 <.001 <.001 >.10
Blank Width	-.109 .257 .021 .648	.620 .805 .382 .161		.01>P>.001 <.001 <.001 >.10
Blank Thickness	-.032 .212 -.109 .131	.833 .779 .688 .388	.836 .864 .596 .320	

Table 8-5.--Relationships among four samples of complete single truncated pieces, based on variation in five attribute sets (TP3, TP7, TP14-TP16). Lower half-matrix contains values of the Mahalanobis generalized distance statistic (D^2). Upper half-matrix contains 2-tailed probability values for the distance measures.

	1	2	3	4
1		>.20	>.20	>.20
2	1.90		>.20	.20>P>.10
3	1.18	.32		>.20
4	.78	1.75	.74	

Sample 1.	Area 3:A.L.1	N = 11
Sample 2.	Area 3:Méroc	N = 14
Sample 3.	Area 2:Méroc	N = 34
Sample 4.	Area 1:Méroc	N = 18

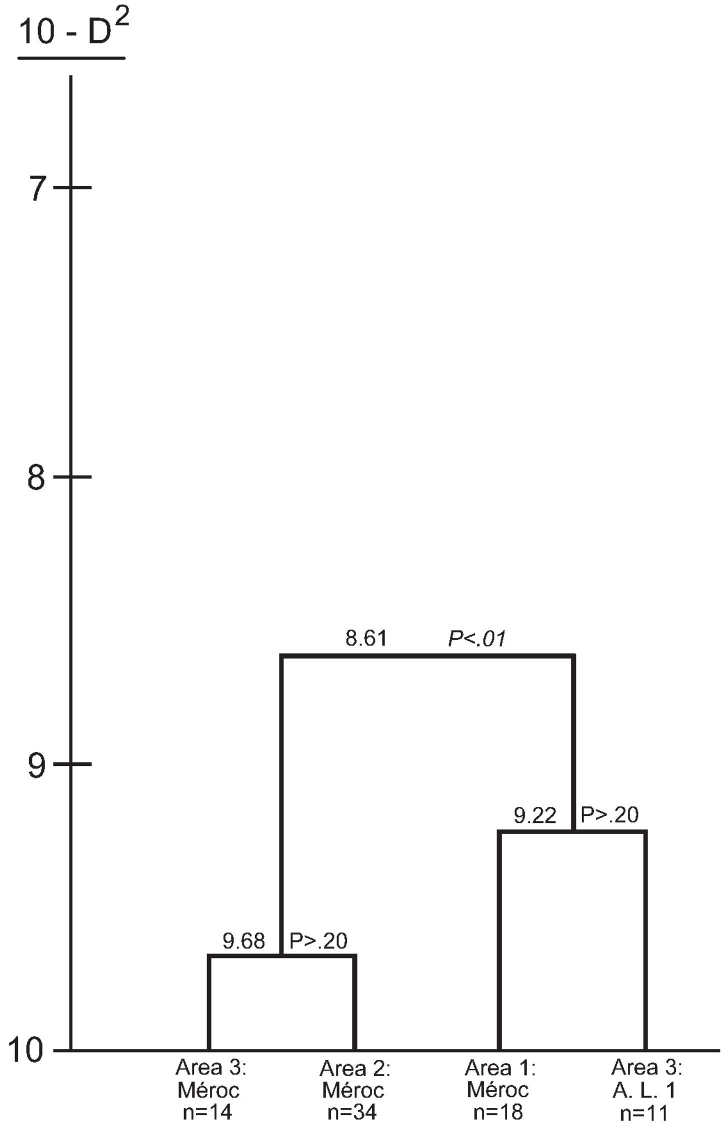

Figure 8-4. Dendrogram showing relationships among samples of truncated pieces at Les Tambourets based on a similarity measure, 10-D2, as discussed in the text.

Table 8-6.--Relationships among four samples of truncated pieces, based on variation in ten attribute sets (TP1, TP2, TP4, TP5, TP7, TP9-TP12, TP15). The half-matrix contains values of the Euclidean distance.

	1	2	3	4
1				
2	3.22			
3	3.51	4.29		
4	4.52	4.92	5.85	

Sample 1. Area 3:A.L.1
Sample 2. Area 3:Méroc
Sample 3. Area 2:Méroc
Sample 4. Area 1:Méroc

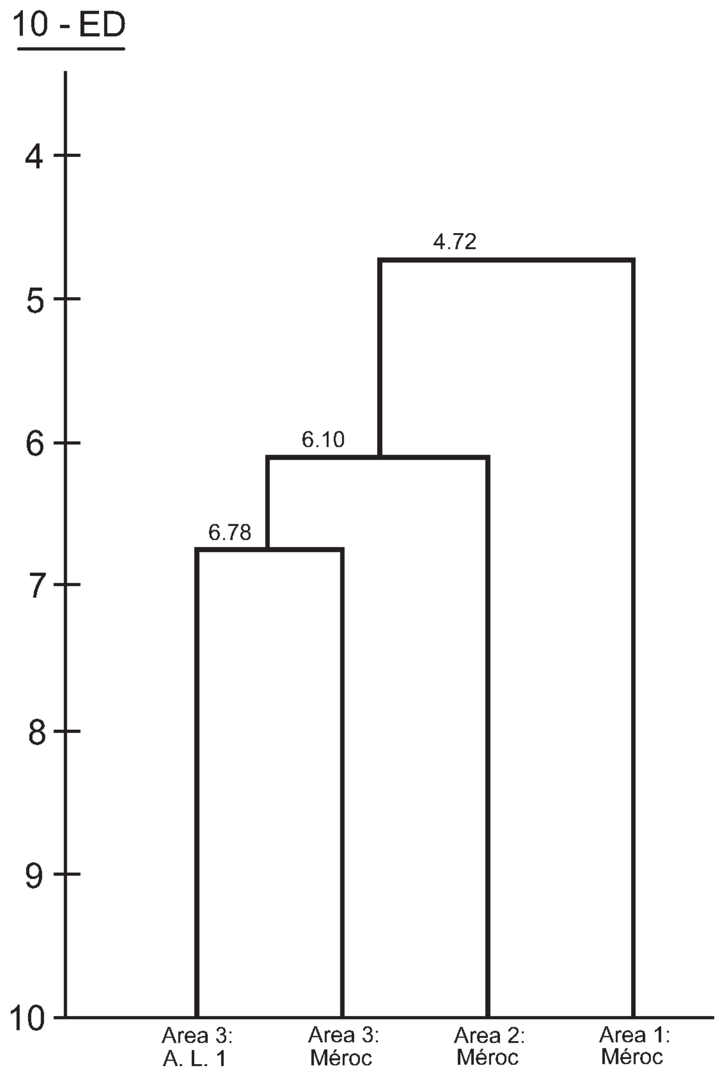

Figure 8-5. Dendrogram showing relationships among samples of truncated pieces at Les Tambourets based on a similarity measure, 10-ED, as discussed in the text.

cation or other extremity because such information was not recorded for the latter tool classes. They may, however, be compared in terms of the kinds of blanks on which they are made. There are, in fact, almost no significant differences between the nature or dimensions of the blanks of truncated pieces and those of the other two tool classes.[6] In this sense, the concept of "pieces related to truncated pieces" is supported by the attribute data available.

ENDNOTES

1. This studied sample excludes one single truncated piece from the 1973 *sondage* for which attribute data were not recorded.
2. Chi-squared=9.90, df=1, P=0.002.
3. For Area 3:Archaeological Level 1, F=10.98, df=1 and 21, P[1-tailed]=0.003. For Area 3:Méroc, F=4.74, df=1 and 21, P[1-tailed]=0.041. For Area 1:Méroc, F=10.34, df=1 and 23, P[1-tailed]=0.004. For Area 2:Méroc, F=0.34, df=1 and 81, P[1-tailed]=0.56.
4. The values of D^2 were calculated using the BMDP3D program (Sookne and Forsythe 1988) run on an IBM 3081 KX computer at the Tulane Computing Services. Clusters were defined using the WPGM linkage method (Sokol and Sneath 1963: 309–310.)
5. The Euclidean distances were calculated using the BMDP2M program (Engelman 1988) run on an IBM 3081 KX computer at the Tulane Computing Services. Clusters were defined using the WPGM linkage method of Sokol and Sneath (1963: 309–310).
6. Interclass variation in the nature of the blank was investigated by a series of Chi-squared and Fisher's Exact tests. The only difference significant at the 0.05 level is in Area 1:Méroc, where pieces lightly retouched across an extremity are made less often on blades than are truncated pieces (Fisher's Exact Test, P=0.031). A series of t tests on blank dimensions of complete, single tools reflects this difference in terms of the width of the blank; pieces retouched across an extremity are significantly wider than truncated pieces in the Area 1:Méroc sample (t=3.44, df=22, P[1-tailed]=0.003).

Table 8-7.--Distributions of extent of truncating retouch and other attribute sets of pieces with partial and/or irregular truncated ends.

	Area 3: A.L.1		Area 3: Méroc	Area 2: Méroc		Area 1: Méroc
	n	%	n	n	%	n
Extent of Truncating Retouch (TP1)						
Partial	21	(100.00)	16	39	(100.00)	9
Complete	0	0	1	0	0	0
TOTAL	21	(100.00)	17	39	(100.00)	9
Dir. of Truncating Retouch (TP2)						
Obverse	20	(95.24)	13	31	(79.49)	7
Inverse	1	(4.76)	3	7	(17.95)	2
Obverse/Inverse	0	0	1	1	(2.56)	0
TOTAL	21	(100.00)	17	39	(100.00)	9
Tool Disposition (TP10)						
Single	21	(100.00)	16	33	(84.62)	9
Double	0	0	0	6	(15.38)	0
Combination	0	0	1	0	0	0
TOTAL	21	(100.00)	17	39	(100.00)	9
Nature of Blank (TP11)						
Blade	9	(42.86)	8	14	(38.89)	6
Flake	12	(57.14)	8	21	(58.33)	3
Chunk	0	0	0	1	(2.78)	0
TOTAL (singles)	21	(100.00)	16	36	(100.00)	9
including n with cortex (TP12)	4	(19.05)	1	5	(13.89)	0
including n with marginal retouch (TP17)	0	0	1	6	(18.18)	0

Table 8-8.--Distributions of length of blank and other attribute sets of complete, single pieces with partial and/or irregular truncated ends. Sample values shown are mean ($\bar{X}$) and standard deviation (s).

	Area 3: A.L.1	Area 3: Méroc	Area 2: Méroc	Area 1: Méroc
N (complete singles)	2*	13	26	4
Blank Length (TP14) in mm				
$\bar{X}$	37.50	39.08	34.62	29.25
s	3.54	11.40	10.51	2.50
Blank Width (TP15) in mm				
$\bar{X}$	27.00	23.15	22.92	21.75
s	5.66	5.91	7.73	10.97
Blank Thickness (TP16) in mm				
$\bar{X}$	10.00	9.15	9.31	7.25
s	5.66	4.51	3.60	4.11

NOTE: * The sample here includes pieces from the 1980 excavations only. Blank dimensions were not recorded for pieces excavated in previous years.

Table 8-9.--Relationships among blank length, blank width, and blank thickness of complete, single pieces with partial and/or irregular truncated ends. The lower half-matrix tabulates correlation coefficients (r); the upper half-matrix tabulates probability values (P). The first listing for each group of three is for Area 3:Méroc, N = 13. The second listing is for Area 2:Méroc, N = 26. The third listing is for Area 1:Méroc, N = 4.

	Blank Length	Blank Width	Blank Thickness
Blank Length		.10>P>.05 >.10 >.10	.05>P>.02 .10>P>.05 >.10
Blank Width	.504 .278 .429		.01>P>.001 <.001 >.10
Blank Thickness	.616 .337 .575	.728 .644 .822	

Table 8-10.--Distributions of extent of "truncating" retouch and other attribute sets of pieces lightly retouched across an extremity.

	Area 3: A.L.1	Area 3: Méroc	Area 2: Méroc	Area 1: Méroc
	n	n	n	n
Extent of Truncating Retouch (TP1)				
Partial	4	1	3	3
Complete	6	4	12	5
TOTAL	10	5	15	8
Dir. of Truncating Retouch (TP2)				
Obverse	9	5	14	6
Inverse	1	0	1	2
Obverse/Inverse	0	0	0	0
TOTAL	10	5	15	8
Tool Disposition (TP10)				
Single	8	5	15	8
Double	2	0	0	0
Combination	0	0	0	0
TOTAL	10	5	15	8
Nature of Blank (TP11)				
Blade	1	0	4	2
Flake	8	5	11	6
Chunk	0	0	0	0
TOTAL (singles)	9	5	15	8
including n with cortex (TP12)	5	2	4	3
including n with marginal retouch (TP17)	0	1	0	0

Table 8-11.--Distributions of length of blank and other attribute sets of complete, single pieces lightly retouched across an extremity. Sample values shown are mean ($\bar{x}$) and standard deviation (s).

	Area 3: A.L.1	Area 3: Méroc	Area 2: Méroc	Area 1: Méroc
N (complete singles)	3*	4	14	6
Blank Length (TP14) in mm				
$\bar{x}$	30.33	36.50	33.29	34.00
s	10.21	11.73	9.67	8.72
Blank Width (TP15) in mm				
$\bar{x}$	20.00	30.50	22.86	29.33
s	3.61	3.00	7.84	7.06
Blank Thickness (TP16) in mm				
$\bar{x}$	7.67	10.50	8.57	9.33
s	1.53	2.89	4.15	3.56

NOTE: * The sample here includes pieces from the 1980 excavations only. Blank dimensions were not recorded for pieces excavated in previous years.

Table 8-12.--Relationships among blank length, blank width, and blank thickness of complete, single pieces with partial and/or irregular truncated ends. The lower half-matrix tabulates correlation coefficients (r); the upper half-matrix tabulates probability values (P). The first listing for each group of four is for Area 3:Archaeological Level 1, N = 3. The second listing is for Area 3:Méroc, N = 4. The third listing is for Area 2:Méroc, N = 14. The fourth listing is for Area 1:Méroc, N = 6.

	Blank Length	Blank Width	Blank Thickness
Blank Length		.10>P>.05 >.10 >.10 >.10	>.10 >.10 <.001 >.10
Blank Width	.991 .540 .247 -.318		>.10 >.10 >.10 >.10
Blank Thickness	.331 .876 .843 .180	.454 .115 .220 -.061	

CHAPTER 9
MARGINALLY RETOUCHED PIECES

INTRODUCTION

Like the truncated pieces discussed in Chapter 8, marginally retouched pieces comprise a formal tool class that is usually defined in strictly morphological terms with no attempt to suggest functional implications. For example, the typological lexicon of de Sonneville-Bordes and Perrot (1956b: 550) defines marginally retouched pieces as blades or flakes with a continuous line of retouch on one margin (their Type 65) or both margins (their Type 66), so long as that retouch is neither so abrupt as to qualify as backing nor so heavily scaled as to qualify as Aurignacian retouch (in the study of the samples from Les Tambourets, two flakes with Aurignacian retouch from the Méroc collection are included with other marginally retouched pieces). In practice, fragmentary blanks that bear marginal retouch on some or all of the remaining portions of the margins are considered to be marginally retouched pieces. To the extent that other tool classes (for example, burins, end-scrapers, etc.) in a given assemblage frequently bear marginal retouch, this practice distorts the true tool inventory by counting as separate tools the snapped-off anterior end of an end-scraper (for example) and the marginally retouched posterior fragment of the same object. Only complete recovery followed by successful refitting could avoid this bias. There are, on the other hand, complete blanks bearing marginal retouch but no other modifying retouch or spall removals that would define some other tool class (Figures 9-1, #322, #3972, #2698, #3658, #6214, and 9-2, #2156). Any attempt to understand the function of marginally retouched pieces within a given assemblage begins by giving special scrutiny to such complete pieces.

The attribute analysis of marginally retouched pieces from Les Tambourets is based on a sample of excavated pieces from Area 3:Archaeological Level 1[1] and three samples collected by Méroc in Areas 3, 2, and 1. The attribute system used for the analysis is defined in Appendix B.

I. ANALYSIS OF THE ATTRIBUTES OF MARGINALLY RETROUCHED PIECES

The majority of marginally retouched pieces in all units except for Area 3:Méroc are fragmentary (Table 9-1); fragmentary proximal portions (see Figure 9-2, #3957) are more frequent than distal portions (see Figure 9-2, #1743) in all units. The marginal retouch type represented is modally fine (see Figure 9-1, #322, #1717, #2698, #3658, and #6214), followed by heavy (see Figure 9-2, #2156) or scaled (see Figure 9-2, #1587). Aurignacian retouch is virtually absent. On half or more of the pieces in each unit, the retouch is complete along one margin or, very infrequently, two margins. For unilaterally retouched pieces, frequencies of left- and right-margin retouch vary greatly among the four units studied. Detailed data on the location by zone of marginal retouch, cross-tabulated with retouch type, is shown in Table 9-2. A series of Chi-squared tests was employed to investigate possible differential localization of different marginal retouch types. In order to deal with small sample sizes, the retouch types were grouped first as fine vs. all others and then, for a second series of tests, as high-angle other retouch (heavy + Aurignacian + stepped) vs. low-angle other retouch (scaled). The results of the testing were entirely negative—there are no significant associations of any retouch type with distal, medial, or proximal thirds or with left or right margins.

The use of blade blanks (see Figures 9-1, #322, #1717, #3972, #2698, #3658, and 9-2, #1587), infrequently cortical, usually predominates. Flake blanks (see Figures 9-1, #6214, and 9-2, #2156), present in all units, are in a slight majority in Area 2:Méroc (see Table 9-1). Sample values for the dimensions of the blanks are shown in Table 9-3. Blank width and thickness are significantly correlated in most units (Table 9-4). Variation in the morphology of the distal termination (where present) is shown in Table 9-1. The majority of terminations are neither steep nor pointed; beyond this general characteristic, there is much variation among the four samples, but intersample differences are not significant at the 0.05 level. The attribute sets of marginally retouched pieces that concern flint variety and other non-class-specific variation are discussed elsewhere in this report.

Several kinds of attribute combinations were investigated in order to determine whether at Les Tambourets there is any difference between marginally retouched blades and marginally retouched flakes that might suggest functional differentiation. A series of Chi-squared and Fisher's Exact tests produced results that provide almost no support for such an idea. The localization of marginal retouch (by zone, by third, or by side) does not differ significantly between blades and flakes in any of the four units, nor does the distribution of marginal retouch type. Tests limited to those pieces on which the distal termination is preserved show that in Area 1:Méroc flakes have a significantly higher frequency of steep terminations (for example, see Figure 9-1, #6214) than do blades,[2] but there are no other significant differences. The conclusion to be drawn is that whereas some marginally retouched pieces at Les Tambourets are made on blades and some are made on flakes, there is no warrant for recognizing more than a single tool class.

Examination of the patterning of retouch and macroscopically visible utilization damage on a subsample of marginally retouched pieces from Area 3:Archaeological Level 1 suggests that many representatives of this tool class functioned as knives. The subsample examined includes six complete pieces (four blades, two flakes) and seven fragmentary pieces (all blades) on which the distal termination is preserved. (The Méroc samples were excluded because of the problems of interpreting as "utilization" edge damage to pieces recovered from an active plough zone.) In this small sample, the marginal retouch is located almost exclusively on one margin; on the two bilaterally retouched pieces, the retouch on the "second" margin is very partial, being limited to one zone immediately adjacent to an extremity. The unretouched margin, directly opposite that affected by retouch, almost always (11 of 13 cases)

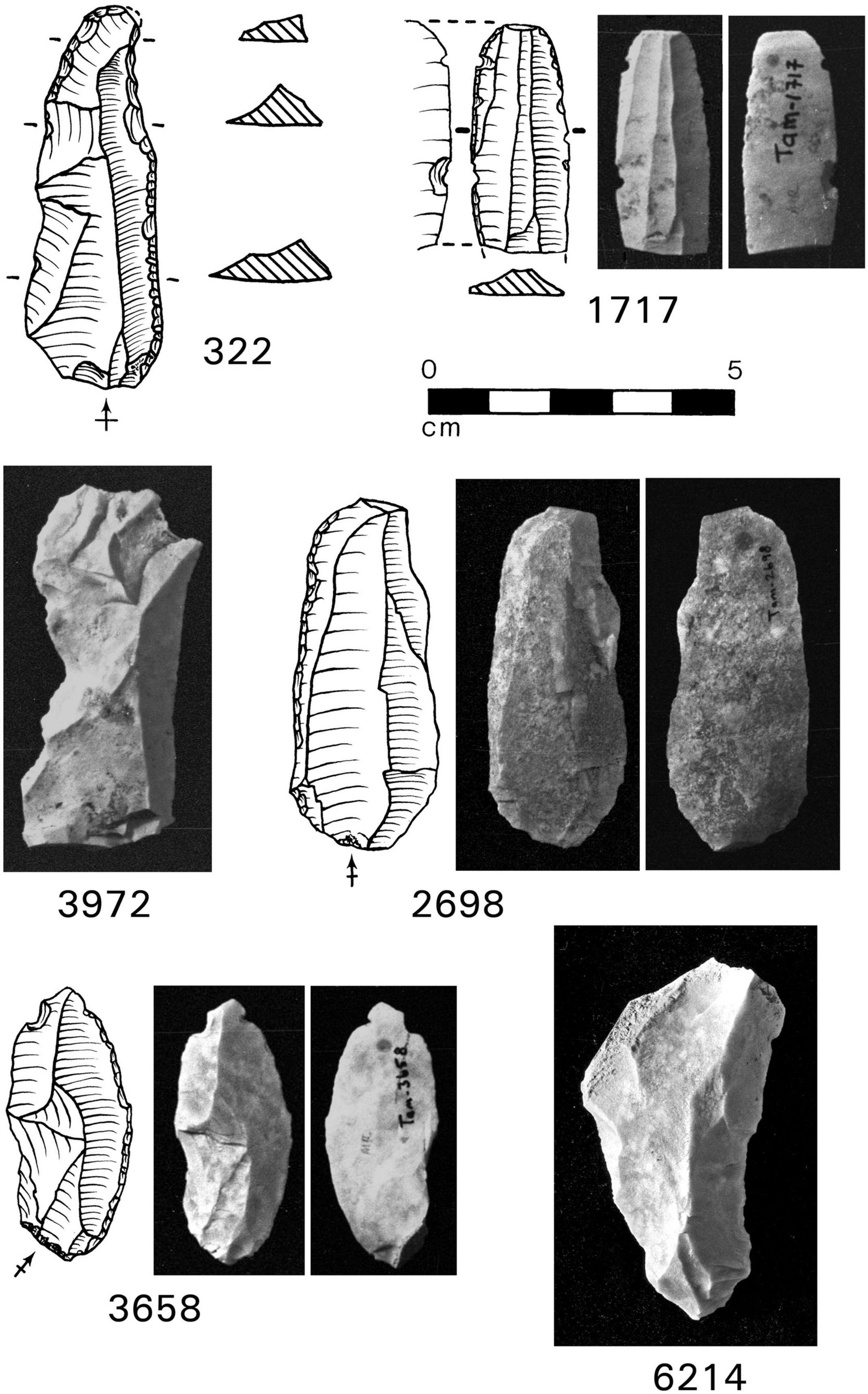

Figure 9-1. Marginally retouched pieces from Archaeological Level 1 in Area 3 at Les Tambourets.

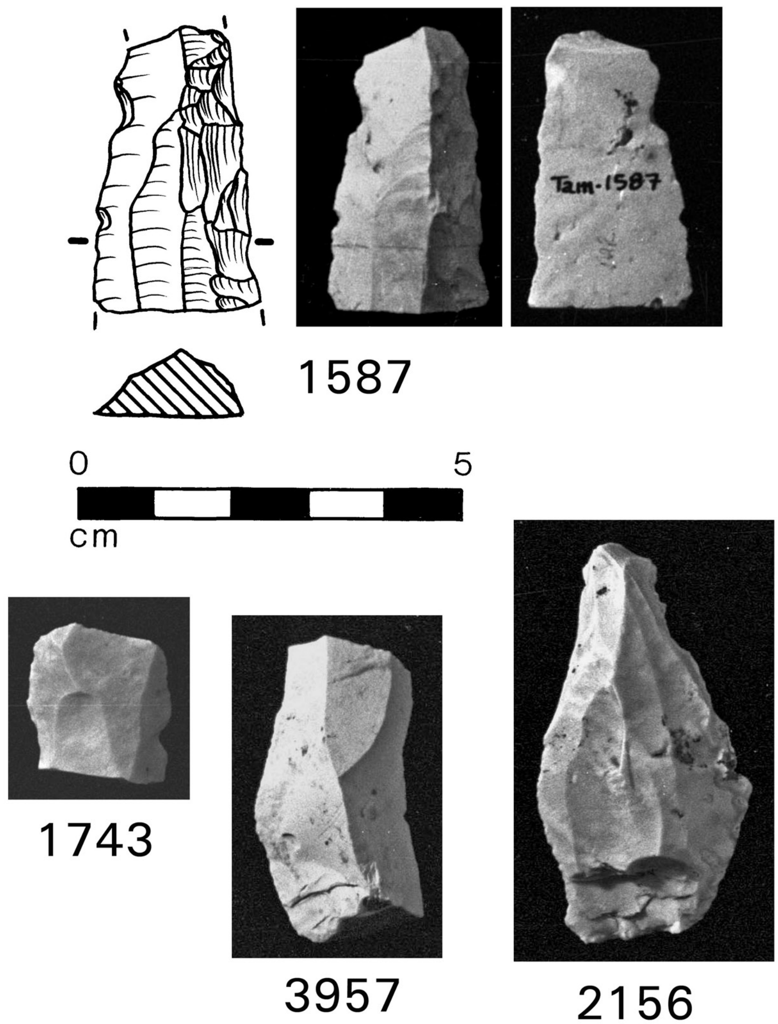

Figure 9-2. Marginally retouched pieces from Archaeological Level 1 in Area 3 at Les Tambourets.

shows macroscopic signs of utilization damage. On all 13 examples, the marginal retouch present is fine retouch; it has the effect of blunting one margin without seriously diminishing the original width of the blank. Under these circumstances, the marginally retouched blades and flakes in Area 3:Archaeological Level 1 are most plausibly seen as functionally similar to backed knives, but in this case the blunting retouch of the noncutting edge does not sufficiently narrow the piece to be called backing. Although patterns of utilization damage were not determined for the Méroc surface-collected pieces, the overwhelming predominance of unilateral retouch and of fine and heavy retouch types suggest that many of these marginally retouched pieces too probably functioned as (not quite backed) knives.

II. RELATIONSHIPS AMONG SAMPLES OF MARGINALLY RETOUCHED PIECES

Only the dimensions of the blank of complete marginally retouched pieces can be used in the determination of the Mahalanobis generalized distance between sample pairs (Table 9-5). The resultant clustering (Figure 9-3) shows that, on the basis of blank dimensions, the excavated sample from Area 3:Archaeological Level 1 is very significantly different from the three surface-collected samples, which are all quite similar.[3] Euclidean distances between sample pairs (Table 9-6) were determined on the basis of variation in seven attribute sets—the percentages in each sample of distal portions (MR1), scaled marginal retouch (MR2), complete retouch (MR4), retouch of the right margin (MR5), blade blanks (MR6), nonsteep distal terminations (MR12), and the mean value of blank width (MR10). The cluster analysis resulting from this more broadly based measure (Figure 9-4) indicates that whereas no two samples are very similar, the most divergent is that from Area 1:Méroc.[4]

ENDNOTES

1. What later was established as the attribute system of marginally retouched pieces was not applied to the very small sample (n=9) recovered from Archaeological Level 1 during the 1973 *sondage*. Attribute determinations were easily reconstructed for the one complete tool that was drawn at the time, but the other eight marginally retouched pieces (six blades and two flakes, all fragmentary) are excluded from the studied series.
2. Fisher's Exact Test, P=0.027.
3. The values of D^2 were calculated using the BMDP3D program (Sookne and Forsythe 1988) run on an IBM 3081 KX computer at the Tulane

Table 9-1.--Distributions of portion and other attribute sets of marginally retouched pieces.

	Area 3: A.L.1		Area 3: Méroc		Area 2: Méroc		Area 1: Méroc	
	n	%	n	%	n	%	n	%
Portion (MR1)								
Complete	7	(20.59)	19	(52.78)	19	27.14	9	(18.37)
Distal Portion	7	(20.59)	2	(5.56)	14	20.00	10	(20.41)
Segment	8	(23.53)	7	(19.44)	9	12.86	9	(18.37)
Proximal Portion	12	(35.29)	8	(22.22)	28	40.00	21	(42.86)
TOTAL	34	(100.00)	36	(100.00)	70	100.00	49	(100.01)
Marginal Retouch Type (MR2)								
Fine	25	(73.53)	29	(80.56)	34	48.57	33	(67.35)
Heavy	4	(11.76)	4	(11.11)	15	21.43	3	(6.12)
Aurignacian	0	0	1	(2.78)	1	1.43	0	0
Scaled	3	(8.82)	1	(2.78)	11	15.71	7	(14.29)
Stepped	2	(5.88)	0	0	6	8.57	3	(6.12)
Mixed	0	0	1	(2.78)	3	4.29	3	(6.12)
TOTAL	34	(99.99)	36	(100.01)	70	100.00	49	(100.00)
of which, n = inverse (MR3)	3*	(8.82)	6**	(16.67)	11Φ	15.71	4ΦΦ	(8.16)
Marginal Retouch Extent (MR4)								
Complete	18	(52.94)	21	(58.33)	37	52.86	34	(69.39)
Partial	16	(47.06)	15	(41.67)	33	47.14	15	(30.61)
TOTAL	34	(100.00)	36	(100.00)	70	100.00	49	(100.00)
Lateral Location of Marginal Retouch (MR5)								
Left margin only	6	(17.65)	17	(47.22)	33	47.14	28	(57.14)
Right margin only	25	(73.53)	15	(41.67)	30	42.86	16	(32.65)
Both margins	3	(8.82)	4	(11.11)	7	10.00	5	(10.20)
TOTAL	34	(100.00)	36	(100.00)	70	100.00	49	(99.99)

Computing Services. Clusters were defined using the WPGM linkage method (Sokol and Sneath 1963: 309–310.)

4. The Euclidean distances were calculated using the BMDP2M program (Engelman 1988) run on an IBM 3081 KX computer at the Tulane Computing Services. Clusters were defined using the WPGM linkage method of Sokol and Sneath (1963: 309–310).

(Table 9-1--continued)

		Area 3: A.L.1		Area 3: Méroc		Area 2: Méroc		Area 1: Méroc	
		n	%	n	%	n	%	n	%
Nature of Blank (MR6)									
Blade		25	(73.53)	21	(58.33)	33	47.14	36	(73.47)
Flake		9	(26.47)	15	(41.67)	37	52.86	13	(26.53)
Chunk		0	0	0	0	0	0	0	0
TOTAL		34	(100.00)	36	(100.00)	70	100.00	49	(100.00)
of which, n = cortical (MR7)		2	(5.88)	4	(11.11)	10	14.29	5	(10.20)
Morphology of Distal Termination (MR12)									
(Pointed; Steep)	02	0		0		0	0	0	
(Pointed; Not Steep)	05	0		4		0	0	0	
	06	2		5		3	(9.09)	2	
	07	1		0		2	(6.06)	0	
	08	0		0		1	(3.03)	0	
(Not Pointed; Steep)	10	1		1		6	(18.18)	3	
	11	3		2		8	(24.24)	4	
	12	1		1		1	(3.03)	1	
(Not Pointed; Not Steep)	15	3		3		8	(24.24)	5	
	16	1		0		1	(3.03)	2	
	17	1		2		3	(9.09)	0	
TOTAL		13		18		33	(99.99)	17	

NOTES:
* 2 fine inverse; 1 scaled inverse
** 5 fine inverse; 1 heavy inverse
Φ 6 fine inverse; 3 heavy inverse; 1 mixed inverse
ΦΦ 3 fine inverse; 1 scaled inverse

Table 9-2.--Cross-tabulation of marginal retouch type (MR2) and marginal retouch zone (MR5) of marginally retouched pieces. N = the total number of occurrences of a given zone available for inspection; n = the total number of occurrences of marginal retouch in that zone.

Area 3:A.L.1

Zone 1: N=20 n=7 F 7	Zone 2: N=20 n=12 F 10 H 1 S 1
Zone 3: N=31 n=3 F 3	Zone 4: N=31 n=22 F 15 H 3 S 3 T 1
Zone 5: N=25 F 1 T 1	Zone 6: N=25 F 14 H 3

Area 3:Méroc

Zone 1: N=22 n=10 F 9 H 1	Zone 2: N=22 n=9 F 7 H 2
Zone 3: N=33 n=16 F 13 H 1 A 1 S 1	Zone 4: N=33 n=14 F 11 H 3
Zone 5: N=30 F 10 H 2 A 1	Zone 6: N=30 F 9 H 2

Area 2:Méroc

Zone 1: N=48 n=20 F 10 H 4 S 4 T 2	Zone 2: N=48 n=18 F 11 H 3 S 3 T 1
Zone 3: N=68 n=36 F 18 H 6 A 1 S 7 T 4	Zone 4: N=68 n=26 F 13 H 6 S 5 T 2
Zone 5: N=55 F 13 H 4 A 1 S 2 T 2	Zone 6: N=55 F 12 H 3 S 4 T 2

Area 1:Méroc

Zone 1: N=26 n=16 F 13 S 2 T 1	Zone 2: N=26 n=11 F 9 S 2
Zone 3: N=48 n=28 F 19 H 2 S 4 T 3	Zone 4: N=48 n=19 F 13 H 2 S 3 T 1
Zone 5: N=34 F 6 S 1 T 4	Zone 6: N=34 F 11 S 2

NOTE: F = fine; H = heavy; A = Aurignacian; S = scaled; T = stepped

Table 9-3.--Distributions of blank width and other attribute sets of marginally retouched pieces. Sample values shown are mean ($\bar{X}$) and standard deviation (s).

	Area 3: A.L.1	Area 3: Méroc	Area 2: Méroc	Area 1: Méroc
N (all pieces)	34	36	70	49
Blank Width (MR10) in mm				
$\bar{X}$	20.71	20.08	20.40	19.00
s	5.54	7.18	6.19	5.44
Blank Thickness (MR11) in mm				
$\bar{X}$	6.97	7.44	7.09	6.00
s	2.56	3.78	3.23	1.96
N (complete pieces)	7	19	19	9
Blank Length (MR9) in mm				
$\bar{X}$	53.86	45.58	39.84	38.56
s	9.56	10.73	6.00	10.97
Blank Width (MR10) in mm				
$\bar{X}$	25.43	23.00	24.89	20.11
s	5.38	7.61	5.91	4.78
Blank Thickness (MR11) in mm				
$\bar{X}$	7.71	8.90	8.32	7.11
s	2.75	4.27	3.58	2.42

Table 9-4.--Relationships among blank length, blank width, and blank thickness of complete marginally retouched pieces. The lower half-matrix tabulates correlation coefficients (r); the upper half-matrix tabulates probability values (P). The first listing for each group of four is for Area 3:Archaeological Level 1, N = 7. The second listing is for Area 3:Méroc, N = 19. The third listing is for Area 2:Méroc, N = 19. The fourth listing is for Area 1:Méroc, N = 9.

	Blank Length	Blank Width	Blank Thickness
Blank Length		>.10 .10>P>.05 >.10 >.10	.10>P>.05 <.001 >.10 >.10
Blank Width	.601 .403 .247 -.166		.01>P>.001 .05>P>.02 .02>P>.01 >.10
Blank Thickness	.714 .938 .197 .007	.888 .469 .538 .064	

Table 9-5.--Relationships among four samples of complete marginally retouched pieces, based on variation in three attribute sets (MR9, MR10, MR11). Lower half-matrix contains values of the Mahalanobis generalized distance statistic (D^2). Upper half-matrix contains 2-tailed probability values for the distance measures.

	1	2	3	4
1		<.01	<.01	.10>P>.05
2	6.41		.20>P>.10	>.20
3	4.74	0.79		>.20
4	3.30	0.50	0.74	

Sample 1. Area 3:A.L.1 N = 7
Sample 2. Area 3:Méroc N = 19
Sample 3. Area 2:Méroc N = 19
Sample 4. Area 1:Méroc N = 9

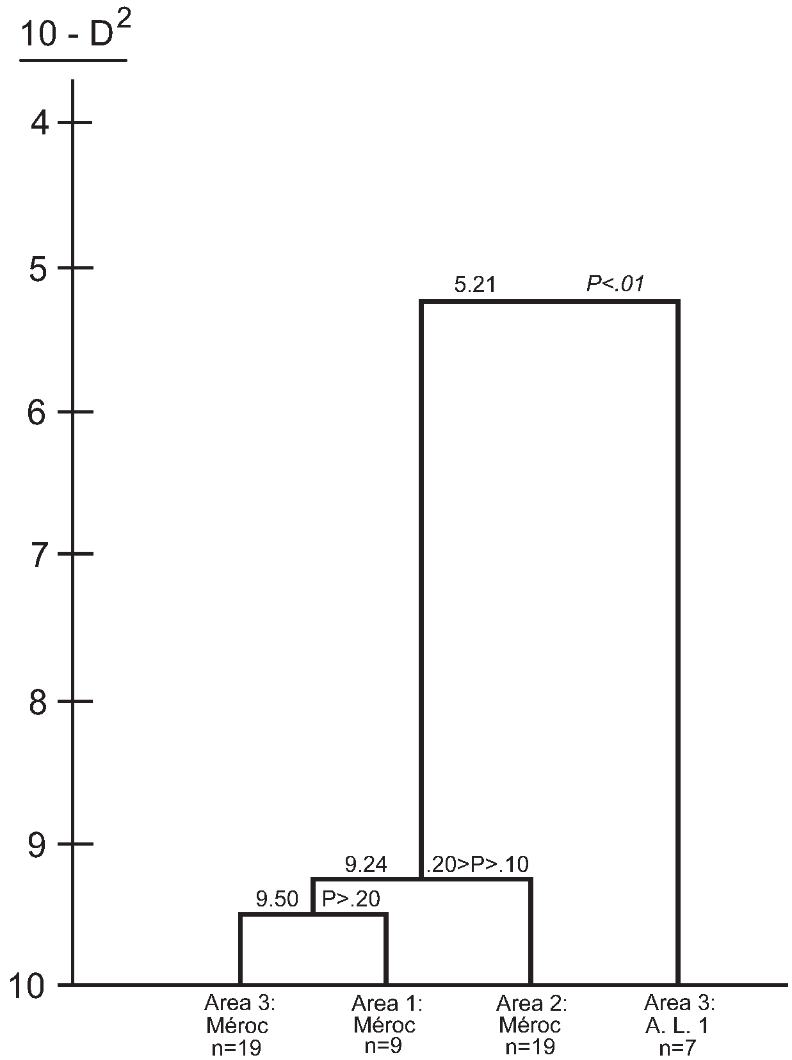

Figure 9-3. Dendrogram showing relationships among samples of marginally retouched pieces at Les Tambourets based on a similarity measure, 10-D2, as discussed in the text.

Table 9-6.--Relationships among four samples of marginally retouched pieces, based on variation in seven attribute sets (MR1, MR2, MR4-MR6, MR10, MR12). The half-matrix contains values of the Euclidean distance.

	1	2	3	4
1				
2	3.55			
3	3.22	3.79		
4	4.15	4.04	3.63	

Sample 1. Area 3:A.L.1
Sample 2. Area 3:Méroc
Sample 3. Area 2:Méroc
Sample 4. Area 1:Méroc

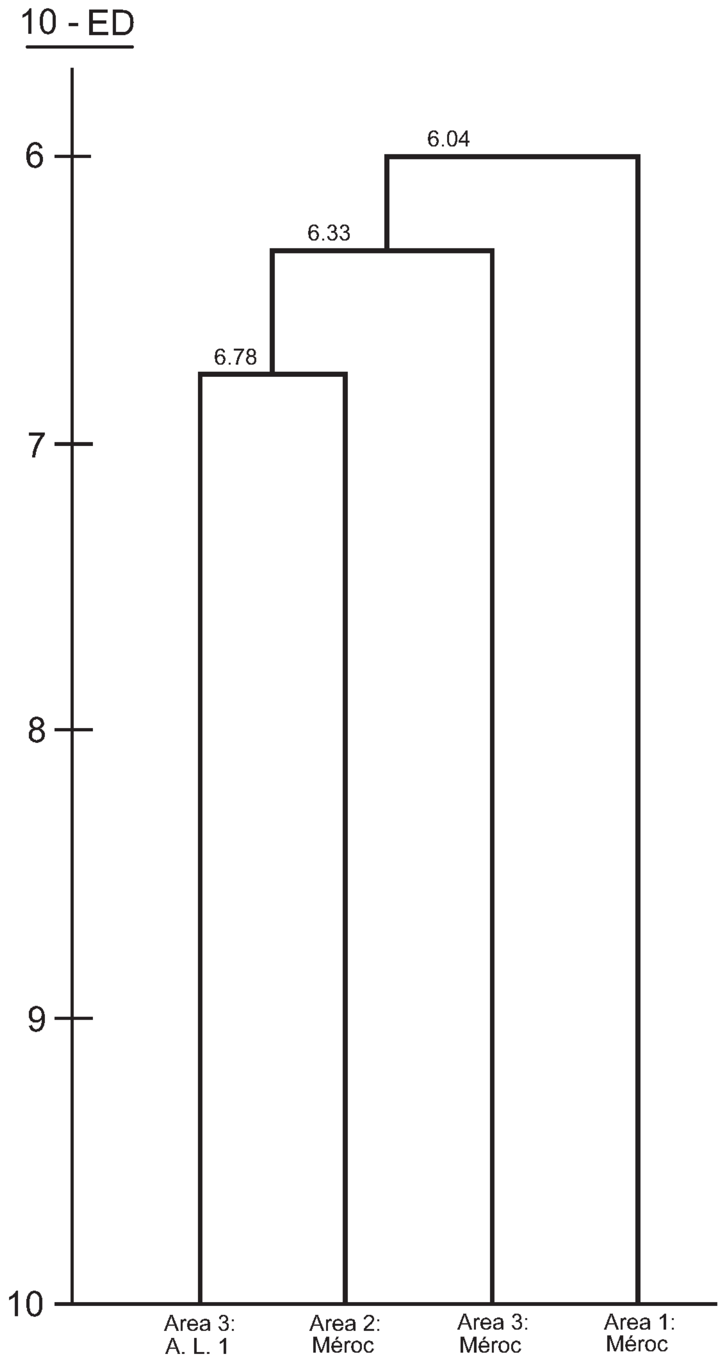

Figure 9-4. Dendrogram showing relationships among samples of marginally retouched pieces at Les Tambourets based on a similarity measure, 10-ED, as discussed in the text.

CHAPTER 10
OTHER CHIPPED LITHIC TOOLS

INTRODUCTION

Several classes of chipped lithic tools that are infrequent at Les Tambourets or very minimally modified were not subjected to formal attribute analysis. These tool classes—perforators, *becs*, splintered pieces, notched pieces, denticulates, inversely chamfered pieces, retouched points, bifaces, and miscellaneously retouched pieces—are described briefly in this chapter.

I. PERFORATORS AND *BECS*

The division here into two classes of tools used for drilling, boring, or piercing follows the distinction made by de Sonneville-Bordes and Perrot (1955: 78) based on the relative length of the piercing point and the degree of disengagement of that point from the edges of the blank on either side of it. A well disengaged point, relatively long for its width, defines a perforator. A not very clearly disengaged, shorter, broader point defines a *bec*.

In the four samples from Les Tambourets reported on here (Table 10-1), only a few of the tools for piercing have points well enough disengaged to be called perforators (Figure 10-1, #3987, #2704, and #1600). *Becs*, while still infrequent, are more numerous than perforators (see Figure 10-1, #16, #1601, #2037, and #3900). The points of most of the perforators and *becs* are formed by the intersection of two lines of obverse retouch. In a few cases, however, both lines of retouch are inverse or one is obverse and one is inverse (see Figure 10-1, #3900). On four of the single *becs* in the Méroc collection, the point is formed by the intersection of very limited retouched concavities amounting to broad retouched notches, one obverse and one inverse. These pieces correspond to the definition of *becs burinants alternes* (Bordes 1961: 37–38). Four of the *becs* are multiple; two separate piercing points occur on the same blank, at opposite ends or opposite corners of the same end. Five of the *becs* occur as combination tools in association with a break burin (Area 3:Archaeological Level 1), a truncation burin (Area 3:Méroc), or an end-scraper (Area 2:Méroc and Area 1:Méroc). Both perforators and *becs* are made predominantly on flake blanks.

The use of a hand-held chipped-stone piercing tool often involves alternating incomplete rotations—about half a turn counterclockwise, half a turn clockwise, half a turn counterclockwise, etc. When a flint tool has been used in this way to pierce a hard material, both sides of the point frequently show a typical pattern of obverse/inverse use damage. Approximately half of the perforators and *becs* from Les Tambourets have such obverse/inverse wear at the point. A smaller number, about one-quarter of the sample, have been so heavily modified that polishing of the point's tip is visible to the naked eye or under low magnification (see Figure 10-1, #2037).

II. SPLINTERED PIECES

Since their first formal definition nearly a century ago (Bardon, J. Bouyssonie, and A. Bouyssonie 1906), splintered pieces have been problematic and controversial components of French Upper Palaeolithic assemblages. Uncertainty about their function in Upper Palaeolithic France—bipolar nuclei, tools shaped by splintering *for* some use, or worked-out tools splintered *by* use—has spurred an active literature, usefully reviewed by Chauchat et al. (1985) and Le Brun-Ricalens (2006). The splintered pieces of Les

Table 10-1.--Frequency distributions and other characteristics of perforators and becs.

	Area 3: A.L.1	Area 3: Méroc	Area 2: Méroc	Area 1: Méroc
Single perforators	4	0	3	3
Single *becs*	22	6*	11*	8**
Multiple *becs*	2	0	2	0
Becs on combination tools	1	1	2	1
TOTAL	29	7	18	12
On blade blank	4	0	4	3
On flake blank	21	5	8	8
On chunk blank	1	1	2	0
TOTAL (single tools only)	26	6	14	11
of which, n = cortical	8	2	1	3

NOTES: * includes 1 *bec burinant alterne*
** includes 2 *becs burinants alternes*

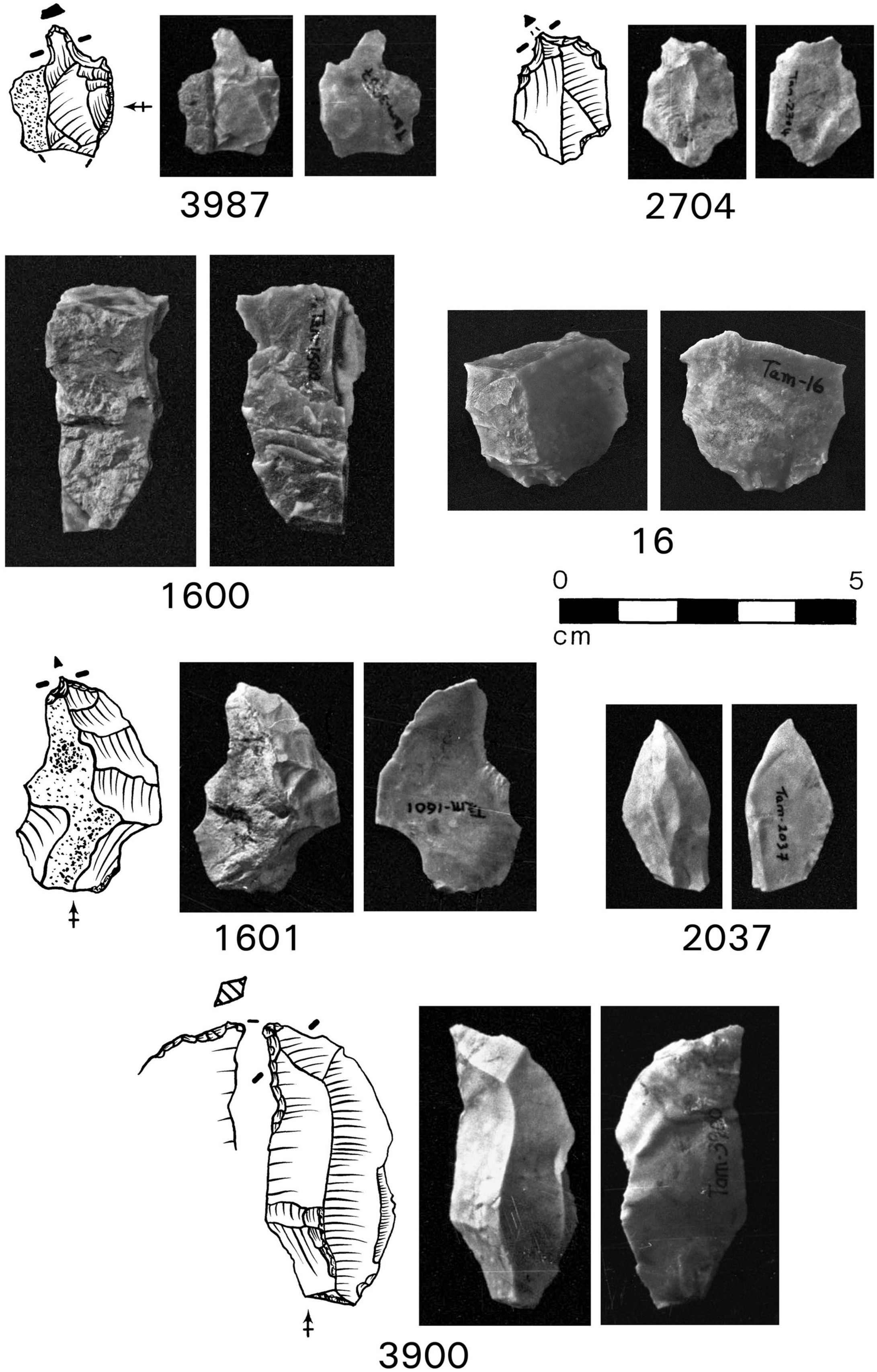

Figure 10-1. Perforators and becs *from Archaeological Level 1 in Area 3 at Les Tambourets. #3987, #2704, #1600: perforators; #16, #1601, #2037, #3900:* becs.

Tambourets (Figures 10-2 and 10-3) are described here as a class of *tools* rather than as bipolar nuclei. The sample of undoubted nuclei from Les Tambourets (see Chapter 11) offers no evidence of the use of bipolar flaking techniques even for quite small nuclei. A very few small bipolar flakes probably detached from splintered pieces (but not able to be refitted to any recovered examples) exist in the series of unmodified *débitage* products from Les Tambourets, but the overwhelming majority of flakes in this size range seem to have been detached from normal cores. The interpretation of the splintered pieces from Les Tambourets as tools rather than bipolar nuclei is completely consistent with the comparative functional research, including experimentation and traceology, of Lucas and Hays (2004) and Le Brun-Ricalens (2006).

Frequencies of splintered pieces in the four principal samples from Les Tambourets are shown in Table 10-2. The objects inventoried as combination tools are scrapers or burins on which the splintering modification does not affect the scraping or burin edge. About three-quarters of the splintered pieces in each sample are flakes (see Figures 10-2, #1985, #LM3, and 10-3, #4832, #343, #5721) or, rarely, blades (see Figure 10-2, #2998 and #2757) on which at least some portion of the ventral surface is clearly visible. Splintered pieces lacking a ventral surface are classified as being on chunk blanks (see Figures 10-2, #6821, and 10-3, #5531, #2923); it is very probable that many of them were originally flakes from which heavy splintering has completely removed the ventral surface and that the tabulated frequencies of chunk blanks are thereby artificially inflated. The splintering modification occurs most frequently on two opposed ends or edges of the blank; it is rarely on more than two ends or edges (see Figures 10-2, #LM3, and 10-3, #5531). In the three surface-collected samples, more than one-quarter of the pieces are splintered on only one end or edge; the frequency is somewhat lower in the excavated sample from Archaeological Level 1 (see Figure 10-2, #2757). Although on most pieces the splintering modification of a given end or edge is bifacial, one-quarter to one-third of the splintered pieces bear unifacial splintering only on one or more of the affected ends or edges. There is no statistically significant association between the number of affected end/edges and the number of affected faces.

During the process of studying the splintered pieces from Les Tambourets, a rough qualitative assessment of the extent of splintering modification was recorded—heavy (for example, Figure 10-2, #1985), medium (for example, Figure 10-3, #5721), or light (for example, Figure 10-2, #2998) splintering. Distributions of these observations are shown in Table 10-2. As noted in the original definition of the tool class, splintered pieces sometimes have pseudo-burin removals on one or more edges parallel to the axis of splintering (Bardon, J. Bouyssonie, and A. Bouyssonie 1906: 172). Such a pseudo-burin removal, which has been designated a "*bâtonnet*" by Tixier (1963, cited by Mazière 1984: 185) and a "*lamelle d'esquille*" by Demars and Laurent (1989: 94), results when the force that caused the splintering has been applied near the margin of the end or edge affected. Detachment of this burin-like spall does not, however, create a true burin edge; rather, the proximal extremity of the spall is a point with no visible platform. Mazière (1984: 185) reports that he has refitted such spalls to splintered pieces from the Châtelperronian levels at Le Loup (Corrèze); although they may be present in the small series of miscellaneous spalls at Les Tambourets, they have not been identified or refitted. Such spalling is, however, common in the Tambourets series (see Figures 10-2, #1985, #LM3, and 10-3, #5531, #2923); approximately 40% of the splintered pieces in each sample have one or more pseudo-burin removals.

Although a full attribute analysis was not employed for splintered pieces, the blank dimensions were recorded for a selected sample—all complete splintered pieces (n=22) in Area 1:Méroc. Blank length was measured in the axis of splintering (or the longer axis if there were two), and width was measured at 90 degrees to length; thickness is the maximum thickness of the blank. Values of the mean and standard deviation for length, width, and thickness are, respectively, 34.05±5.74mm, 26.14±6.39mm, and 11.05±5.08mm. Each dimension is significantly positively correlated with the other two. Several analyses of variance were employed to investigate possible interaction between dimensions of the blank and other characteristics. There are no significant interactions with length or thickness, but pieces splintered at only one end are significantly narrower ($\bar{X}$=21.75mm) than pieces splintered at two opposed ends ($\bar{X}$=29.08mm).[1] This finding almost certainly relates to how splintered pieces were used, but in the absence of confirming data from other samples, it cannot be interpreted with confidence.

According to the comparative study of Chauchat et al. (1985: 36), a French Upper Palaeolithic site may be described as rich in splintered pieces if they comprise about 10% of the tool inventory. Based on their work with various Upper Palaeolithic sites in the Brive Basin (Corrèze), Chauchat et al. suggested a) that certain assemblage samples rich in splintered pieces reflect brief, seasonal occupation of hunting camps rather distant from winter occupation sites, b) that the principal activities at such camps were the acquisition of prey animals and the extraction from the carcasses of meat, bone, and antler for transport to the winter occupation sites, and c) that splintered pieces were expediently produced objects associated with the brief occupation of a hunting camp—objects used perhaps in the manufacture of organic hunting paraphernalia or in the processing of the products of the hunt (1985: 39–40). More recent traceological and experimental studies have confirmed that despite some functional variability, many splintered pieces were indeed used in splitting or otherwise working bone or other hard organic materials (Le Brun-Ricalens 2006: 101; Lucas and Hays 2004: 119). Frequencies of splintered pieces at Les Tambourets vary from one area to another (from a low of 5.63% of all graphed tools in Area 1:Méroc to a high of 10.71% in Area 3:Archaeological Level 1), but the global frequency approaches 10% for the site as a whole. Whatever may be the merit of the overall model constructed by Chauchat et al., Les Tambourets—a site rich in splintered pieces and almost certainly only seasonally occupied—con-

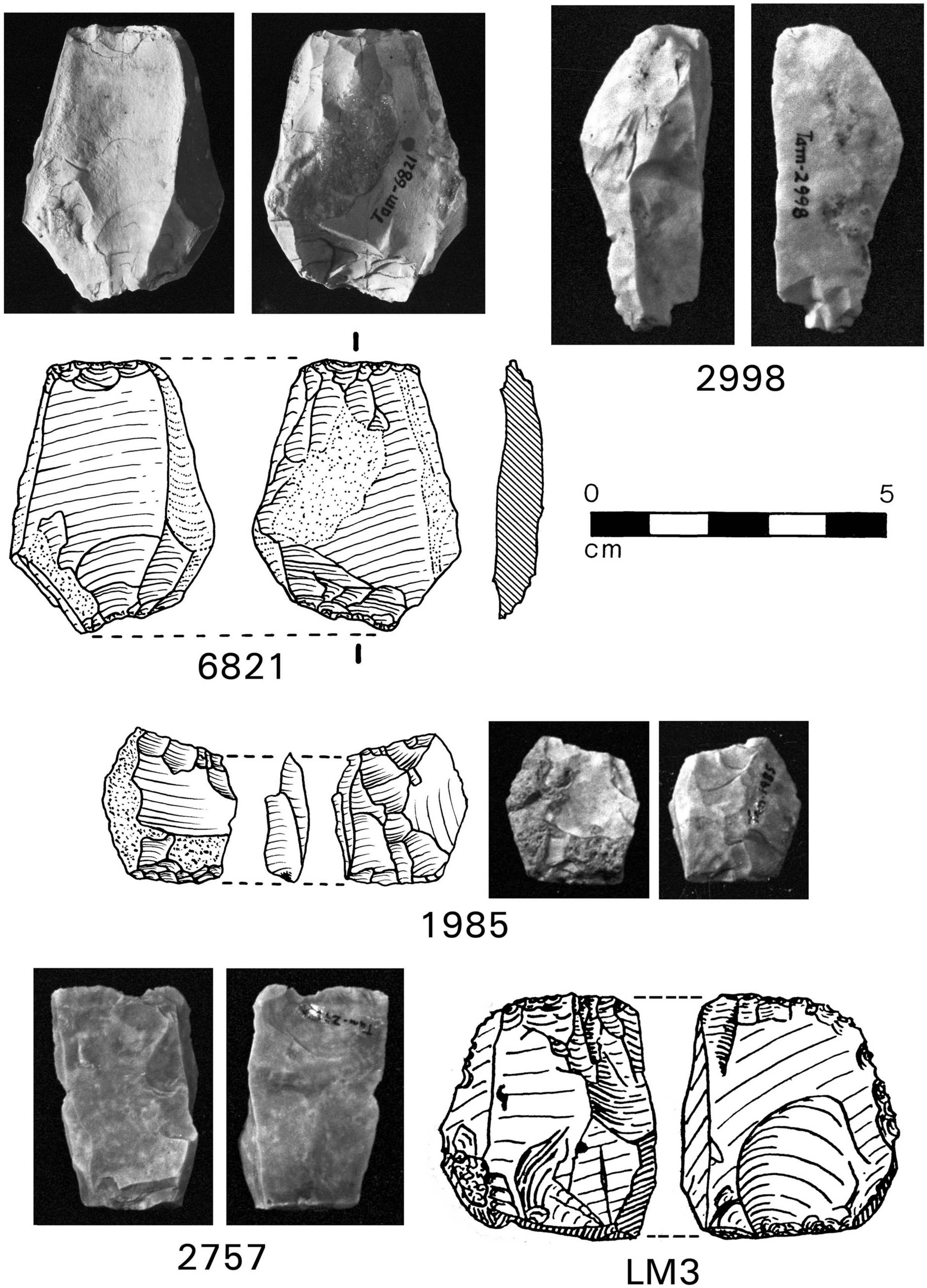

Figure 10-2. Splintered pieces from Area 3 at Les Tambourets. #LM3 is from the Méroc Collection (drawing by L. Méroc); all others are from Archaeological Level 1.

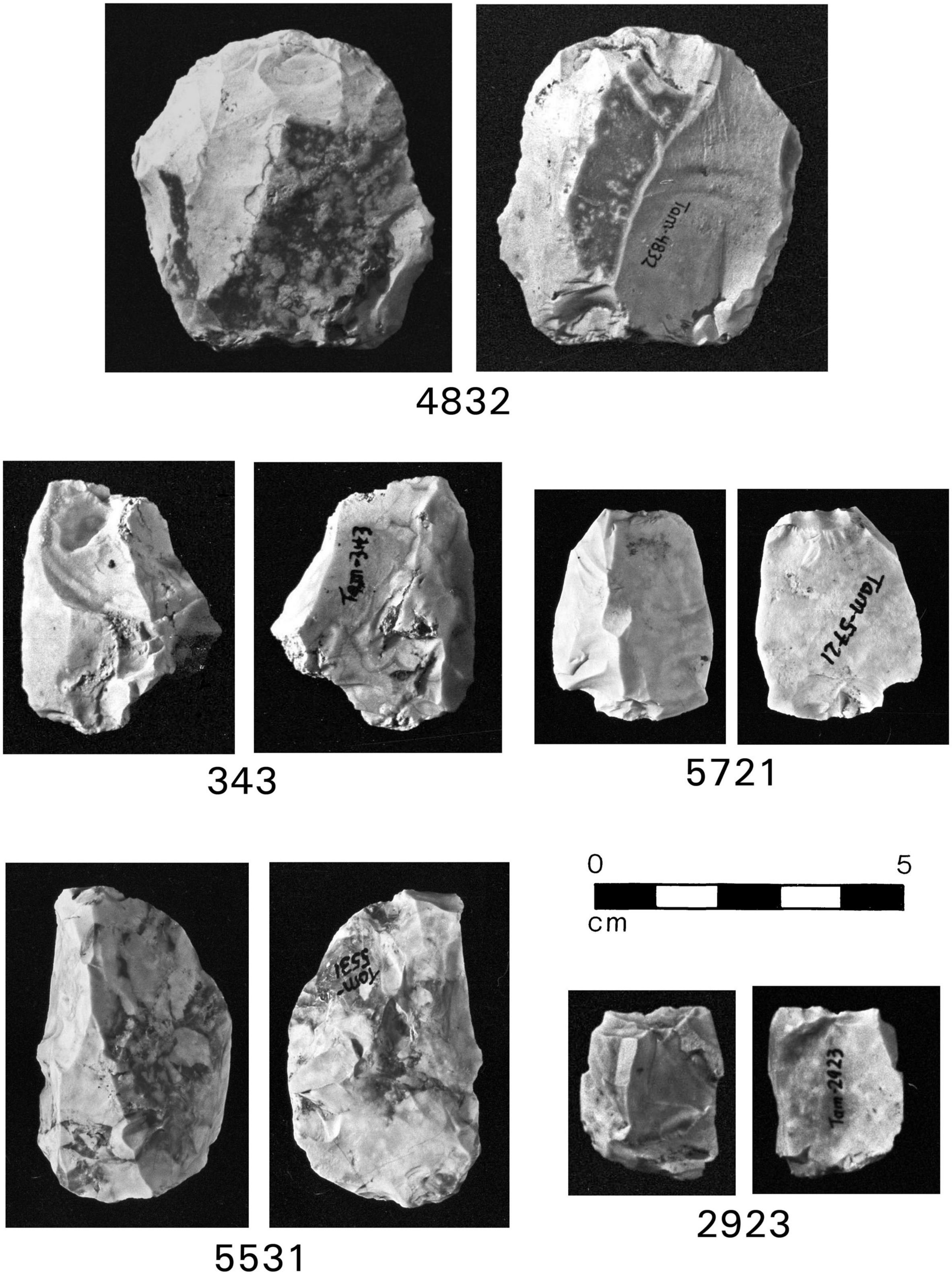

Figure 10-3. Splintered pieces from Archaeological Level 1 in Area 3 at Les Tambourets.

Table 10-2.--Frequency distributions and other characteristics of splintered pieces.

	Area 3: A.L.1		Area 3: Méroc		Area 2: Méroc		Area 1: Méroc
Single splintered pieces	77		55		64		27
Combined with end-scraper	2		0		4		0
Combined with side-scraper	1		0		0		0
Combined with dihedral burin	1		0		2		0
TOTAL	81		55		70		27
	n	%	n	%	n	%	n
On blade blank	8	10.39	3	5.45	2	3.13	0
On flake blank	54	70.13	39	70.91	44	68.75	21
On chunk blank	15	19.48	13	23.64	18	28.13	6
TOTAL (singles)	77	100.00	55	100.00	64	100.01	27
of which, n = cortical	25	32.47	4	7.27	15	23.44	2
Number of ends/edges splintered:							
1 only	9	16.67	15	27.78	16	27.59	8
2 opposed	43	79.63	33	61.11	34	58.62	13
2 adjacent	0	0	1	1.85	1	1.72	0
2 opposed + 1 adjacent	0	0	4	7.41	5	8.62	0
2 opposed + 2 opposed	2	3.70	1	1.85	2	3.45	1
TOTAL (complete singles)	54	100.00	54	100.00	58	100.00	22
Heavy splintering	18	33.33	18	33.33	23	39.66	12
Medium splintering	26	48.15	30	55.56	30	51.72	7
Light splintering	10	18.52	6	11.11	5	8.62	3
TOTAL (complete singles)	54	100.00	54	100.00	58	100.00	22
Pseudo burin removals on one or more ends/edges	23	42.59	21	38.89	23	39.66	9

forms well to the distributional expectations of that model.

III. NOTCHED PIECES

The definition of notched pieces used in the description of the archaeological materials from Les Tambourets is based on the very inclusive one given by de Sonneville-Bordes and Perrot (1956b: 552) for their Type 74: any blade, flake, or chunk bearing one or more noncontiguous retouched notches, obverse or inverse, of any size, located anywhere on the blank. Such a definition results in large samples of notched pieces from sites that were excavated or surface-collected carefully, but it does not necessarily provide clear information about frequencies of intentionally created tools. Some unknown but potentially high proportion of notched pieces may be the products of accidental damage during or after the occupation in question; this possibility is certainly relevant for materials collected from the surface of an active plough zone. In an attempt to recognize this problem while still describing the Tambourets materials in standard terms, all the notched pieces were assigned to one of four different categories, as follows:

Category A: fragments of blades bearing small marginal notches (Figure 10-4, #208). Such pieces are most likely to have been notched unintentionally as a result of use or postdepositional processes. In some assemblages, they may be fragments of end-scrapers or other tools that were marginally notched to facilitate hafting.

Category B: blades or elongated flakes or fragments thereof with a single notch at one extremity, not on a margin (see Figure 10-4, #149). It is again most likely that such notches were created unintentionally.

Category C: flakes or chunks, complete or broken, with one or more notches of small or moderate size located anywhere on the periphery (see Figure 10-4, #370). Notched pieces of this category could be deliberately created tools, but most are probably the result of use wear or postdepositional damage.

Category D: blanks of any kind, complete or broken,

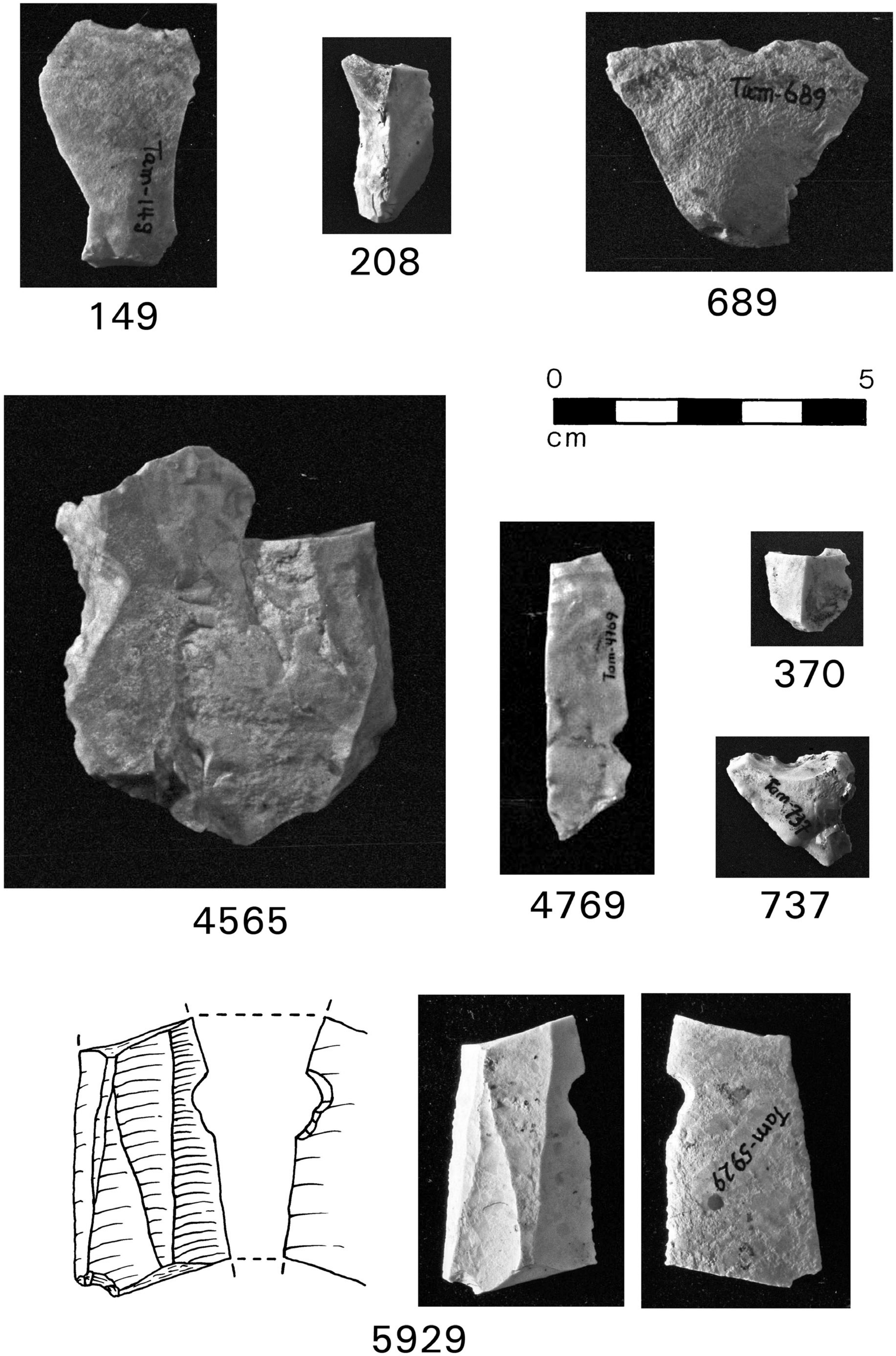

Figure 10-4. Notched pieces from Archaeological Level 1 in Area 3 at Les Tambourets.

Table 10-3.--Frequency distributions and other characteristics of notched pieces.

	Area 3: A.L.1		Area 3: Méroc		Area 2: Méroc		Area 1: Méroc	
	n	%	n	%	n	%	n	%
Category A pieces	29	20.42	11	9.02	23	11.27	27	19.01
Category B pieces	7	4.93	4	3.28	5	2.45	6	4.23
Category C pieces	71	50.00	70	57.38	112	54.90	66	46.48
Category D pieces	35	24.65	37	30.33	64	31.37	43	30.28
TOTAL	142	100.00	122	100.01	204	99.99	142	100.00
N (all graphed tools)	719		654		947		480	
Category D (as % of N)	35	4.87	37	5.66	64	6.76	43	8.96
On blade blank	43	30.28	15	12.30	39	19.12	33	23.24
On flake blank	94	66.20	105	86.07	163	79.90	107	75.35
On chunk blank	5	3.52	2	1.64	2	0.98	2	1.41
TOTAL (all categories)	142	100.00	122	100.01	204	100.00	142	100.00
Category D, on blade	9	(25.71)	3	(8.11)	15	23.44	4	(9.30)
Category D, on flake	22	(62.86)	34	(91.89)	48	75.00	38	(88.37)
Category D, on chunk	4	(11.43)	0	0	1	1.56	1	(2.33)
TOTAL (cat. D only)	35	(100.00)	37	(100.00)	64	100.00	43	(100.00)

bearing a large, well retouched notch (see Figure 10-4, #689, #4565, #4769, #737, and #5929). These pieces may be considered with some confidence to have been created deliberately as notched tools.

Inspection of the typological inventories reported in Chapter 3 shows that notched pieces (Types 74 and 89) are the single most frequent taxon at Les Tambourets, accounting for approximately 20% to 30% of each unit. When, however, only the notched tools of category D are considered, frequencies drop to between about 5% and 9% of all graphed tools (Table 10-3). Despite the expectation that one would find more accidentally notched pieces in the surface-collected samples, frequencies of categories A+B+C vs. category D do not differ significantly among the four units studied.[2]

The great majority of notched pieces occur on flake blanks (see Table 10-3); approximately one-quarter of the blanks are cortical. The notched tools of category D are also made predominantly on flakes.

IV. DENTICULATES

Denticulates are defined by de Sonneville-Bordes and Perrot (1956b: 552) as pieces bearing "a series" of contiguous or almost contiguous small notches. For the study of the material from Les Tambourets, a piece was called a denticulate if it had three or more contiguous notches, creating at least two teeth or salients between notch concavities. Like notched pieces, denticulates (Figures 10-5 and 10-6) occur predominantly on flakes (Table 10-4), of which between 15% and 20% are cortical. Only a few (about 10%) of the denticulates have regularly and extensively denticulated edges such that they can be confidently considered to be intentionally produced denticulate tools (see Figures 10-5, #510, and 10-6, #4551). The great majority of the series is composed of minimally modified pieces that, although conforming to the technical definition, could well be the products of accidental damage (see Figures 10-5, #2733, #3806, #5717, and 10-6, #368, #3891).

V. INVERSELY CHAMFERED PIECES

Several examples of inversely chamfered pieces have been recovered from Les Tambourets. The clearest example is a complete flake (45mm x 3mm2 x 11mm) from Area 3:Archaeological Level 1 (Figure 10-7, #2210); three chamfering removals originating from the left margin of the distal end extend completely across the ventral surface, intersecting the opposite margin. A second, thicker flake (54mm x 34mm x 22mm) from Area 3:Méroc (not illustrated) has four chamfering removals that extend across the entire ventral surface from their origins on the right margin at the distal end. On the other examples, what may be chamfering removals are shorter and fewer in number.

The recognition of chamfered pieces as patterned if infrequent components of French Upper Palaeolithic assemblages stems from the work of Bordes (1970b) with the Upper Périgordian materials from Corbiac (Dordogne). On all the Corbiac examples described or illustrated by Bordes, the chamfering removal or removals appear on the dorsal surface of the blank, whereas at Les Tambourets they appear only on the ventral surface. Despite this

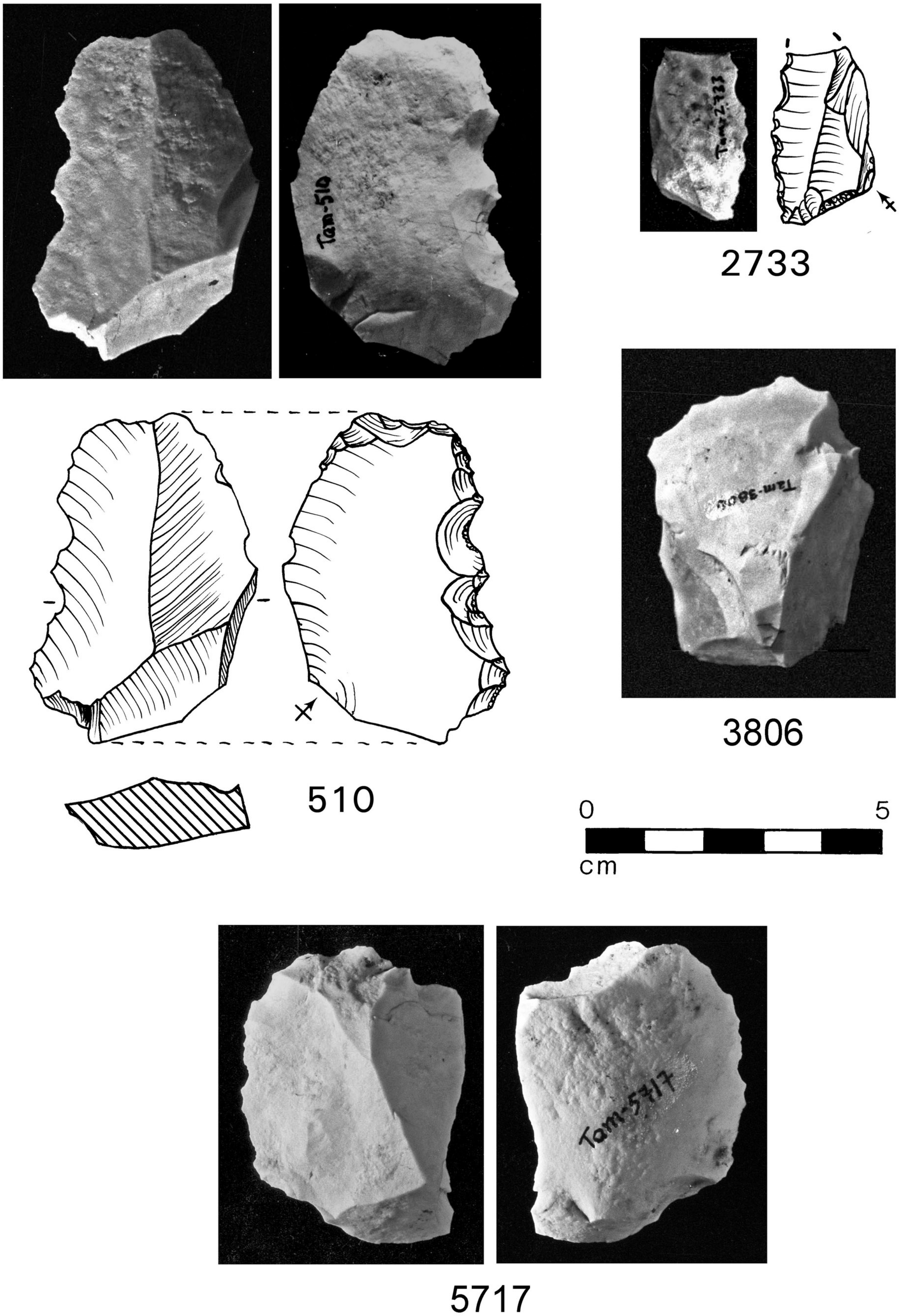

Figure 10-5. Denticulates from Archaeological Level 1 in Area 3 at Les Tambourets.

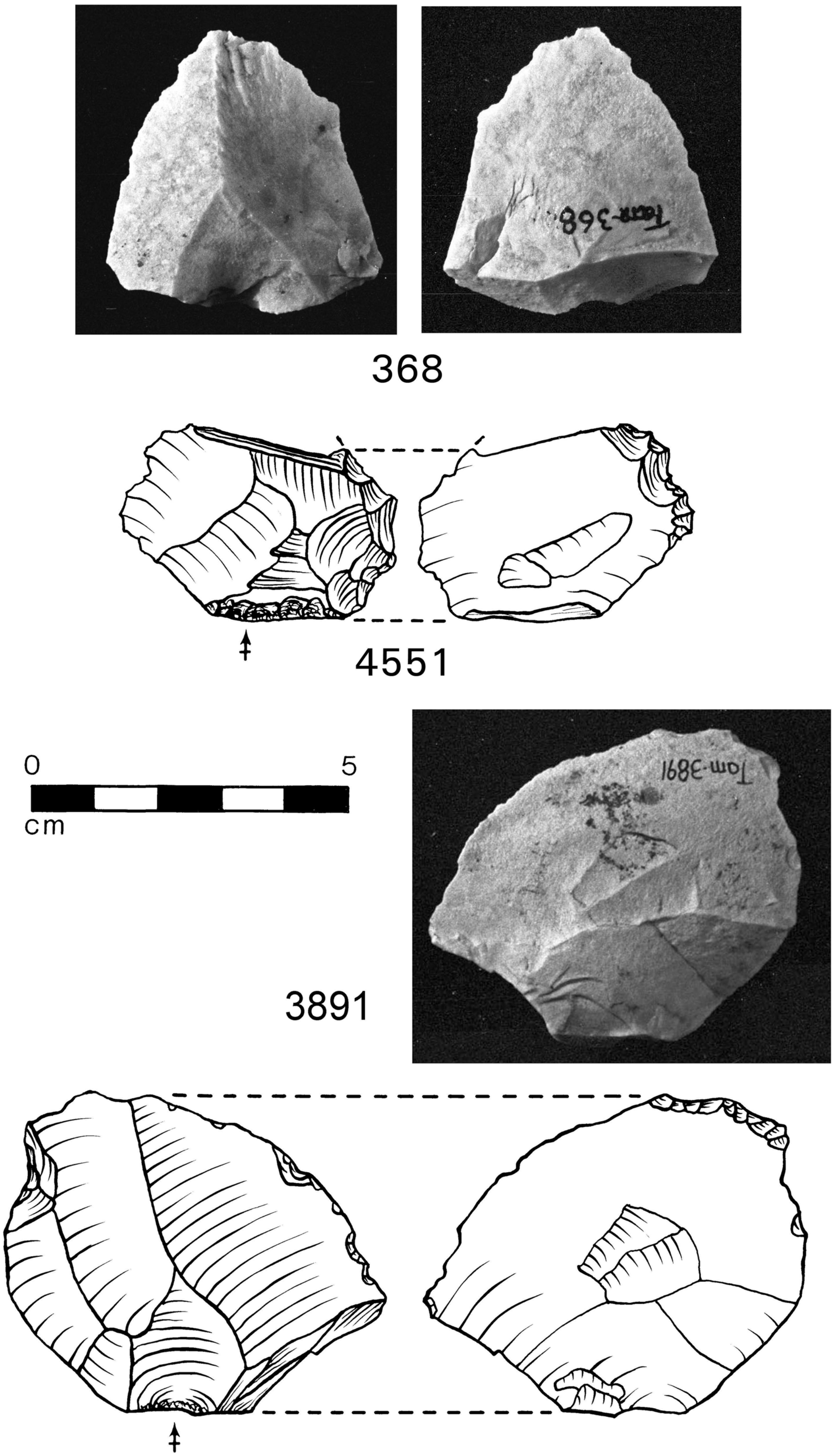

Figure 10-6. Denticulates from Archaeological Level 1 in Area 3 at Les Tambourets.

Table 10-4.--Frequency distributions of denticulates.

	Area 3: A.L.1 n	%	Area 3: Méroc n	%	Area 2: Méroc n	%	Area 1: Méroc n	%
On blade blank	4	(11.11)	5	(13.51)	13	17.57	10	(26.32)
On flake blank	30	(83.33)	29	(78.38)	59	79.73	27	(71.05)
On chunk blank	2	(5.56)	3	(8.11)	2	2.70	1	(2.63)
TOTAL	36	(100.00)	37	(100.00)	74	100.00	38	(100.00)

ventral location, the objects from Les Tambourets are not like the so-called "La Bertonne pieces" of the Early Magdalenian (Demars and Laurent 1989: 88–89; Lenoir 1987), on which the oblique ventral removals continue from one end of an inversely retouched truncation. Bordes (1970b: 108) suggests that the chamfered pieces at Corbiac may be no more than unsuccessful attempts to produce a sharply pointed trihedral tool that has been named the Corbiac burin (1970b: 105, 108, 110). No Corbiac burins have been recognized from Les Tambourets. The inversely chamfered pieces may be intentionally created tools similar to those described by Bordes, or they may be randomly occurring examples of ventral modification with no typological significance. Their rarity suggests the latter but precludes further investigation.

VI. RETROUCHED POINTS

Among the very infrequent tools at Les Tambourets are more than a dozen retouched points, all but one from the Méroc surface collections. They form a very heterogeneous series of tools that are neither backed points, perforators, nor *becs*. With the exception of one blade, the blanks are flakes, often thick and sometimes cortical (see Figure 10-7, #4j1984). On one end (or, in several cases, one edge) a very regular point has been created by intersecting lines of retouch; the retouch is usually steep (heavy or fine), but on several examples it is nonsteep scaled retouch. In about two-thirds of cases, the point is blunt, forming a broad, open angle (see Figure 10-7, #411); in the others, the point is sharp (see Figure 10-7, #4j1984). These retouched points are too thick and heavy to consider them weapon armatures or hafted tools of any kind (the largest example, from Area 2:Méroc, not illustrated, measures 58mm x 33mm x 20mm). Furthermore, although they have a pointed morphology, these tools are not similar in other ways to Aurignacian *grattoirs à museau*.[3]

VII. BIFACES

Two complete bifaces were recovered by Méroc from Les Tambourets. The first (not illustrated), recovered from the surface of Area 2:Méroc, is probably a Mousterian piece. It is a small (68mm x 60mm x 24mm), crudely worked cordiform handaxe, heavily patinated and very heavily rolled. Except for three small damage chips off one corner, there is no post-rolling modification. The second object is a large bifacial foliate from Area 3:Méroc (Figure 10-8, #4f1984). Méroc's marking of this piece indicates that it was not collected from the surface, but rather excavated from the archaeological level where it crops out in the road-cut along the Gensac road at the southern limit of Area 3. The foliate, made of light gray flint patinated to a bluish white, is absolutely fresh and unrolled. In view of its physical condition and its reported *in situ* provenience, this object is probably a legitimate part of the Châtelperronian assemblage rather than an older object. It may be a bifacial side-scraper or an unfinished rough-out of some other tool, or, indeed, exactly what it looks like—a handaxe. Finally, a small broken tip of a third bifacial object is present in the "undifferentiated" surface collection; the shape of the original object cannot be determined.

VIII. MISCELLANEOUS RETROUCHED PIECES

Miscellaneous retouched pieces are blades, flakes, or chunks, often fragmentary, that bear a few apparently intentional retouch removals variously disposed on the circumference of the blank. In no case does the retouch occur in a sufficiently patterned way to permit assignment to a more formal tool class. Frequency distributions of miscellaneous retouched pieces, most of which are flakes, are shown in Table 10-5.

ENDNOTES

1. F=8.70, df=1 and 19, P[1-tailed]=0.008.
2. Chi-squared=2.032, df=3, P=0.57.
3. Thick, massive retouched points are normal though infrequent components of Early Gravettian assemblages (where, however, they are usually made on blades)—for example, at La Gravette, where Lacorre (1960: 263, Pl. LXIII, 281, Pl. LXIX, 285, 289, Pl. LXII) calls them augers (*tarières*), daggers (*poignards*), or hunting-spear points (*épieux*).

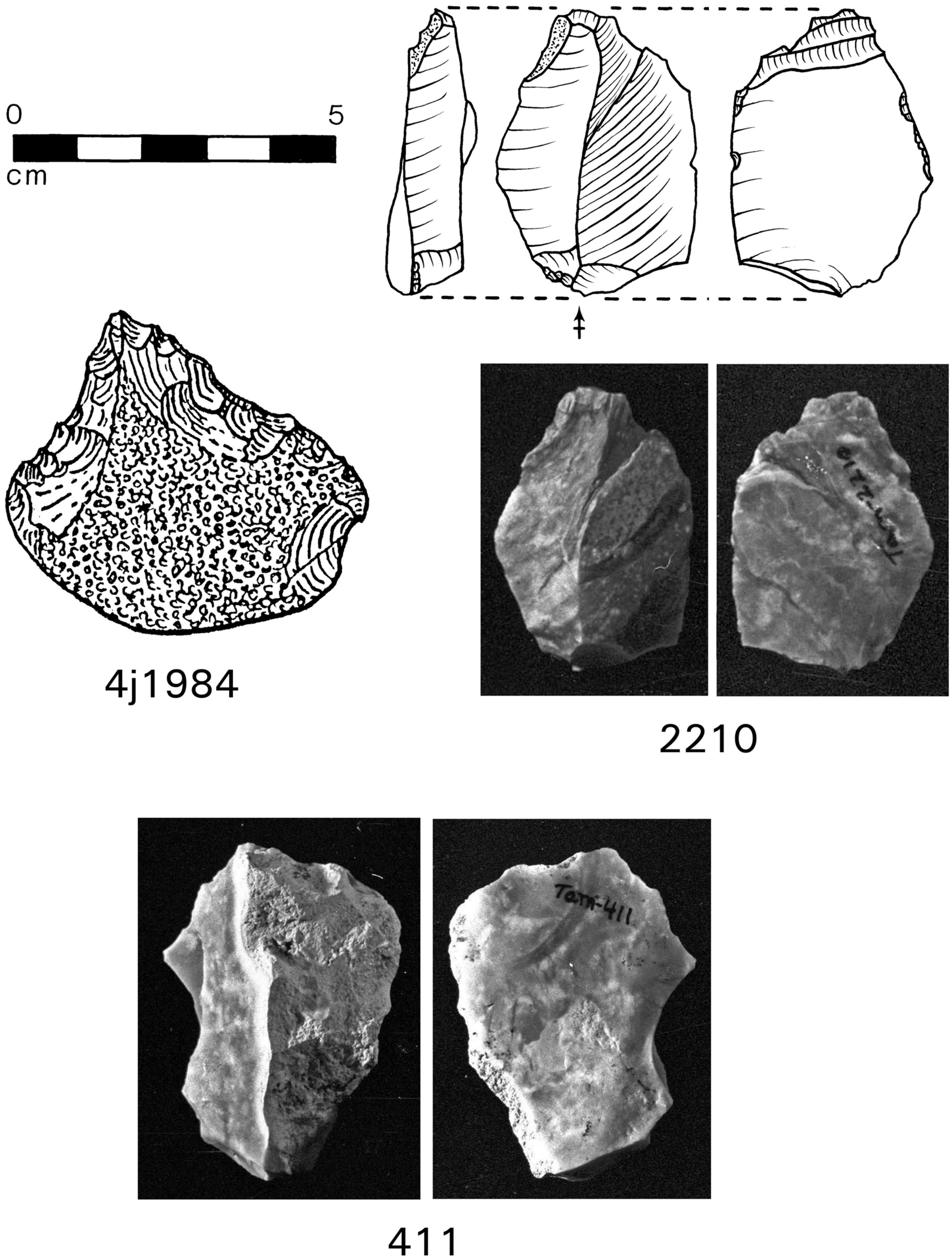

Figure 10-7. Chamfered piece and retouched points from Les Tambourets. #2210: inversely chamfered piece; #4j1984, #411; retouched points. #4j1984 is from the Méroc Collection, area unspecified (drawing by L. Méroc); #2210, #411: Archaeological Level 1 in Area 3.

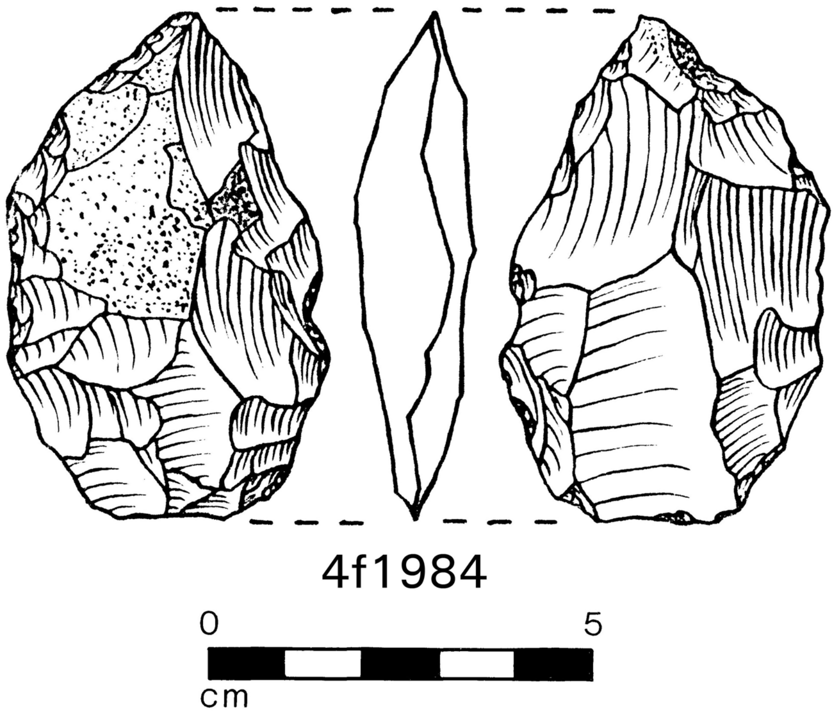

Figure 10-8. Foliate biface in the Méroc Collection, excavated by Méroc from the archaeological level in Area 3 at Les Tambourets.

Table 10-5.--Frequency distributions of miscellaneous retouched pieces.

	Area 3: A.L.1		Area 3: Méroc		Area 2: Méroc		Area 1: Méroc	
	n	%	n	%	n	%	n	%
On blade blank	29	19.73	8	7.34	15	7.77	12	14.63
On flake blank	107	72.79	79	72.48	156	80.83	68	82.93
On chunk blank	11	7.48	22	20.18	22	11.40	2	2.44
TOTAL	147	100.00	109	100.00	193	100.00	82	100.00

CHAPTER 11
NUCLEI

INTRODUCTION

The contents of the artifact assemblage samples excavated or otherwise collected at Les Tambourets make it clear that the manufacture of chipped stone tools was one of the major cultural activities practiced on the site. Among the by-products of the *débitage* process, which comprise the overwhelming majority of artifacts recovered, are over 1,500 nuclei, all but a few of flint available in the local area, from which were produced the blanks for the shaped tools on which the typological analysis is concentrated. Several different approaches have been developed for the description, analysis, and interpretation of nuclei. An emphasis on the "reduction sequence" (*la chaîne opératoire*), including replicative experimentation and, where possible, refitting the tools and blanks to nuclei, produces information that is concerned primarily with the technological processes of stone-working. When the detailed provenience of materials studied in this way is under very tight control, the approach can produce, as well, excellent information about intrasite functional variation (Audouze and Cahen 1984). A more traditional approach to the study of nuclei combines replicative experimentation with a primarily morphological analysis of both the nuclei and the blanks produced from them (without, however, attempting to make the mechanical linkages through refitting). The aims and achievements of such an approach encompass both intrasite processual concerns and the more traditional culture-historical comparisons. Given excellent control of stratigraphy and provenience, this approach also produces data on functional variation within a site, but the data are very generalized. These two major approaches to the study of nuclei are complementary; each provides its own kind of valid and useful information about the materials studied.

The study of nuclei from Les Tambourets reported here uses the traditional morphological approach (Figures 11-1 to 11-7). The attribute system employed (see Appendix B, Section XI), informed by the replicative experiments of others and, to a very limited extent, of my own, concentrates on the preparations made for blank removal and the morphological consequences of such removals.

Another study of the nuclei excavated from Archaeological Level 1 at Les Tambourets formed a major part of the Master's thesis (*Mémoire de Master II*) of René Scandiuzzi (2008) at the Université de Toulouse II le Mirail. Through the courtesy of M. Scandiuzzi, a link to a digital copy of his thesis, which the reader of this monograph is encouraged to consult, is located in the file of TDoc25. The Scandiuzzi study used a *chaîne opératoire* model, without, however, the benefits of refitting.[1] Its results constitute a very welcome supplement to the attribute analysis reported here, and the two studies are, for the most part, in broad agreement (significant *dis*agreement will be signaled in the discussions that follow). Scandiuzzi's conclusion (2008: 96) that the major goal of the reduction sequence at Les Tambourets was the production of blades from prismatic cores is precisely the same as that following from the attribute analysis.

I. ATTRIBUTE ANALYSIS OF NUCLEI

Of the more than 1,500 nuclei known from Les Tambourets, only those excavated from Archaeological Level 1 were included in the analyzed sample. The nuclei not considered further here are 1,335 examples in the Méroc collection (mostly surface finds) and 34 examples excavated from stratigraphic units in Area 3 other than Archaeological Level 1.

A total of 229 nuclei were recovered by excavation from Archaeological Level 1 in the Main Area and Test Pits Beta, 3W1, 3W3, and 3W5. Of these, a total of 32 are classified as *ébauches*, nodules on which some preliminary roughing-out removals, usually to create a platform, were not followed by the detachment of useful blanks. In most cases, examination of the *ébauches* suggests an obvious reason why the nodule was discarded without proceeding to the stage of blank detachment. For many examples, the quality of the raw material is poor—very granular (n=6), checked and therefore not able to be shaped by conchoidal fracture (n=7), or filled with fossils, geodes, or other impurities (n=3). In other cases, the quality of the flint seems adequate, but the size of the nodule or previously worked chunk was probably deemed too small to merit further effort (n=10). A few of the *ébauches* (n=6) suggest no apparent reason why the working was not continued. An additional 23 nuclei from Archaeological Level 1 could not be studied further because serious breakage (often the complete removal of one end) prevented the accurate determination of dimensions, platform number, or other attributes. Among these broken nuclei are five examples shattered by heat and four examples apparently shattered by cold (*pièces gelivées*).

With the subtraction of the *ébauches* and the broken nuclei, the studied sample of nuclei from Archaeological Level 1 contains 174 pieces, of which 79 (45.40%) are prismatic (see Figures 11-1, 11-2, 11-3, #6302, and 11-7), 1 (0.58%) is pyramidal (see Figure 11-3, #6735), 33 (18.97%) are flat (see Figures 11-3, #6328, 11-4, and 11-6, #3905), 26 (14.94%) are tabular (see Figure 11-5), and 35 (20.12%) are irregular (see Figure 11-6, #4729 and #5454). Among the prismatic nuclei is a series of 13 so-called bossed nuclei (*nucleus bossués*) (see Figure 11-2). They most often (n=9) have two platforms, and the back of the nucleus is bossed, angulated, or humped. Extreme examples are wedge-shaped, with the two opposed platforms nearly meeting at the back. On others, working the core face or faces back toward a cortical protuberance has produced a rounded, cortical boss. Bossed nuclei are regarded as a nonsignificant variant of the prismatic shape that has resulted from the small size of the mass remaining at the time of discard.

Nearly 20% of the studied nuclei are assigned to the "flat" category; as explained in Appendix B, this could quite justifiably be regarded as a subcategory of prismatic nuclei. The totals of prismatic (n=79) and flat (n=33) nuclei in the present study sum to about 64% of nuclei, in tight agreement with the relative frequency of "prismatic" nuclei as defined by Scandiuzzi (2008: 27, Table 2), also 64%.

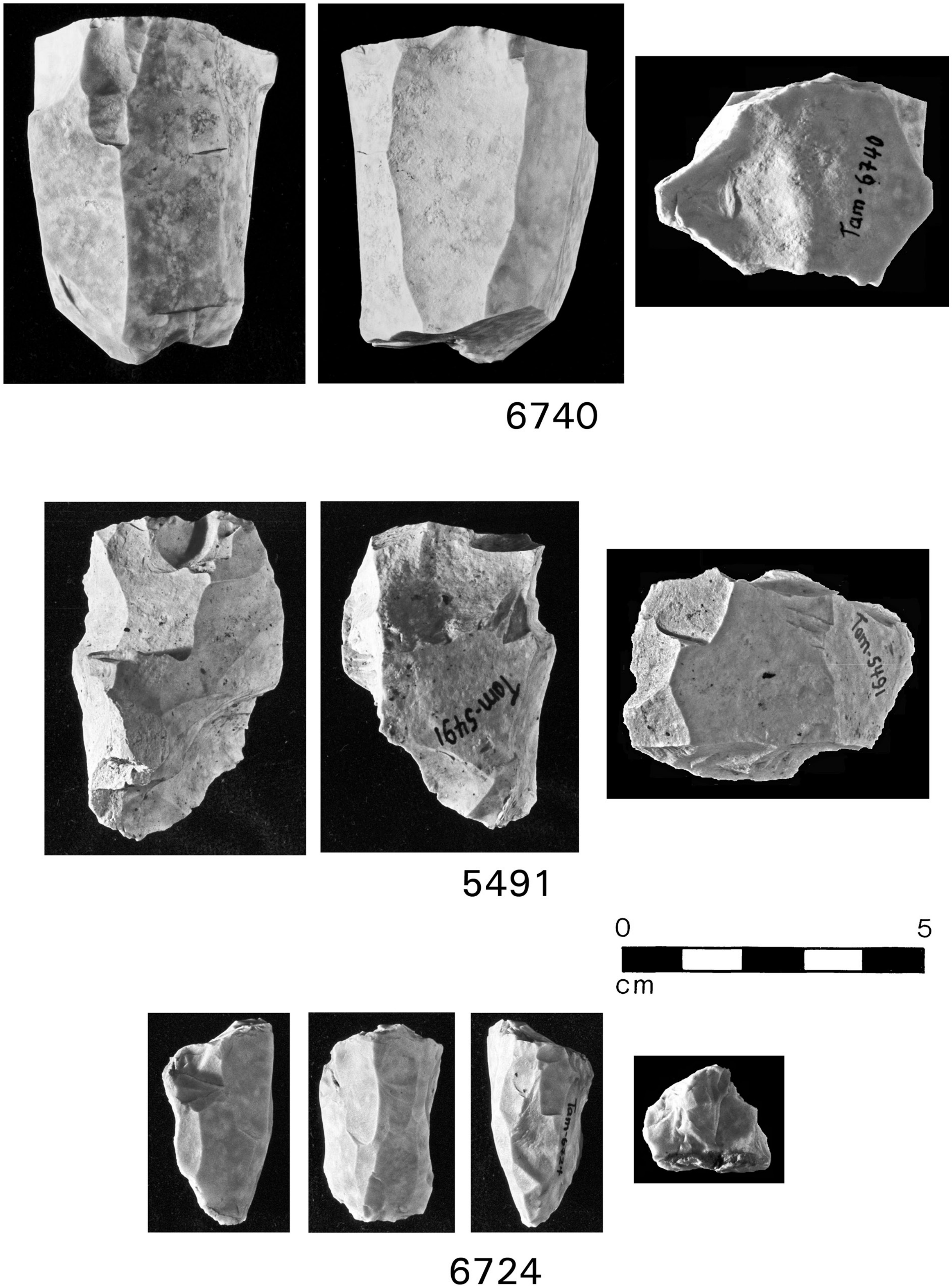

Figure 11-1. Prismatic nuclei from Archaeological Level 1 in Area 3 at Les Tambourets.

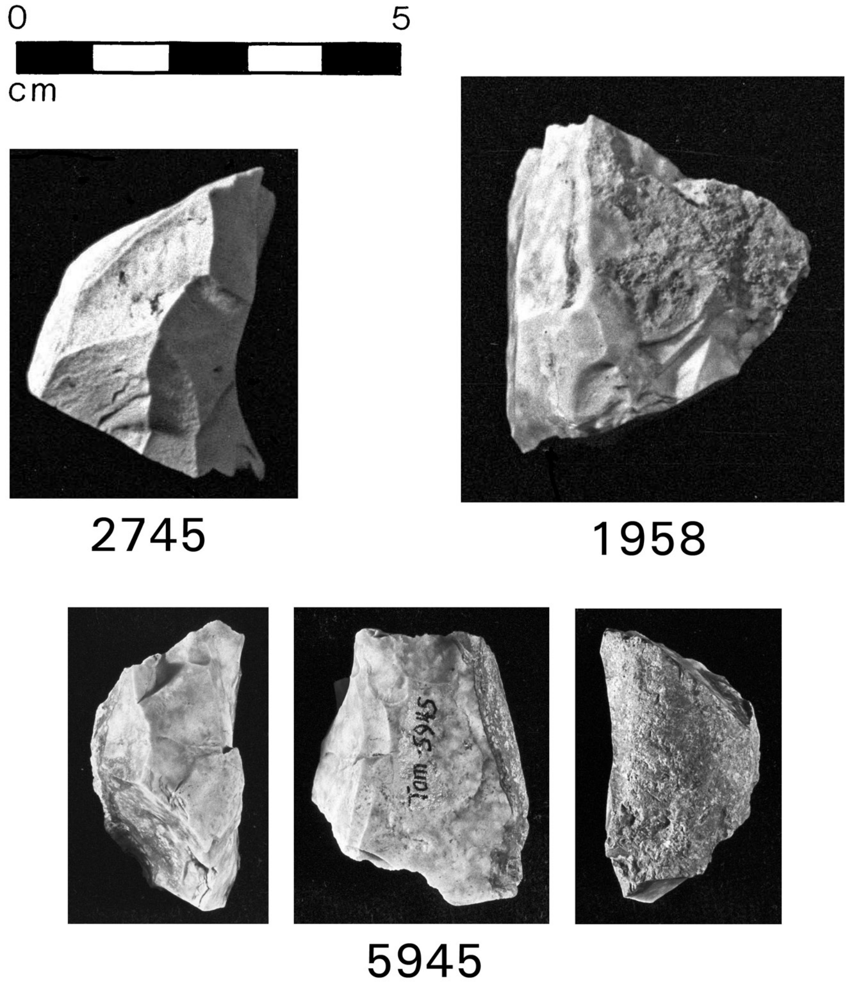

Figure 11-2. Bossed prismatic nuclei from Archaeological Level 1 in Area 3 at Les Tambourets.

Among the 26 nuclei classified as "tabular" are 8 that show a minor but distinctive pattern of variation (see Figure 11-5, #3371 and #3013). On these examples, the back of the nucleus has been regularized by a line of unifacial or bifacial retouch. Although a *crête*-like morphology is created by the retouch, its location far from the core face makes it unlikely that rectification in aid of subsequent blank removal was at issue here. When the retouch is not abrupt, the morphology resembles that of a side-scraper, and—as in the case of many other tabular nuclei—the possibility exists that the platform/core-face junction was used as a burin. Despite these indications, the primary use of these objects is considered to have been the production of blanks, and they are included in the nucleus sample.[2] Slightly more than half the nuclei in the studied sample have multiple platforms (Table 11-1), but this varies significantly among the shape classes. Prismatic nuclei and irregular nuclei are significantly more often multiplatformed than flat or tabular nuclei.[3] Among the nuclei having regular shapes and more than one platform, the "O2" pattern is overwhelmingly predominant (for example, Figures 11-1, #6724, 11-2, #1958, 11-4, #1676, and 11-5, #3013). As would be expected, most irregular multiplatformed nuclei have one or another variety of crossing pattern, most often "C2" (see Figure 11-6, #4729 and #5454). In a pooled sample of all platforms (N=280) on all studied nuclei, mean platform angle is 75.57 degrees, with a standard deviation of 10.04 degrees. Mean platform angle varies little among shape categories (Table 11-2), and the differences are not significant at the 0.05 level.[4]

Platform regularization removals from the platform are present on a slight majority of nuclei, whereas small platform regularization removals from the face are found on only about one-third of nuclei (see Table 11-1); for neither attribute set are there significant differences among shape categories. The presence of large-scale or broad facetting on the platform occurs on a majority of the total sample (see Figures 11-1, #6724, 11-3, and 11-7, #1835) and may be regarded as a modal characteristic of the Tambourets nuclei, but there are highly significant differences among the shape categories.[5] The formation of the platform by the use of large facetting is preferentially associated with prismatic and flat nuclei; it occurs less often than expected on tabular nuclei (where the platform is, in any case, smaller) and on irregular nuclei.

A retouched *crête* occurs on about one-third of the nu-

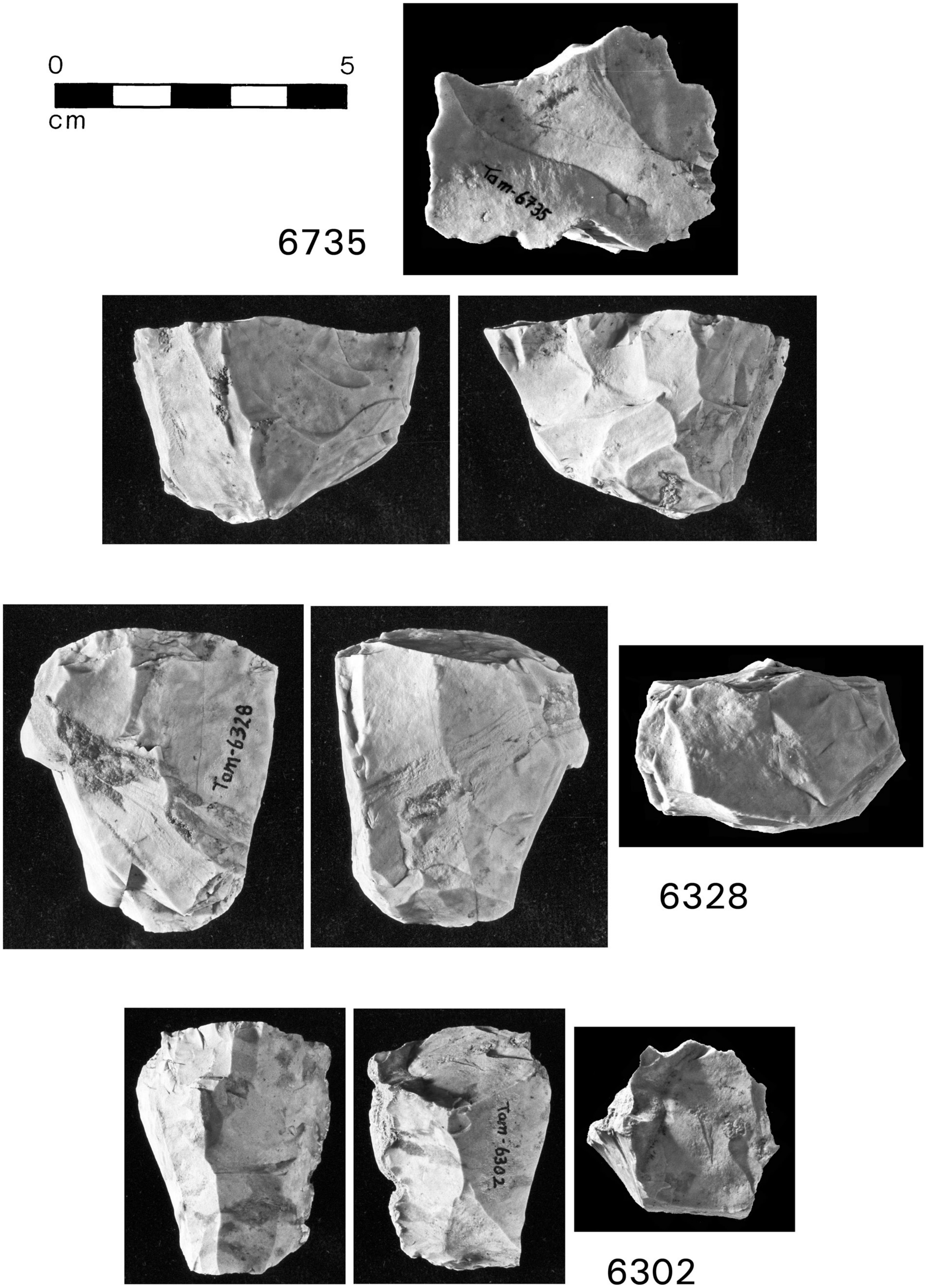

Figure 11-3. Nuclei from Archaeological Level 1 in Area 3 at Les Tambourets. #6735: pyramidal; #6328: flat; #6302: prismatic.

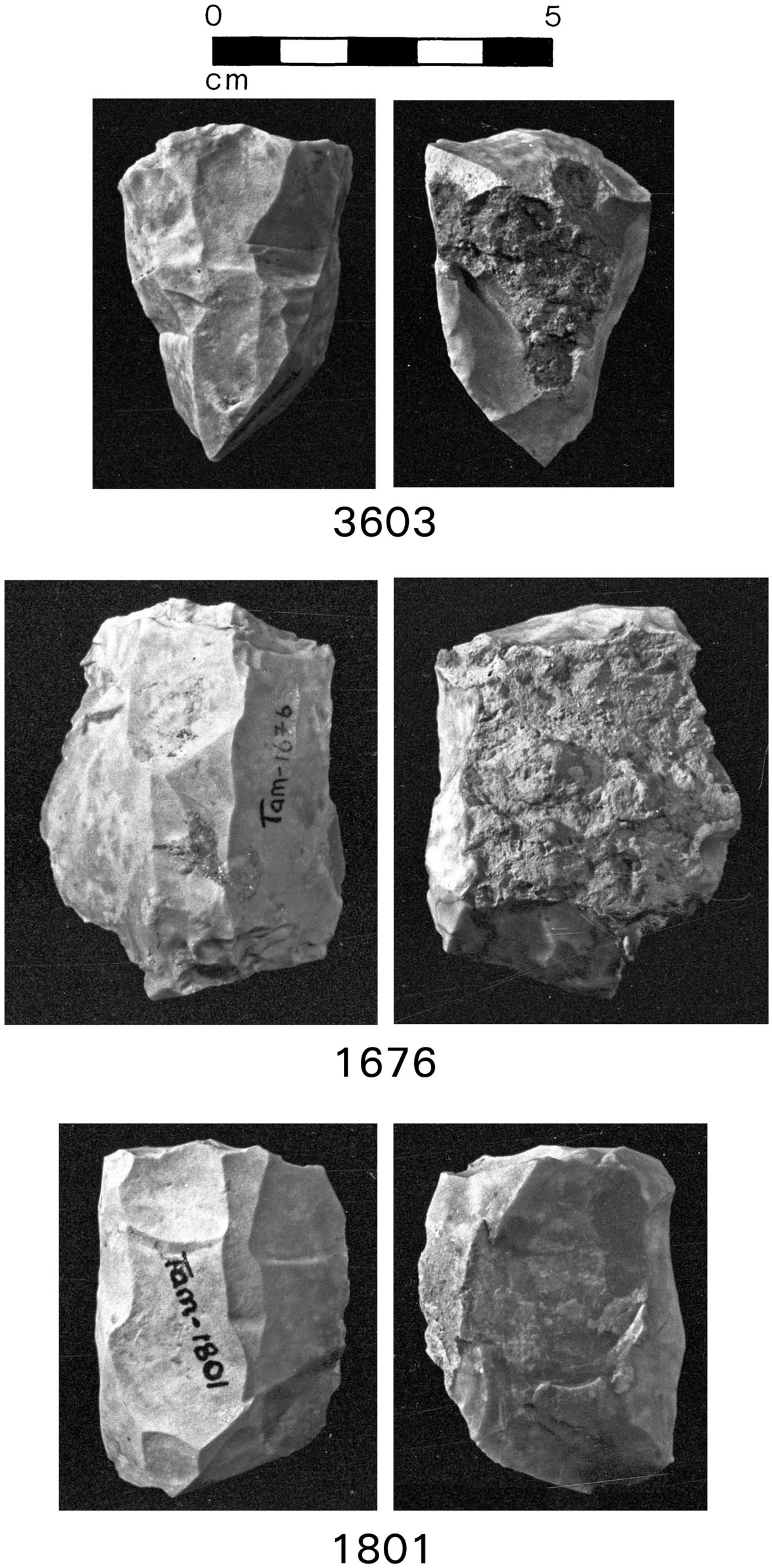

Figure 11-4. Flat nuclei from Archaeological Level 1 in Area 3 at Les Tambourets.

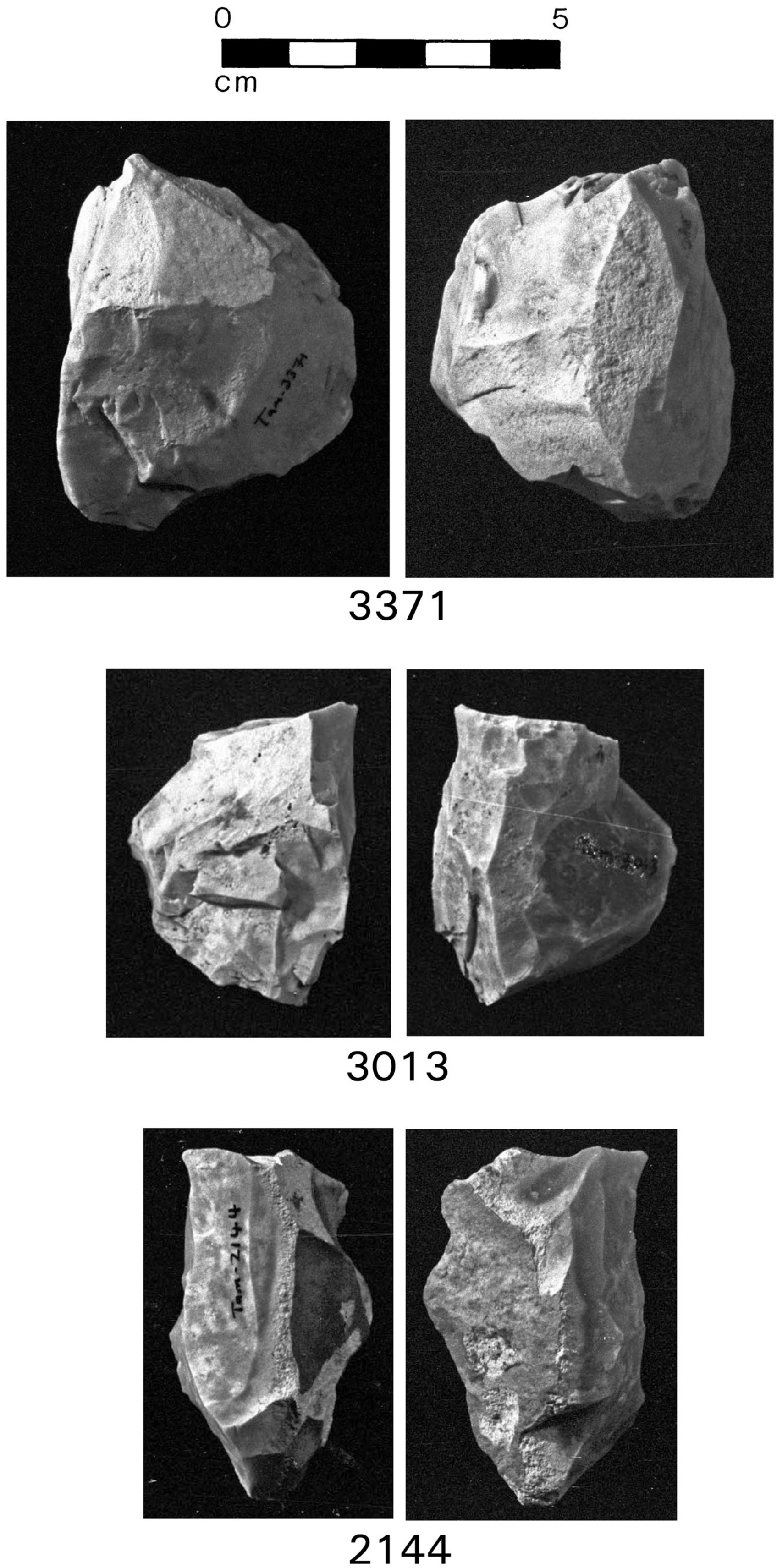

Figure 11-5. Tabular nuclei from Archaeological Level 1 in Area 3 at Les Tambourets.

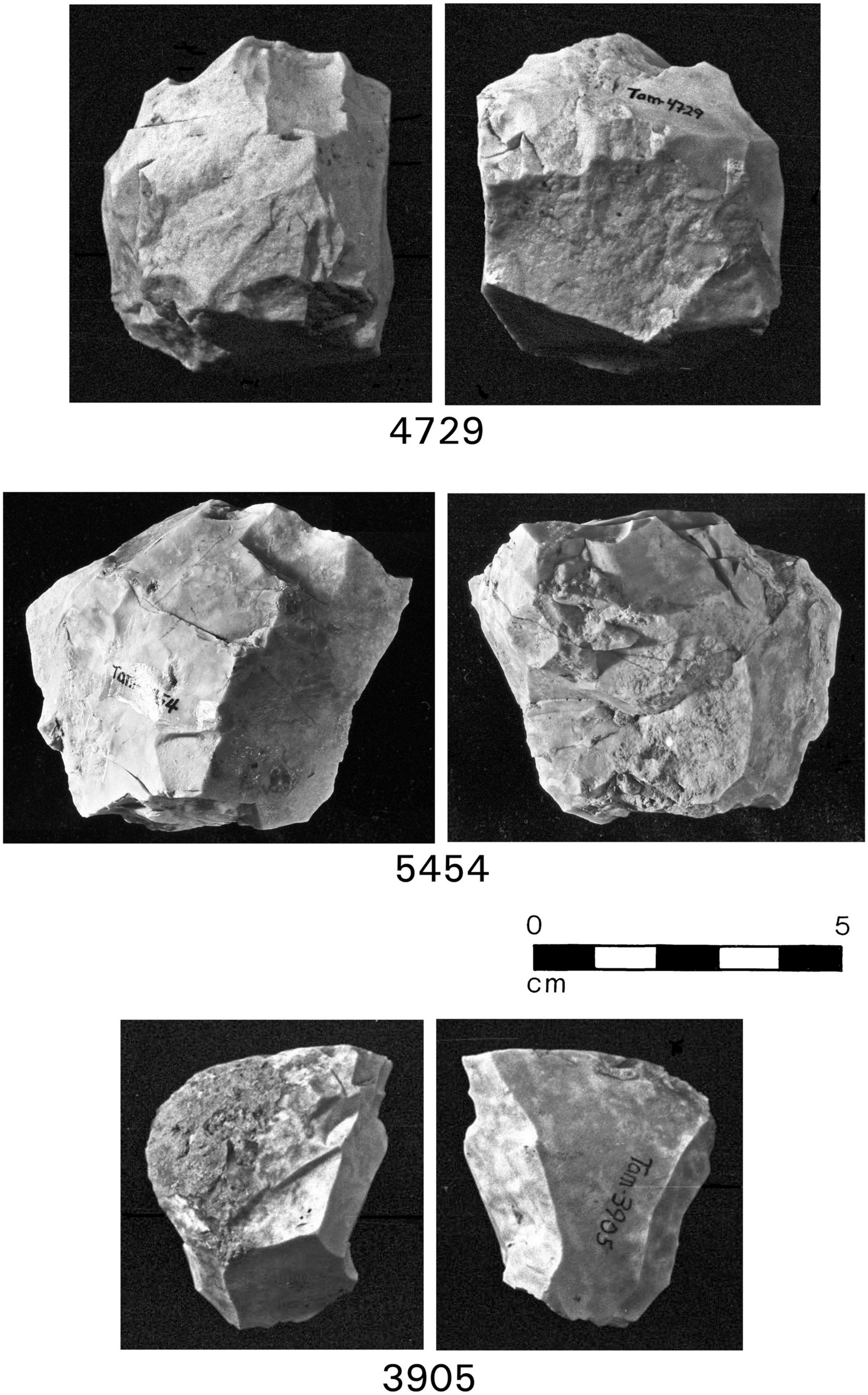

Figure 11-6. Nuclei from Archaeological Level 1 in Area 3 at Les Tambourets. #4729, #5454: irregular; #3905: flat.

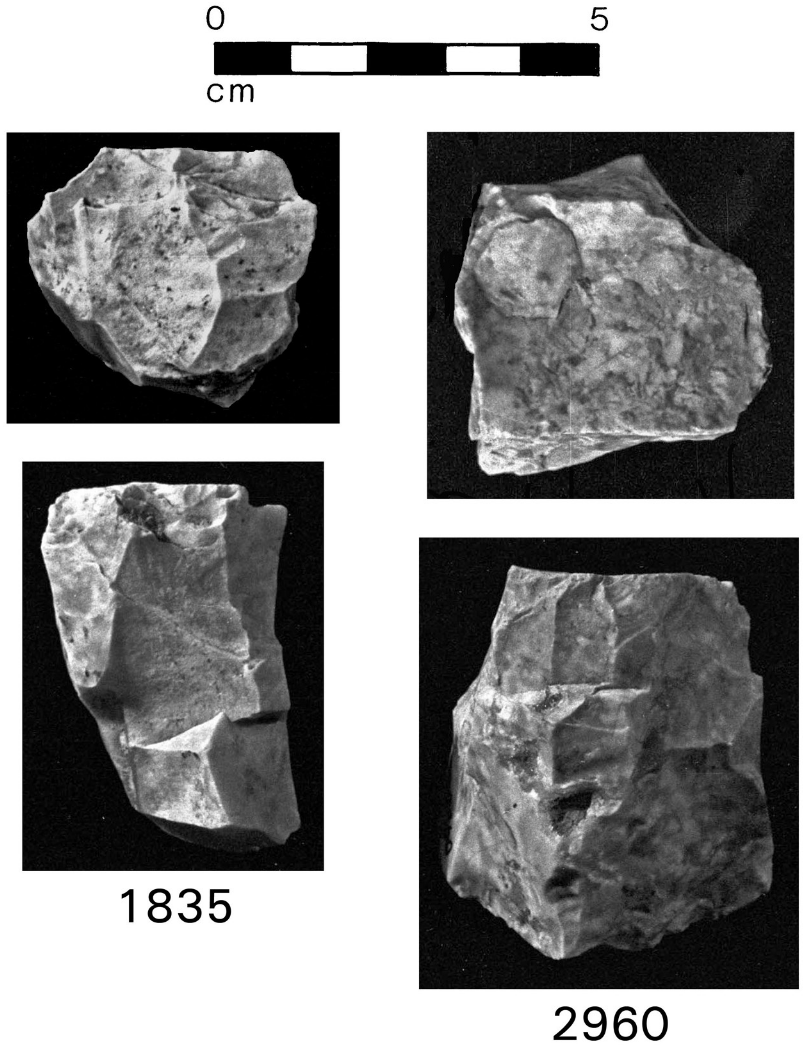

Figure 11-7. Prismatic nuclei from Archaeological Level 1 in Area 3 at Les Tambourets.

clei (see Table 11-1) (for example, Figure 11-1, #6724), and there are no significant differences among shape categories. Very few nuclei (n=6, 3.45%) are positive hinge spalls (see Figure 11-4, #3603).

Sample values (mean ± standard deviation, in mm) for the dimensions of nuclei in the total studied sample (N=174) are as follows: maximum length = 48.72±9.63; maximum width = 37.25±9.64; maximum thickness = 30.79±8.03.[6] The same values for individual shape categories are shown in Table 11-2. Maximum length does not vary significantly among shapes, but the other two dimensions do vary significantly at the 0.05 level. Interpretation of the analyses of variance with the aid of Scheffe tests[7] indicates that: a) tabular nuclei, the narrowest, are significantly narrower than any other type (this, of course, is true by definition); b) irregular nuclei, the widest, are significantly wider than prismatic and tabular examples; and, c) all thickness differences among shapes are significant. Interactions among the dimensions and between each of them and platform angle are shown as a correlation matrix in Table 11-3. The dimensions are positively and significantly intercorrelated in the pooled sample and in all shape-based subsamples except that of tabular nuclei (emphasizing the anomalous shape of the latter). Very weak correlations, usually positive, between dimensions and platform angle fail to reach the 0.05 significance level except in one case—in the pooled sample (but not in the smaller subsamples), maximum thickness is significantly correlated with platform angle.

It would be desirable to include in an attribute system designed for the morphological study of nuclei an estimate of mass as approximated by weight. The Tambourets nuclei were not weighed, however,[8] and the only feasible approximation that can be derived from the data collected is an estimation of volume from maximum length, width, and thickness. A certain amount of trial-and-error experimentation suggests that a) the volume of a cube (LxWxTh) is clearly an overestimate, giving too great a role to irregularities in shape; b) the volume of a sphere, with radius calculated as half of the cube root of (LxWxTh), is just as clearly an underestimate; and c) a better estimate, between the two previously mentioned but closer to the volume of a cube, is the volume of a right circular cylinder, with height represented by maximum length and radius equal to one-half the arithmetic mean of maximum width and maximum thickness—

Table 11-1.--Distributions of number of platforms and other attributes of nuclei in Archaeological Level 1.

	Prismatic n	Prismatic %	Py. n	Flat n	Flat %	Tabular n	Tabular %	Irregular n	Irregular %	ALL n	ALL %
Number of Platforms (NU2)											
1 platform	32	40.51	1	19	(57.58)	18	(69.23)	8	(22.86)	78	44.83
2 platforms	47	59.49	0	14	(42.42)	8	(30.77)	17	(48.57)	86	49.43
3 platforms	0	0	0	0	(0)	0	(0)	10	(28.57)	10	5.75
TOTAL	79	100.00	1	33	(100.000	26	(100.00)	35	(100.00)	174	100.01
Multiple Platform Arrangement (NU3)											
Pattern O2	42	(89.36)	0	13	(92.86)	8	(100.00)	1	(3.70)	64	66.67
Pattern A2	5	(10.64)	0	0	(0)	0	(0)	0	(0)	5	5.21
Pattern C2	0	(0)	0	1	(7.14)	0	(0)	16	(59.26)	17	17.71
Pattern O2+	0	(0)	0	0	(0)	0	(0)	6	(22.22)	6	6.25
Pattern A2+	0	(0)	0	0	(0)	0	(0)	2	(7.41)	2	2.08
Pattern C3	0	(0)	0	0	(0)	0	(0)	2	(7.41)	2	2.08
TOTAL	47	(100.00)	0	14	(100.00)	8	(100.00)	27	(100.00)	96	100.00
Plat. Reg. Rems. from Platform (NU5)											
Present	72	57.14	1	27	(57.45)	22	(64.71)	39	54.17	161	57.50
Absent	54	42.86	0	20	(42.55)	12	(35.29)	33	45.83	119	42.50
TOTAL	126	100.00	1	47	(100.00)	34	(100.00)	72	100.00	280	100.00
Plat. Reg. Rems. from Face (NU6)											
Present	41	32.54	0	19	(40.43)	10	(29.41)	17	23.61	87	31.07
Absent	85	67.46	1	28	(59.57)	24	(70.59)	55	76.39	193	68.93
TOTAL	126	100.00	1	47	(100.00)	34	(100.00)	72	100.00	280	100.00

i.e., (W+Th)/4. Estimating cylindrical volume (Pi x r^2 x h) in this fashion, the Tambourets nuclei are shown to vary greatly ($\bar{X}$=48.24cm^3, s=28.81cm^3), and intershape differences are significant.[9] Irregular nuclei have the greatest mean volume (63.10cm^3), followed in order by tabular (47.28cm^3), prismatic (45.08cm^3), and flat (40.79cm^3). Although such estimates of volume are no more than simple manipulations of the linear dimensions, they are useful for the synthetic view they provide. The fact that flat nuclei preserve the least volume of raw material is consistent with the suggestion that they are, in general, the most worked-out or exhausted nuclei in the sample. The fact that irregular nuclei preserve a significantly greater volume of raw material may suggest that it was the complex and unfavorable relationships among multiple platforms and core-faces (the results of less than optimal knapping choices necessitated by raw-material constraints?) that dictated their discard, rather than the attainment of minimal size limits.

Almost all nuclei having shapes other than tabular are true core objects (see Table 11-1), but half of the tabular nuclei are made on large, thick flakes, and only three flake nuclei do not have the tabular shape. It makes intuitive sense that the use of a thick flake as a nucleus for the removal of blades will usually be accomplished most efficiently by locating a narrow core-face at one *side* of the flake; as discussed above, the similarity between the geometry of this model and that of a burin creates frequent ambiguity about the existence of "nucleiform burins" (for example, Figures 11-5, #3371, and 11-6, #3905), particularly in the tabular shape-class. For the Tambourets sample, the more relevant concept would probably be that of "buriniform" nuclei (were a new term needed, which is not the case!).

Some cortex is preserved on approximately half of the Tambourets nuclei (see Table 11-1) (see Figures 11-2, #5945, and 11-3, #6302), but there are significant differences among shape categories.[10] As can be seen from the distri-

(Table 11-1--continued)

	Prismatic n	Prismatic %	Py. n	Flat n	Flat %	Tabular n	Tabular %	Irregular n	Irregular %	ALL n	ALL %
Large Facets on Platform (NU7)											
Present	83	65.87	1	28	(59.57)	13	(38.24)	34	47.22	159	56.79
Absent	43	34.13	0	19	(40.43)	21	(61.77)	38	52.78	121	43.21
TOTAL	126	100.00	1	47	(100.00)	34	(100.01)	72	100.00	280	100.00
Crête (NU8)											
Present	26	32.91	0	8	(24.24)	12	(46.15)	7	(20.00)	53	30.46
Absent	53	67.09	1	25	(75.76)	14	(53.85)	28	(80.00)	121	69.54
TOTAL	79	100.00	1	33	(100.00)	26	(100.00)	35	(100.00)	174	100.00
Nature (NU13)											
Core	77	97.47	1	32	(96.97)	13	(50.00)	35	(100.00)	158	90.81
Flake	2	2.53	0	1	(3.03)	13	(50.00)	0	(0)	16	9.20
TOTAL	79	100.00	1	33	(100.00)	26	(100.00)	35	(100.00)	174	100.01
Cortex (NU14)											
Score 0	42	53.16	0	10	(30.30)	16	(61.54)	22	(62.86)	90	51.72
Score 1	35	44.30	1	20	(60.61)	7	(26.92)	10	(28.57)	73	41.95
Score 2	0	0	0	2	(6.06)	2	(7.69)	3	(8.57)	7	4.02
Score 3	2	2.53	0	1	(3.03)	1	(3.85)	0	(0)	4	2.30
TOTAL	79	99.99	1	33	(100.00)	26	(100.00)	35	(100.00)	174	99.99
Mean Score	0.519		-	0.818		0.538		0.457		0.569	

butions of both frequencies and mean cortex scores, flat nuclei are most often cortical (see Figure 11-4, #3603, #1676, and #1801), whereas there is little difference among the other shapes. Determination of the state (fresh or rolled) of the raw material used as a nucleus can be determined only when the object bears either cortex or a double patination. In the total studied sample, 25 nuclei (14.37%) bear double patination (see Figures 11-4, #3603, 11-5, #2144, and 11-6, #4729 and #5454), 84 (48.28%) have some cortex, and 97 have either cortex or double patination. Of the 97 for which the state of the raw material may be determined, 31 (31.96%) show signs of rolling (see Figures 11-2, #5945, 11-3, #6302, and 11-6, #4729) and 66 do not. The other 77 nuclei are indeterminate. These data suggest very clearly that the majority of flint sources exploited by the Tambourets artificers were close to the outcrops of limestone in which the flint occurred, rather than being alluvial sources (river cobbles) that had been transported some distance as part of stream load. This suggestion is in good agreement with the conclusion of Scandiuzzi (2008: 27) that the majority of the nuclei in Archaeological Level 1 came directly from outcrops near the site rather than alluvial sources.[11] Nucleus attribute sets NU16 and NU18, concerning flint variety and heat alteration, are described elsewhere in this report as part of analyses concerning more than a single artifact class.

Only a small minority (n=26, 14.94%) of the studied nuclei from Les Tambourets show evidence of some probable or possible secondary use. One nucleus was subsequently used as a hammerstone, and two irregular nuclei were modified by retouch along one side to form tools that may be recognized as side-scrapers. The question of reuse of the other 23 nuclei centers on the possible use of platform/core-face junctions as nucleiform burins, as already discussed, or scrapers. There are among the nuclei seven examples of "scraper morphology" (see Figure 11-7, #2960) and two of "partial scraper morphology" (see Figure 11-7, #1835), as defined in Appendix B. In light of serious uncertainties about these 9 pieces and the 14 "nucleiform burins", the conclusion to be drawn is that most Tambourets nuclei were discarded without further use once they were no longer useful as sources of blanks.

As was done for several of the major tool classes discussed in previous chapters, the technique of discriminant analysis was employed as a check on the primary criterion for typological sorting used in the study, the shape of the nucleus. The four variables used for the analysis were platform angle (or mean platform angle for nuclei with multiple platforms) and the three linear dimensions. Nuclei were grouped by shape category, with the unique example of a pyramidal nucleus excluded from the sample.

The major results of the discriminant analysis[12] are shown in Table 11-2. All four attribute sets employed were retained by the analysis. The most important set for dis-

Table 11-2.--The first two canonical variates and other results of the discriminant analysis of nuclei from Archaeological Level 1.

Canonical Variates

	Canonical Variate 1	Canonical Variate 2
Eigenvalue	2.365	0.239
Cumulative % of total dispersion	90.63	99.80
Canonical correlation	0.838	0.439
Group means for:		
Prismatic nuclei	-0.147	0.311
Flat nuclei	-1.698	0.252
Tabular nuclei	3.351	-0.005
Irregular nuclei	-0.556	-0.936

Attribute Sets Retained by the Analysis

		Pris.	Flat	Tab.	Irr.
1. Maximum thickness in mm	$\bar{X}$	29.06	24.39	40.19[a]	33.49
	s	6.05	4.42	8.15	7.29
2. Maximum width in mm	$\bar{X}$	36.01	39.64	28.27[a]	44.09
	s	8.12	7.18	6.38	10.89
3. Maximum length in mm	$\bar{X}$	49.48	48.03	48.92	47.94
	s	9.87	8.59	7.67	11.28
4. Mean platform angle	$\bar{X}$	75.06	72.42	77.31	74.86
	s	9.72	10.01	10.41	9.51

Comparison of Initial Classification (rows) and Reclassification (columns)

		Prismatic	Flat	Tabular	Irregular
Prismatic	(n = 79)	54	7	1	17
Flat	(n = 33)	5	27	0	1
Tabular	(n = 26)	1	0	25	0
Irregular	(n = 35)	8	4	0	23

Correct reclassification of:
Prismatic: 54 of 79, 68.35%
Flat: 27 of 33, 81.82%
Tabular: 25 of 26, 96.15%
Irregular: 23 of 35, 65.71%

All nuclei in sample: 129 of 173, 74.57%

a. Input for this analysis uses reversed definitions for width and thickness of tabular nuclei. Width, the side-to-side measurement across the face, is less than thickness, the face-to-back measurement.

Table 11-3.--Correlation matrix of platform angle and dimensions of nuclei in Archaeological Level 1. Lower half-matrix tabulates correlation coefficients (r); upper half-matrix tabulates probability values (P). The first listing for each group of five is for all studied nuclei; the second listing is for prismatic nuclei, the third for flat nuclei, the fourth for tabular nuclei, and the fifth for irregular nuclei. Sample totals vary.[a]

	Platform Angle (NU4)	Maximum Length (NU10)	Maximum Width[b] (NU11)	Maximum Thickness[b] (NU12)
Platform Angle		>.10 >.10 >.10 >.10 >.10	>.10 >.10 >.10 >.10 >.10	.05>P>.01 >.10 >.10 >.10 >.10
Maximum Length	.020 .046 .114 .249 .023		<.001 <.001 .01>P>.001 >.10 <.001	<.001 <.001 .01>P>.001 >.10 <.001
Maximum Width	.057 .136 .018 .071 .027	.454 .607 .504 .312 .645		<.001 <.001 .02>P>.01 <.001 <.001
Maximum Thickness	.176 .091 .041 .254 .165	.353 .525 .477 .122 .577	.346 .789 .438 .653 .771	

a. For correlations involving platform angle, N(total) = 280, n(prismatic) = 126, n(flat) = 47, n(tabular) = 34, and n(irregular) = 72. For correlations involving only the linear dimensions, N(total) = 174, n(prismatic) = 79, n(flat) = 33, n(tabular) = 26, and n(irregular) = 35. In both cases, the total sample includes one pyramidal nucleus.

b. Input for the calculation of correlation coefficients that involve tabular nuclei uses reversed definitions for width and thickness for tabular nuclei only. Width, the side-to-side measurement across the face, is less than thickness, the face-to-back measurement.

criminating among shape classes is maximum thickness, followed in order by maximum width, maximum length, and platform angle. The first two canonical variates account cumulatively for over 99% of the dispersion in the sample. The overall rate of success of reclassification of nuclei into shape categories is high, ca. 75%, and, as usual, the patterning of erroneous reclassification is itself informative. Tabular nuclei have the most distinctive morphology, and their almost completely correct reclassification results directly from the special definitions of width and thickness used for this shape category. The majority of reclassification errors are between prismatic and irregular nuclei (57% of all errors, affecting 22% of all prismatic and irregular examples). This datum accords well with analytic results discussed previously—whereas prismatic and irregular nuclei differ significantly in mean width, thickness, and estimated volume, there is an overlap in the range of dimensions within which separation must depend on the *arrangement* of multiple platforms, which is an attribute set not included in the discriminant analysis. The only other consistent reclassification error is the confounding of prismatic and flat nuclei (27% of all errors, affecting 11% of all prismatic and flat examples). The fact that misclassified flat nuclei are almost always reclassified as prismatic reinforces the interpretation that these shapes are very closely related, resulting probably from different degrees of exhaustion of the nodule.

II. SUMMARY AND SOME COMPARISONS

The morphologically oriented attribute analysis of nuclei in Archaeological Level 1 at Les Tambourets, as discussed in the preceding section, makes it possible to describe these objects along multiple dimensions of variation. In this section, some of the results of analysis that seem to be particularly relevant to the general processes of stone-tool production are briefly summarized. It should be emphasized that these results agree in all general aspects with the results of Scandiuzzi (2008), whose analysis followed a very different model.

In several instances, comparative data on Gravettian nuclei from the Abri Pataud (Les Eyzies, Dordogne) (Bricker 1973, 1995: 160–161), which were analyzed in terms of the same attribute system employed here, are cited as an aid to the interpretation of the Tambourets nuclei.

The process of stone-tool production begins with the procurement of raw material. Even without considering information on the possible proveniences of the flint used at Les Tambourets (see Chapter 13), it is apparent from the low frequency of rolled examples that the majority of the Tambourets nuclei are on flint nodules that were probably obtained quite close to the source outcrops. The presence of many *ébauches* at the site (more than 10% of the total nucleus sample) suggests that triage or culling at the source locations was not always practiced (or, at least, was not always effective).

The nodules chosen were apparently relatively small, as indicated by the mean dimensions of the exhausted nuclei. The meaning of the phrase "relatively small" is brought into focus by data on early Gravettian nuclei from the later units of Level 5 at the abri Pataud: maximum length means for the Pataud nuclei range from ca. 61mm for irregular nuclei to ca. 73mm for prismatic nuclei (Bricker 1973: 921, Table 25-8). (It may be recalled that the comparable values for the Tambourets nuclei are 48mm and 49mm, respectively.) The fact that nuclei of such size were discarded as exhausted by the Pataud:5 artificers suggests that the raw material sources available to them—including Maestrichtian flint from the vicinity of Bergerac and the Couze Valley (1973: 928, Table 25-14)—permitted a more generous view of minimal size limits than was feasible at Les Tambourets. What may be another indication of a more penurious use of (smaller) raw material at Les Tambourets is the observation that the majority (ca. 55%) of nuclei have removals from more than one platform; by comparison, only 41% of the Pataud:5 nuclei have multiple platforms (1973: 916, Table 25-4).

Despite the relatively small size of the Tambourets nuclei, the majority of platforms now present on the (exhausted) cores are composed of multiple broad facets rather than the scar of a single "truncating" or "decapitating" removal. Because the existing platforms are very likely to be the results of core rectification, rather than the first platform created on the nodule, it is not surprising that classic "core tablet" trimming flakes are infrequent in the sample of unretouched *débitage* flakes (see Chapter 12).

Although flakes are more numerous than blades among the *débitage* products, both retouched and unretouched, it is clear from the distribution of shape categories of nuclei that the techniques of blank production at Les Tambourets were based primarily on a *blade*-core model (ca. 79% of nuclei are prismatic, flat, or tabular). The distributional data on *crêtes*, the use of which is known to be an important part of various techniques of blade removal, are consistent with this observation. The fact that a *crête* is still present on about one-third of the exhausted nuclei, representing in many cases a *crête* whose potential was not exploited, suggests that the true frequency of this technique of core rectification was even greater and that *lames à crête* will be well represented in the samples of blade blanks and unretouched *débitage* products (as is in fact the case—see the following chapter, below).

It is clear from the preceding paragraphs that the further explanatory potential of the attribute analysis of the Tambourets nuclei depends upon comparisons between them and the objects struck from them—both the blanks for retouched tools and the blades and flakes that were not so modified. Such comparisons are discussed in the chapter that follows, Chapter 12.

ENDNOTES

1. Despite his best efforts, Scandiuzzi (2008: 120) was able to add only one refit to the handful of refits previously identified by our study.
2. Scandiuzzi (2008: 27, 37) recognized a category of nuclei "*sur tranche d'éclat*," which might be taken as the approximate equivalent of the "tabular" category of our study. He inventoried 38 such pieces, half again as many as in our "tabular" sample, but some of the extra objects were studied here as burins. For example, Scandiuzzi's Figure 12-1 illustrates artifact #1853 as a "*nucléus à production de petites lames, sur tranche d'éclat*," whereas in this study it is classified as a truncation burin (see Figure 7-3, #1853). Occasional such classificatory disagreements are to be expected when the analyst is trying to decide whether a given artifact functioned as a core for the production of *lamelles*, a burin with a wide burin edge, or a core subsequently used as a burin. Obviously, these categories are not mutually exclusive. Evidence of wear or other modification on the core/face junction (or, alternatively interpreted, the burin edge), as well as the thickness of the artifact in question vis-a-vis the thickness distribution of burins and undoubted tabular nuclei, serve as objective criteria aiding classification. For example, artifact #1853 has tertiary modification of what is here regarded as the burin edge, and the maximum thickness of the flake is 19mm, more than one standard deviation smaller than the mean of the analogous dimension of the sample of tabular nuclei. The conclusion to be drawn from the frequency differences in the two studies is that the typological criteria of Scandiuzzi's "*nucléi sur tranche d'éclat*" differ appreciably from those of our "tabular" nuclei.
3. Chi-squared=15.87, df=3, P=0.001.
4. F=2.05, df=3 and 275, P[2-tailed]>0.20.
5. Chi-squared=11.83, df=3, P=0.008.
6. For tabular nuclei, the usual definitions of nucleus width and thickness given in Appendix B are reversed. For tabular nuclei *only*, maximum width is defined as the lesser of the two possible dimensions lying in a plane at a right angle to the plane in which maximum length

was measured; maximum thickness therefore becomes the greater of these two possible measurements. This reversal of definitions permits "width" to be a side-to-side measurement across the face and "thickness" to be a face-to-back measurement, more closely analogous to the dimensions of other nucleus shapes.

7. For maximum length: F=0.29, df=3 and 169, P[2-tailed]>0.20. For maximum width: F=19.22, df=3 and 169, P[2-tailed]<0.01; all pairwise differences are significant at the 0.05 level except for flat vs. prismatic and flat vs irregular. For maximum thickness: F=33.54, df=3 and 169, P[2-tailed]<0.01; all pairwise differences are significant at the 0.01 level.
8. Scandiuzzi *did* weigh each nucleus, and sample values for several shape classes are given in his Tableau 9 (Scandiuzzi 2008: 43). For his "prismatic" nuclei he shows a mean of 75 grams with a standard deviation of 77.3 grams. The limited utility of these figures is demonstrated by a frequency curve of these data (Scandiuzzi 2008: 44), which is *extremely* J-shaped, as well as by the stated range of prismatic nuclei, 15 to 565 grams (Scandiuzzi 2008: 43, Tabl. 9).
9. F=4.41, df=3 and 169, P[2-tailed]<0.01.
10. Chi-squared=8.87, df=3, P=0.03.
11. Scandiuzzi (2008: 27) reported that 12% of the nuclei have a "*néo-cortex*" that demonstrates their alluvial origin. This figure is nearly identical to our conclusion that ca. 14% of the nuclei have double patination.
12. The analysis was performed using the "BMD07M: Stepwise Discriminant Analysis" program included as part of the SIGSTAT statistical software marketed by Significant Statistics (Provo, UT) for use on microcomputers. The program was run on a Zenith Z-200 computer.

CHAPTER 12
UNRETOUCHED *DÉBITAGE* PRODUCTS

INTRODUCTION

Unretouched blades, spalls, flakes, and chunks are, of course, the most numerous kinds of artifacts from Les Tambourets. There are more than 18,000 unretouched *débitage* products in the Méroc surface collections from the various areas (†Méroc and Bricker 1984: 58–61, Tableau II), more than 3,100 such objects in the excavated series from Area 3:Archaeological Level 1, and smaller quantities in other excavated series from Areas 3 and 2 (see Tables 3-2 and 3-3). Attribute analysis of unretouched *débitage* products was limited to several small samples of excavated material, as specified below. The attribute sets used in the analysis are those not specific to a single artifact class (Appendix B, Section I).

As was the case for nuclei, the unretouched *débitage* products from Archaeological Level 1 were studied by Scandiuzzi (2008) using a different analytic model (TDoc25). His results are noted here where relevant.

I. BURIN SPALLS

Burin spalls are a distinctive by-product of the manufacture of burins, a special kind of *débitage* product with the dimensional characteristics of a blade or, more often, a bladelet. In a lithic industry in which burins are prominent, which is the case at Les Tambourets, burin spalls are usually well represented. Where burins are made on blades or flakes, which is true of about 88% of examples in Archaeological Level 1 (see Table 7-8), burin spalls are recognized by having two ventral (convex) surfaces. One of the convex surfaces is the original ventral surface of the blade or flake, and the other is the surface resulting from the striking off of the spall from the main body of the burin. Thus, burin spalls may almost always be distinguished from other long, narrow objects of similar size—for example, bladelets struck from specialized bladelet cores.

A total of 42 burin spalls are present in Archaeological Level 1 assemblage sample. No attribute analysis of these objects was done, but Figure 12-1 illustrates a representative series. As can be seen, the size range of burin spalls is great, as is true, of course, of the burin sample.

II. ANALYSIS OF ATTRIBUTES OF UNRETOUCHED *DÉBITAGE* PRODUCTS

Metric and other characteristics were investigated in a sample composed of all complete *débitage* blades (excluding spalls) (Figures 12-2 and 12-3) and flakes (Figures 12-4, 12-5, and 12-6) excavated from Archaeological Level 1 during the 1973 and 1980 seasons. The attribute distributions are shown in Table 12-1 for blades and flakes separately and for a combined blades+flakes sample. Differences in cortex frequencies between blades and flakes are slight and not significant at the 0.05 level,[1] but the contextual interpretation of the presence of cortex on the two kinds of blanks differs. A series of t tests indicates that the dimensions of blades do not differ significantly whether they are cortical blades struck from the exterior of the nodule (see Figures 12-2, #6314, #6310, and 12-3, #6373) or, during a later stage of reduction, the noncortical interior blades (for example, Figure 12-2, #6614, #6840, and #6013). For flakes, on the other hand, the dimensions of the flakes detached during the different reduction stages are very significantly different. Cortical flakes (see Figures 12-4, #5445, #5489, and 12-6, #436) are, on average, longer, wider, and quite a bit thicker than noncortical flakes (see Figures 12-4, #5426, #5489, and 12-5, #6609).[2] Macroscopically visible utilization damage of the margins is twice as frequent on blades (see Figures 12-2, #6614, and 12-3, #6373) as on flakes (see Figures 12-4, #5489, and 12-5, #6669), and this difference is highly significant.[3] On one flake in the studied sample (see Figure 12-6, #436), part of one margin is rounded and highly polished. Both utilized blades and utilized flakes are on average significantly longer and wider than blades and flakes lacking utilization damage.[4]

Distributions of the nature and dimensions of the striking platform are shown in Table 12-1. With the exception of a few pin-point platforms of indeterminate dimensions, the platforms of both blades and flakes are almost exactly divided between the smooth (see Figure 12-5, #6669) and facetted (see Figures 12-2, #6408, #6614, and 12-4, #5445, #6266) forms.[5] The striking platforms of flakes are both longer and wider than those of blades, and these differences are statistically significant.[6] On flakes alone, facetted striking platforms are significantly longer and wider than smooth ones,[7] but there is no such significant difference on blades. Platform length and width are significantly correlated with each other and with all three dimensions of the blank (Table 12-2).

A very valuable part of Scandiuzzi's report is his study of the percussion techniques used by the artificers of Les Tambourets, a dimension of variation not included in our attribute study. Based on his examination of the striking platforms of blades, he concluded (Scandiuzzi 2008: 62) that most were produced by direct percussion using a hard stone hammer; some, however, seem to have been struck off with a soft stone hammer ("*percussion à la pierre tendre*").

III. COMPARISONS WITH ATTRIBUTE DATA FOR NUCLEI

One of the attribute sets used for the study of nuclei is maximum length (NU10), which is described in Appendix B as "a rough estimate of the longest blank that might be produced from an existing platform of the nucleus in its present (presumably exhausted) state". The mean length of 79 prismatic nuclei in Area 3:Archaeological Level 1 is 49.48mm (see Table 11-2), whereas the mean length of the 57 blades in the studied sample of unretouched *débitage* products is only 39.58mm (see Table 12-1). This suggests that the largest blades produced from nuclei, even nuclei approaching exhaustion and discard, were used as blanks for retouched tools, whereas unretouched *débitage* blades represent very predominantly the smaller objects not chosen for tool blanks.

It seems most likely that there are not discrete size

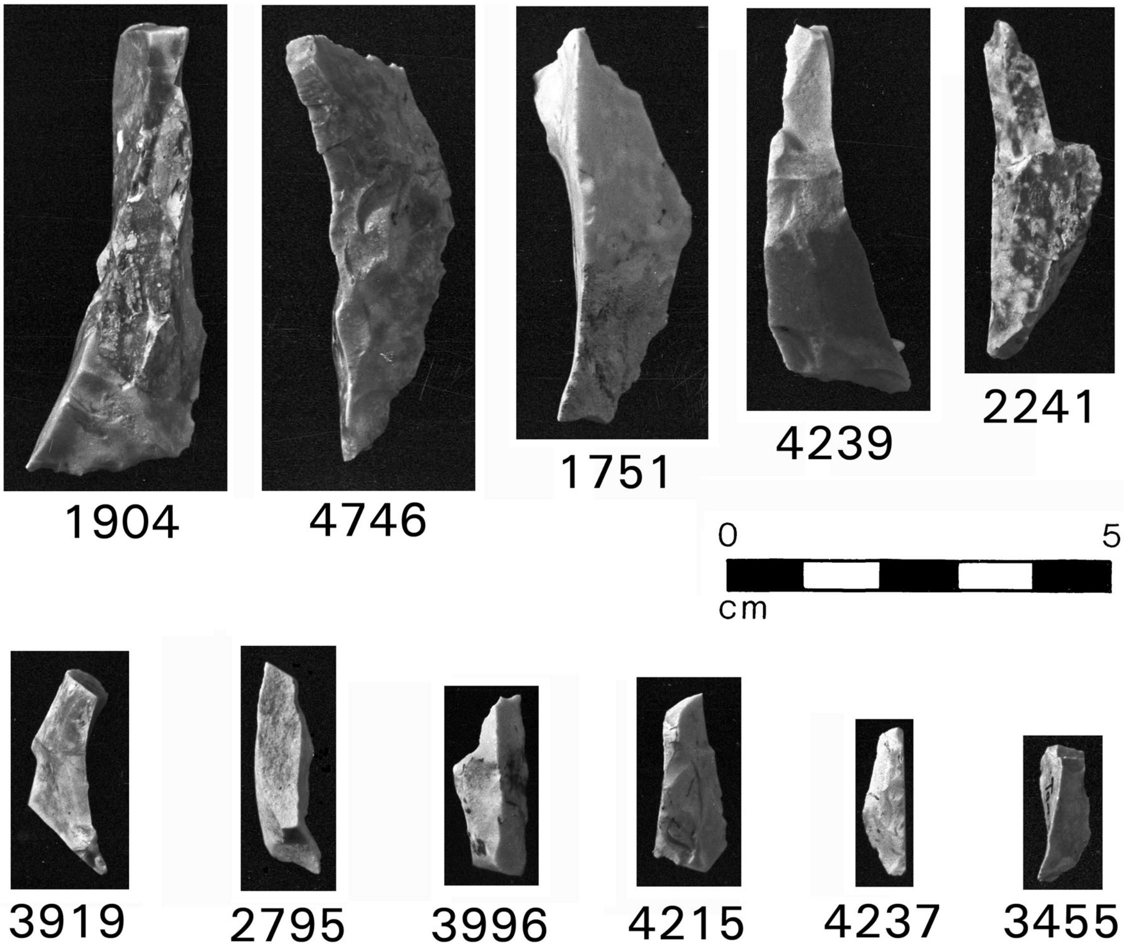

Figure 12-1. Burin spalls from Archaeological Level 1 in Area 3 at Les Tambourets.

classes of unretouched *débitage* blades. Scandiuzzi (2008: 49–64) divided the blades into two size categories, "petites *lames*," with a width of less than 12mm, and "*lames*," with a width of 12mm or greater. Realizing that such a division is arbitrary and "subjective", he pointed out (2008: 63) that the longest *petites lames* are longer than the shortest *lames*. The extensive overlap in length distributions is shown clearly in Scandiuzzi's Figure 22 (2008: 64). The question of discrete size classes is best investigated plotting length and width together in a scattergram (not present in Scandiuzzi's study). In our rather small sample of complete unretouched *débitage* blades, from 1973 and 1980 only, there is perhaps a hint of a small-blade subgroup composed of pieces with lengths <30mm and widths <12mm (Figure 12-7). However, the sample is small, and this possible pattern may well result from sampling error. These data are, in fact, very satisfactorily explained as one single group in which length and width are related by curvilinear regression (Figure 12-8).[8] Based on the results of both Scandiuzzi's study and our own, there is no adequate evidence of discrete size classes of unretouched *débitage* blades at Les Tambourets.

The preparation and rejuvenation of platforms on nuclei from Les Tambourets were normally accomplished by the use of several removals, not a single "decapitating" removal. As noted above in the previous chapter, such a technology may be expected to produce very few of the specialized "core-tablet" trimming flakes that are common in some later Upper Palaeolithic industries. This is indeed the case at Les Tambourets. A systematic examination of all unretouched *débitage* flakes (n=530) recovered from Archaeological Level 1 in 1980 revealed only three core-tablet trimming flakes (0.57% of all *débitage* flakes) (see Figures 12-5, #6594, and 12-6, #6606).

Another characteristic of the Tambourets nuclei that was discussed in the previous chapter was the apparently frequent creation of a *crête* as a technique for rectifying the face of the core. The results of this practice are clearly visible in the *débitage* products. Among the 140 unretouched blades (excluding spalls) recovered from Archaeological Level 1 in 1980, 31 (22.14%) are *lames à crête* (see Figures 12-2, #6376, and 12-3, #6099, #6330).

Finally, it was noted in the previous chapter that approximately one-third of the Tambourets nuclei had small platform-regularization removals from the face (attribute set NU6). A somewhat greater number, nearly half, of the unretouched *débitage* flakes and blades in the studied sample have facetted striking platforms (see Table 12-1) (see Figures 12-2, #6408, #6614, and 12-4, #5445). This difference in frequencies suggests that some of the very large removals used to create the core platform, like those visible on the striking platform of flake #6266 in Figure 12-4, are contributing, along with the smaller removals dealt with by set

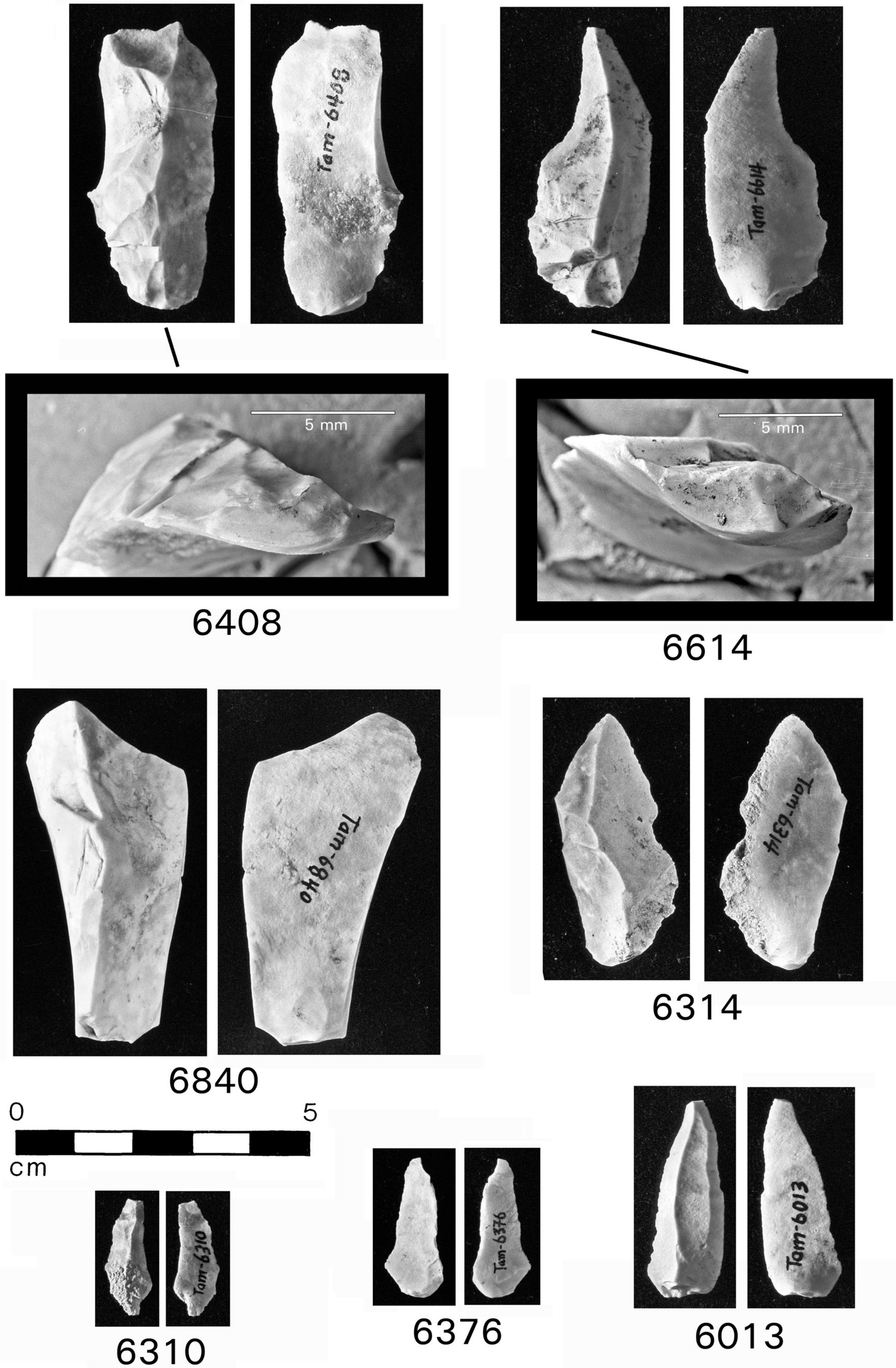

Figure 12-2. Unretouched débitage *blades from Archaeological Level 1 in Area 3 at Les Tambourets. An enlarged view of the surface of the striking platform is shown for #6408 and #6614.*

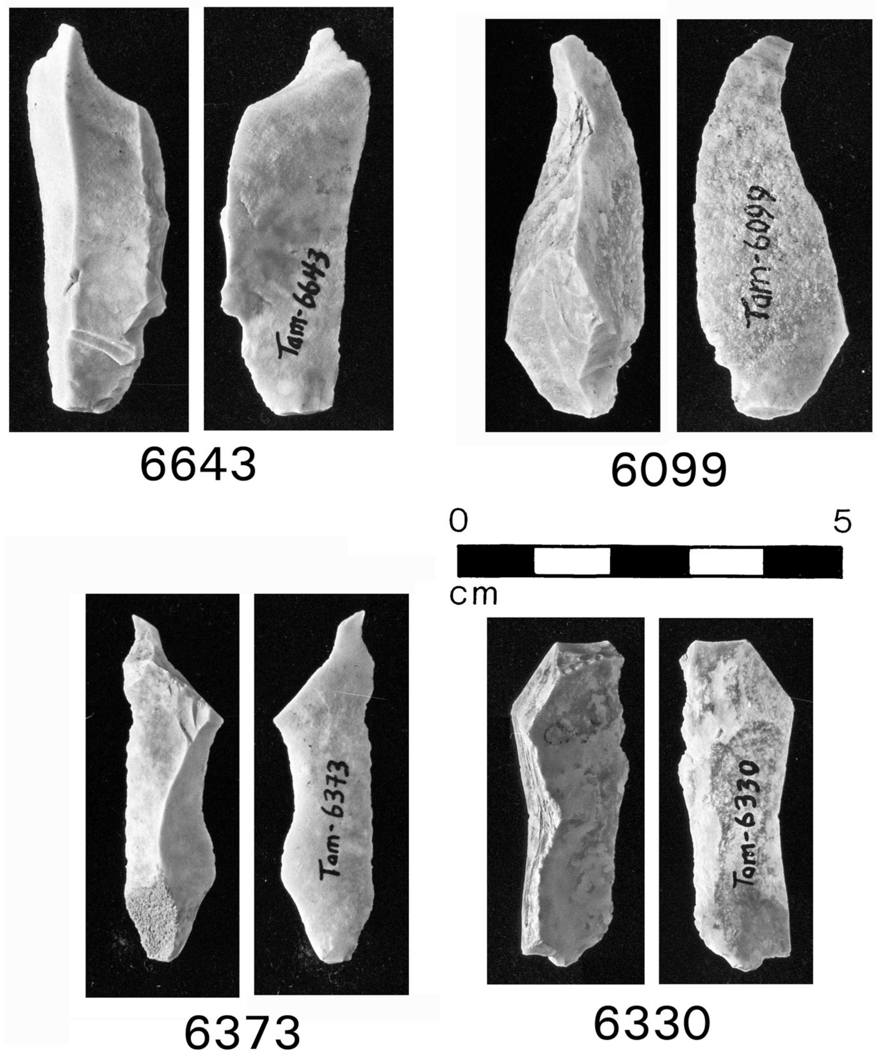

Figure 12-3. Unretouched débitage *blades from Archaeological Level 1 in Area 3 at Les Tambourets.*

NU6, to the frequencies of striking platform facetting on the blanks struck from these cores.

IV. COMPARISONS WITH ATTRIBUTE DATA FOR RETOUCHED TOOLS

Information on tool blank dimensions reported above in previous chapters is summarized graphically in Figures 12-9, 12-10, and 12-11, which include the data on unretouched *débitage* blades and flakes given in Table 12-1. It is apparent from Figure 12-9 that the unretouched *débitage* products are shorter than any retouched tools except pieces lightly retouched across an extremity. The general message of the scatterplot is clear: there was a selection of the larger blanks for tool production, and the unretouched blades and flakes are primarily the residua of tool manufacture.

Considering flakes only (see Figure 12-10), the small sample of truncated flakes comprises the smallest tools, even smaller than unretouched *débitage* flakes. The largest blade tools are end-scrapers and marginally retouched blades (see Figure 12-11). Châtelperron points are the smallest blade tools, but unretouched *débitage* blades are even shorter. The suggestion advanced above from the comparative data on nucleus length—that unretouched débitage blades represent objects rejected as tool blanks because they were too small—is very strongly supported by Figure 12-11.

Another simple but informative comparison concerns the presence of cortex on retouched tools and unretouched *débitage* blades and flakes. Figure 12-12 uses the data of Table 12-1 on the pooled sample of *débitage* flakes and blades and data on retouched tool classes reported above in previous chapters. It is quite clear that the unretouched *débitage* products are *not* the most cortical of the artifact classes—they are not just the products of the earliest stages of core reduction. Scrapers of all kinds and burins have higher frequencies of cortex than the unretouched *débitage* products (as do pieces lightly retouched across an extremity, which look a lot like *débitage* on Figure 12-9). Combining the cortex data with those on the length-width scattergrams, it seems likely that scrapers and burins were considered by the Tambourets artificers as preferentially large tools. With generally small flint nodules available, it was most often only the cortical flakes removed from the nodules at a very early stage in the reduction process that were large enough

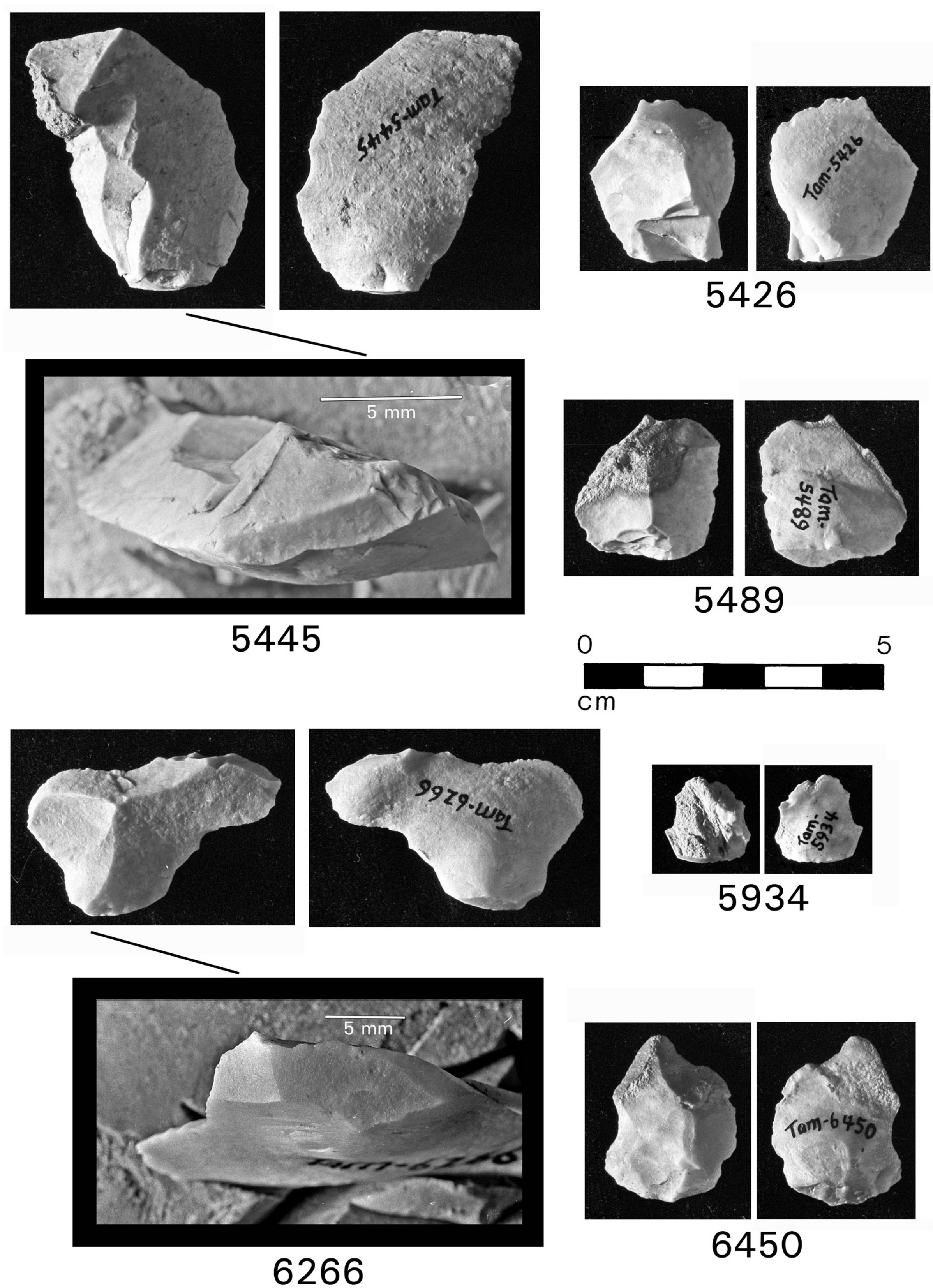

Figure 12-4. Unretouched débitage *flakes from Archaeological Level 1 in Area 3 at Les Tambourets. An enlarged view of the surface of the striking platform is shown for #5445 and #6266.*

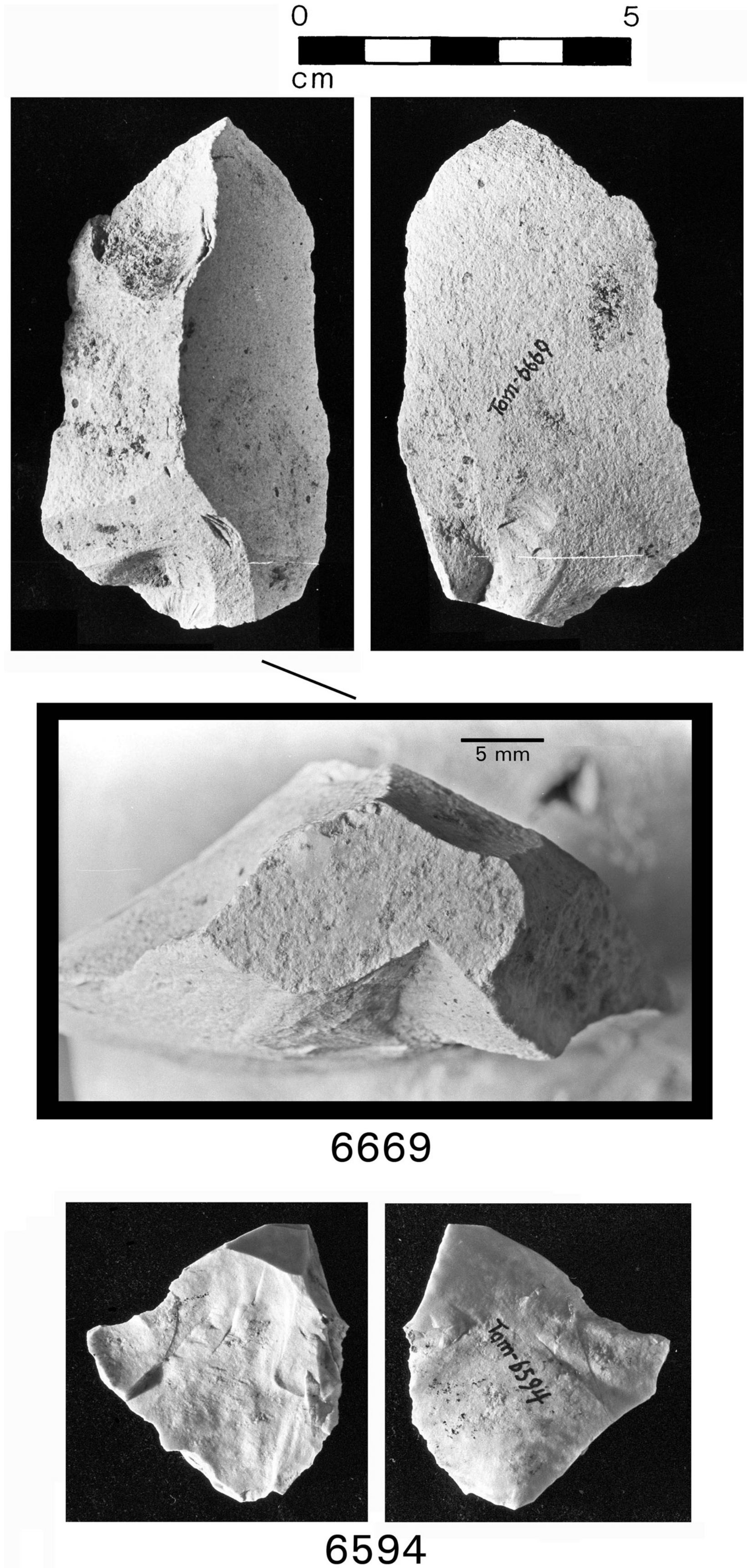

Figure 12-5. Unretouched débitage *flakes from Archaeological Level 1 in Area 3 at Les Tambourets. An enlarged view of the surface of the striking platform is shown for #6669.*

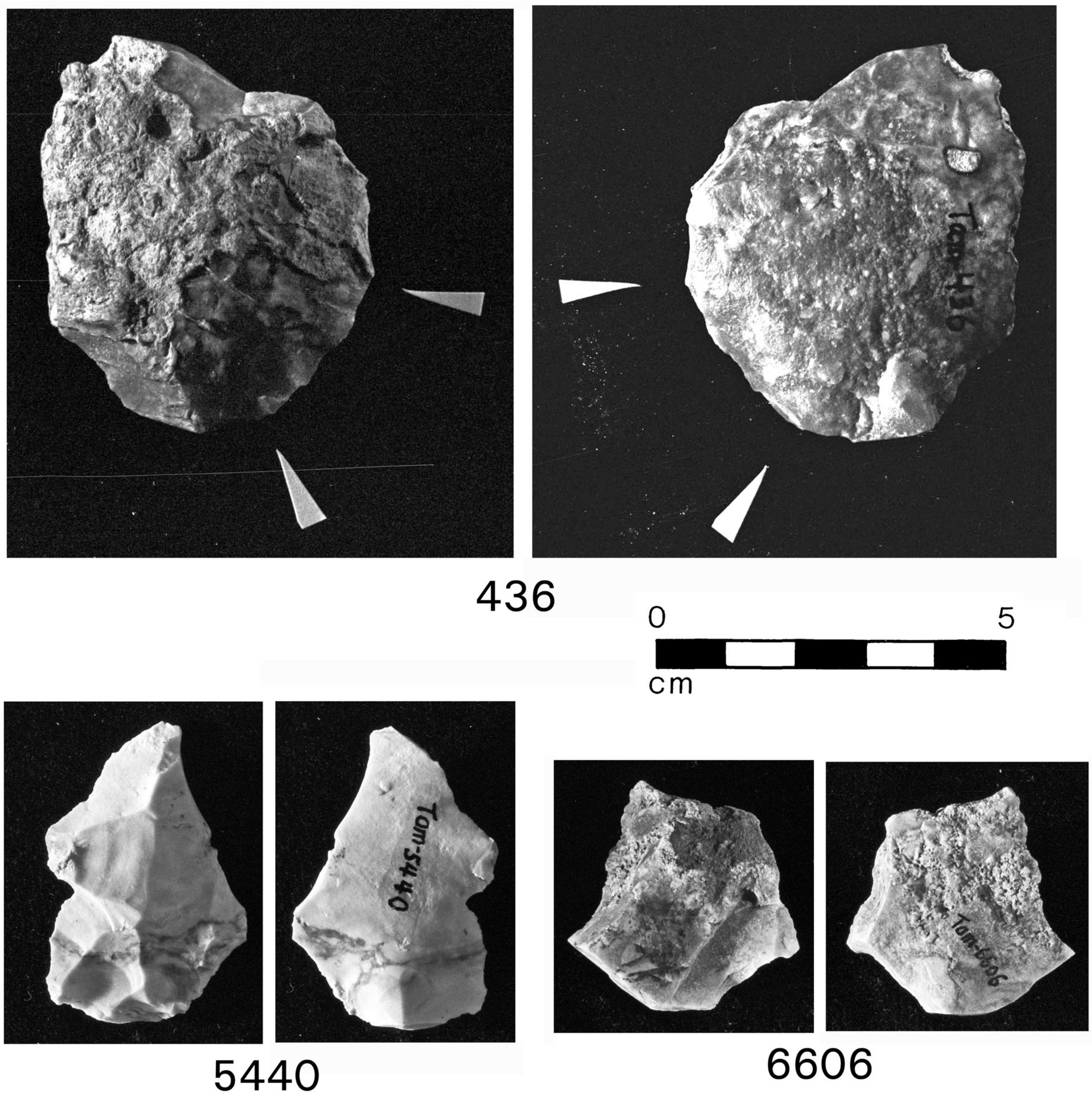

Figure 12-6. Unretouched débitage *flakes from Archaeological Level 1 in Area 3 at Les Tambourets. White markers point to areas of rounding and polishing on the margin of #436.*

for the intended purposes.

The least cortical tool classes at Les Tambourets are two that functioned, at least in part, as knives—Châtelperron points, which are not cortical, and marginally retouched pieces, which seldom are. The marginally retouched pieces are among the longest of retouched tool classes, but they are not particularly wide. Blanks for their production could have been produced in an early stage of core reduction but after the cortex had been removed.

Finally, the characteristics of the striking platforms of the unretouched *débitage* products may be compared with those of the retouched tool blanks in a very small sample (n=24) from the 1980 excavations. The frequencies of smooth and facetted platforms in the tool and *débitage* samples are almost identical. The platforms of tool blanks are considerably larger (for blades and flakes combined, length $\bar{X}$±s is 19.26±11.90mm and width is 8.39±6.65mm) than those for unretouched *débitage* products (see Table 12-1). Given the strong positive correlations among platform dimensions and blank dimensions (see Table 12-2), this is precisely what is to be expected given the data of Figure 12-9.

V. RELATIONSHIPS AMONG SAMPLES OF UNRETOUCHED *DÉBITAGE* FLAKES

The unretouched *débitage* products in the Méroc surface collections were not subjected to attribute analysis. However, three small samples of flakes recovered by excavation during the 1980 season from stratigraphic units other than Archaeological Level 1 (see Table 12-1) may be compared with flakes from the latter. Calculation of values of Mahalanobis' D^2 was based on five attribute sets[9]—the three dimensions of the blank (NS4, NS5, NS8) and the two dimensions of the striking platform (NS21, NS22). All values of D^2 (Table 12-3) are low; the four samples of unretouched *débitage* flakes are quite similar. In the three samples excavated from Area 3, the flakes are somewhat smaller in couche B(Basal) and couche C than in Archaeological Level 1; it is likely that the postdepositional disturbance processes responsible for the presence of artifacts in the sediments immediately above and below the archaeological level acted preferentially on smaller objects. The results of a cluster analysis (not shown here) are the expected ones: the two series mechanically derived from Archaeological Level 1 are the most similar, and the series from Area 2 is the most divergent, but all four samples are very similar in their dimensions.

ENDNOTES

1. Chi-squared=1.472, df=1, 0.25>P>0.10.
2. For cortical and noncortical flakes, respectively, the sample values of length are 31.1±11.9 and 27.8±11.6mm; width values are 28.8±10.0 and 25.2±10.1mm; thickness values are 10.2±4.6 and 7.6±4.4mm. For comparisons of length, width, and thickness, respectively: t=2.489, df=343, P(1-tailed)=0.006; t=3.158, df=343, P(1-tailed)=0.001; t=5.051, df=343, P(1-tailed)<0.0001.
3. Chi-squared=20.42, df=1, P<0.0001.
4. For utilized and unutilized blades, respectively, the sample values of length are 43.0±11.6 and 32.8±14.4mm (t=2.88, df=55, P[1-tailed]=0.003); the sample values of width are 19.3±6.7 and 14.5±7.0 mm (t=2.49, df=55, P[1-tailed]=0.008). For utilized and unutilized flakes, length values are 30.5±11.6 and 28.1±11.8mm (t=1.81, df=343, P[1-tailed]=0.034) and width values are 27.9±10.3 and 25.6±10.2mm (t=1.99, df=343, P[1-tailed]=0.022).
5. Scandiuzzi (2008: 59, 66) reports that 77% of blades and 79% of flakes have "*lisse*" striking platforms. Clearly, then, his "*lisse*" is not the equivalent of our "smooth."
6. For platform length, t=4.757, df=365, P(1-tailed)<0.0001. For platform width, t=2.967, df=365, P(1-tailed)=0.002.
7. For platform length, facetted values are 16.16±8.68mm, and those of smooth platforms are 11.77±7.78mm (t=4.707, df=311, P[1-tailed]<0.0001). For platform width, facetted values are 6.30±4.03mm, and those of smooth platforms are 4.56±3.36mm (t=4.142, df=311 P[1-tailed]=0.0001).
8. The CURVE curve-fitting program in SIGSTAT (1986), run on a "PC" personal computer, was used to determine the best-fit regression function for the length-width data of Figure 12-7. The best-fit equation, defining a curvilinear regression, is: Length = Width/[(.004968xWidth)+0.355999]. This equation was used to plot the regression line shown in Figure 12-8.
9. The values of D2 were calculated using the BMDP3D program (Sookne and Forsythe 1988) run on an IBM 3081 KX computer at the Tulane Computing Services.

Table 12-1.--Distributions of blank length and other attribute sets of unretouched *débitage* products.

	Area 3: A.L.1 (Blades)		Area 3: A.L.1 (Flakes)		Area 3: A.L.1 (Fls+Bls)		Area 3: c.B(Bas) (Flakes)	Area 3: c.C (Flakes)	Area 2: Str.III (Flakes)
N (complete)	57		345		402		30	9	10
Blank Length (NS4) in mm									
$\bar{X}$	39.58		28.94		30.45		26.23	27.67	23.18
s	13.40		11.76		12.55		11.74	12.79	7.56
Blank Width (NS5) in mm									
$\bar{X}$	17.70		26.44		25.20		21.43	24.67	21.91
s	7.11		10.23		10.30		7.31	9.43	6.56
Blank Thickness (NS6) in mm									
$\bar{X}$	7.88		8.52		8.43		6.83	8.00	7.09
s	4.30		4.65		4.60		3.32	3.20	4.11
	n	%	n	%	n	%	n	n	n
Presence of Utilization (NS9)	38	66.67	121	35.07	159	39.55	18	7	6
Presence of Cortex (NS2)	15	26.32	119	34.49	134	33.33	7	3	2

(Table 12-1--continued)

	Area 3: A.L.1 (Blades) n	%	Area 3: A.L.1 (Flakes) n	%	Area 3: A.L.1 (Fls+Bls) n	%	Area 3: c.B(Bas) (Flakes) n	Area 3: c.C (Flakes) n	Area 2: Str.III (Flakes) n
Nat. of Striking Platform (NS20)									
Indeterminate	3	5.26	32	9.28	35	8.71	0	0	1
Smooth	28	49.12	154	44.64	182	45.27	18	5	4
Facetted	26	45.61	159	46.09	185	46.02	12	4	5
TOTAL	57	99.99	345	100.01	402	100.00	30	9	10
N (determinate)	54		313		367		30	9	9
Platform Length (NS21) in mm									
$\bar{X}$	8.33		14.00		13.17		9.37	9.56	10.60
s	4.75		8.53		8.32		6.26	5.75	6.22
Platform Width (NS22) in mm									
$\bar{X}$	3.82		5.44		5.20		3.97	4.11	4.00
s	3.01		3.81		3.75		3.46	2.93	1.94

Table 12-2.--Relationships among blank dimensions and striking-platform dimensions of 367 unretouched *débitage* blades and flakes with smooth or facetted platforms from Area 3:Archaeological Level 1. The lower half-matrix tabulates correlation coefficients (r); the upper half-matrix tabulates probability values (P).

	Bl.L.	Bl.W.	Bl.Th.	Pl.L.	Pl.W.
Blank Length		<.01	<.01	<.01	<.01
Blank Width	.575		<.01	<.01	<.01
Blank Thickness	.668	.689		<.01	<.01
Platform Length	.281	.583	.473		<.01
Platform Width	.332	.497	.552	.815	

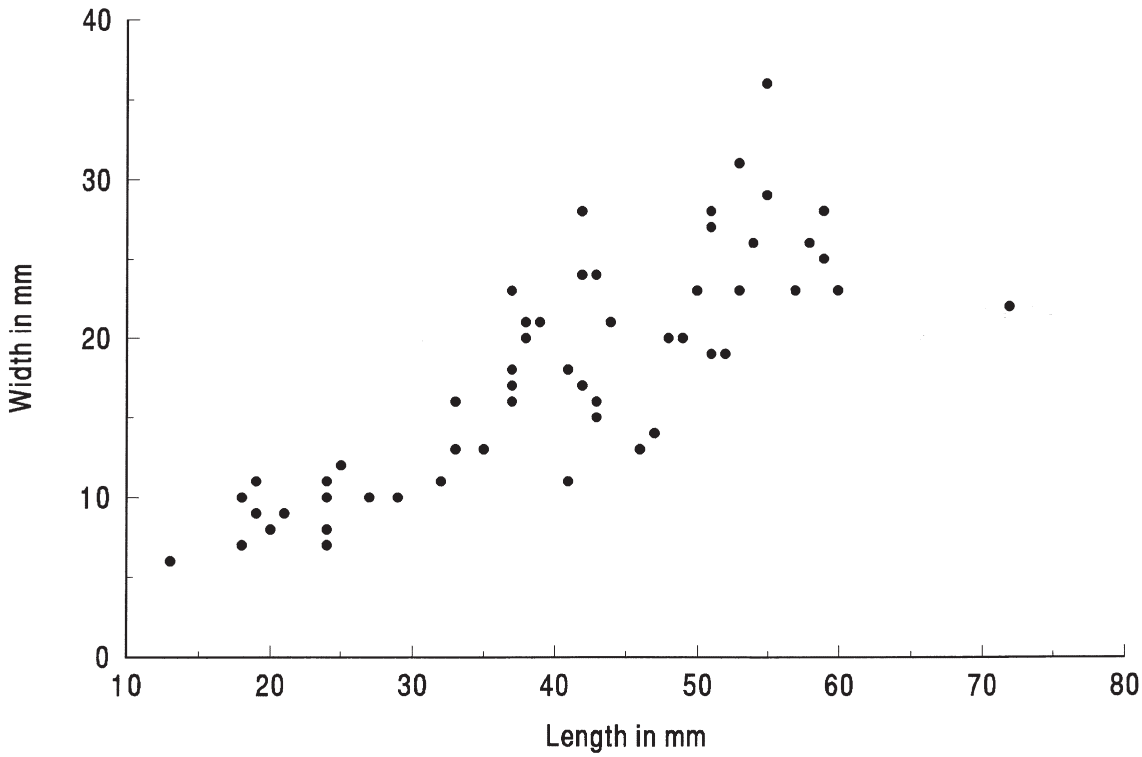

Figure 12-7. Scattergram of length and width of complete unretouched débitage *blades from Archaeological Level 1 in Area 3 at Les Tambourets.*

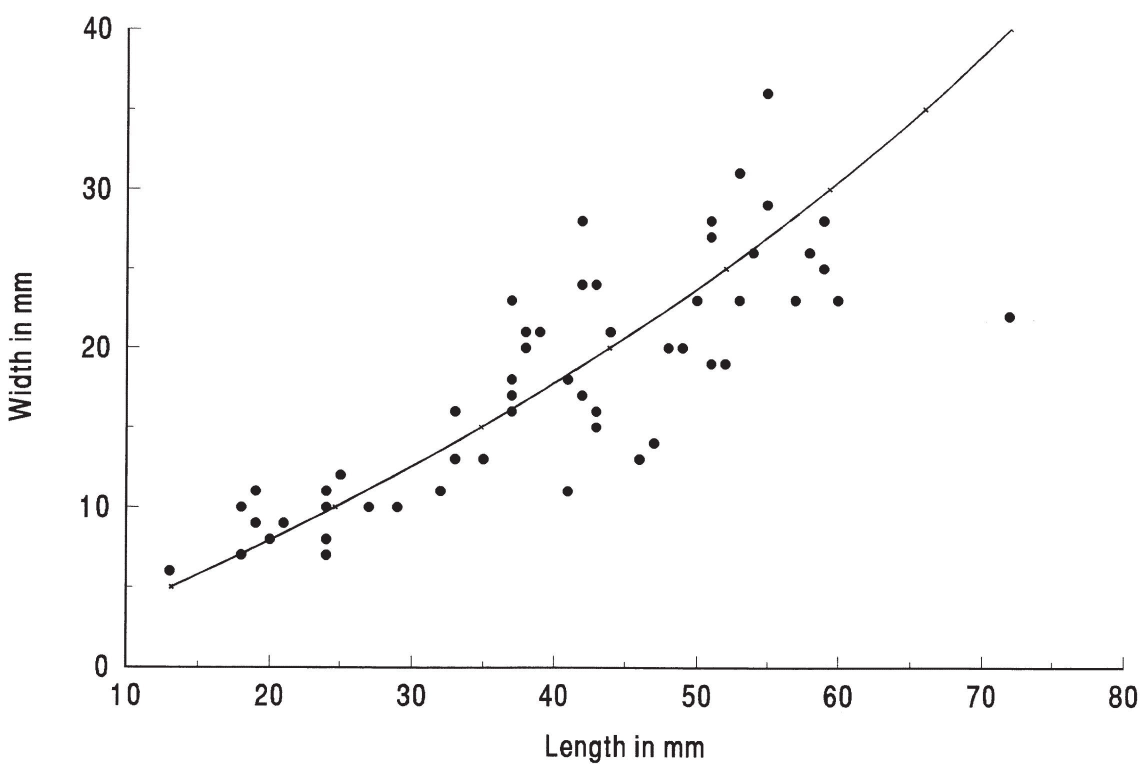

Figure 12-8. Best-fit regression line superposed on scattergram of Figure 12-7, as discussed in the text.

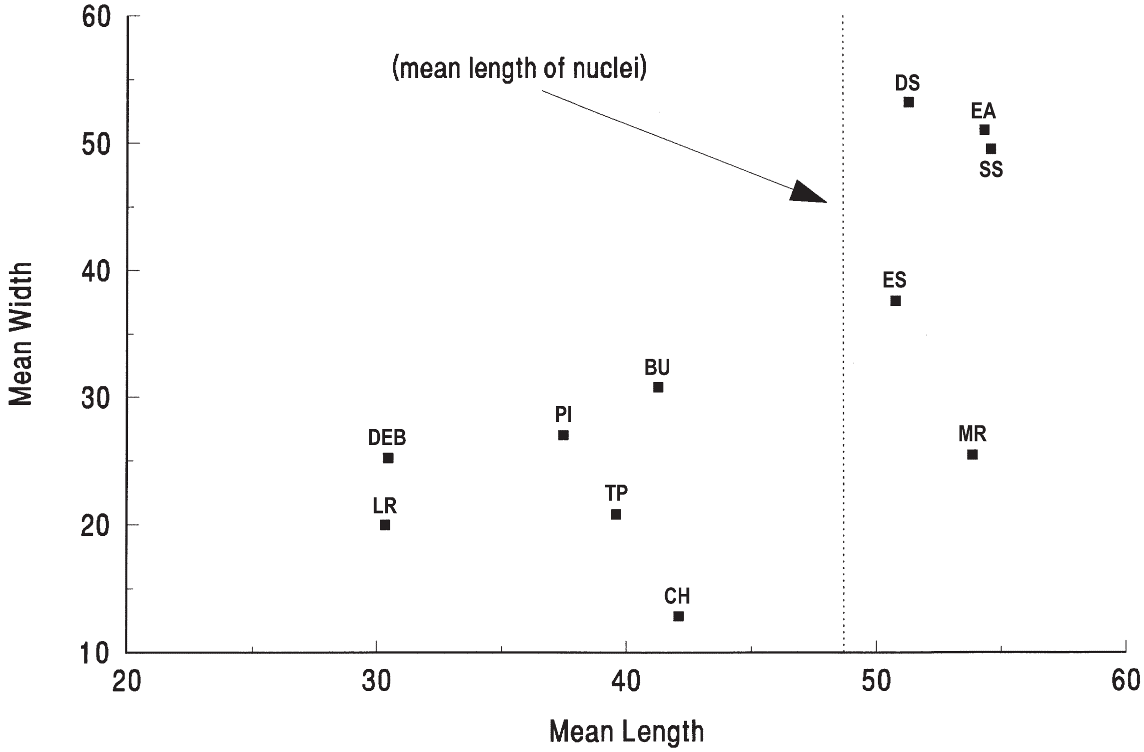

Figure 12-9. Scattergram of mean length and mean width of studied samples of lithic artifacts from Les Tambourets compared with the mean length of studied nuclei. BU: burins; CH: Châtelperron points; DS: discoidal scrapers; EA: end-and-side-scrapers; ES: end-scrapers; DEB: unretouched débitage *products; LR: pieces lightly retouched across an extremity; MR: marginally retouched pieces; PI: pieces with partial and/or irregularly truncated extremities; SS: side-scrapers; TP: truncated pieces.*

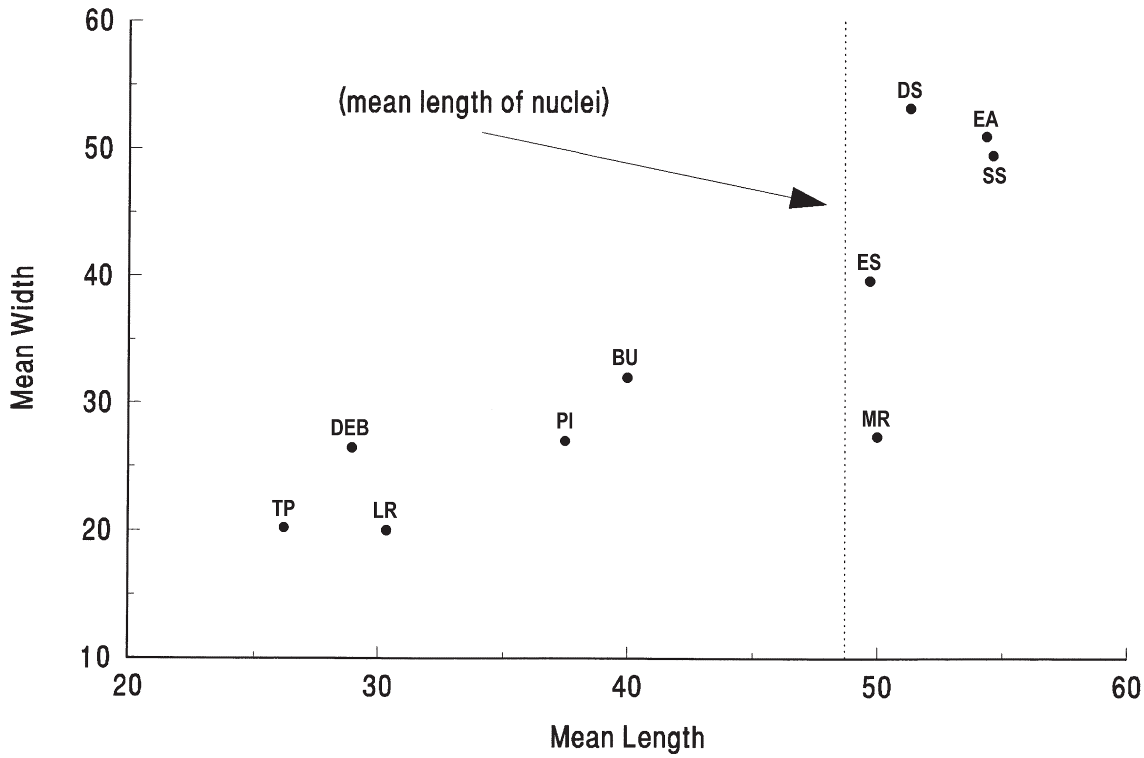

Figure 12-10. Scattergram of mean length and mean width of studied samples of lithic artifacts on flakes from Les Tambourets compared with the mean length of studied nuclei (artifact category abbreviations as for Figure 12-9).

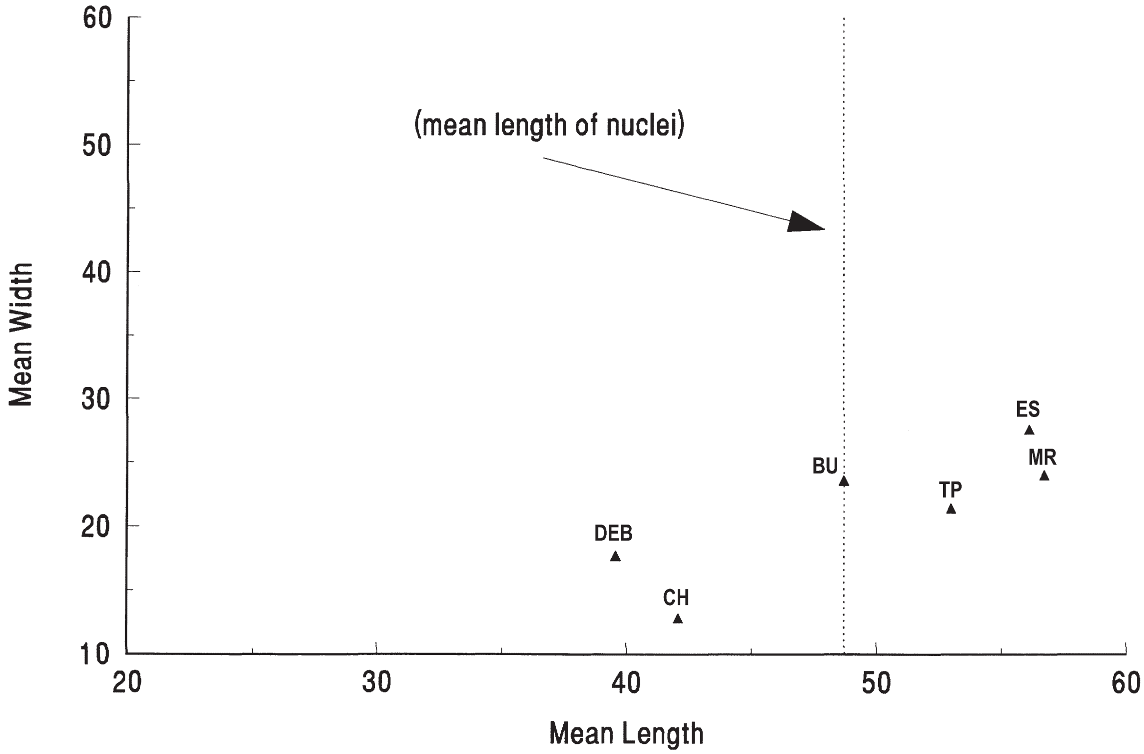

Figure 12-11. Scattergram of mean length and mean width of studied samples of lithic artifacts on blades from Les Tambourets compared with the mean length of studied nuclei (artifact category abbreviations as for Figure 12-9).

Table 12-3.--Relationships among four samples of complete unretouched <u>débitage</u> flakes, based on variation in five attribute sets (NS4, NS5, NS8, NS21, NS22). Lower half-matrix contains values of the Mahalanobis generalized distance statistic (D^2). Upper half-matrix contains 2-tailed probability values for the distance measures.

	1	2	3	4
1		.10>P>.05	>.20	>.20
2	0.43		>.20	>.20
3	0.47	0.26		>.20
4	0.46	0.48	0.79	

Sample 1. Area 3:A.L.1 N = 213
Sample 2. Area 3:c.B(Basal) N = 30
Sample 3. Area 3:c.C N = 9
Sample 4. Area 2:Str.III N = 10

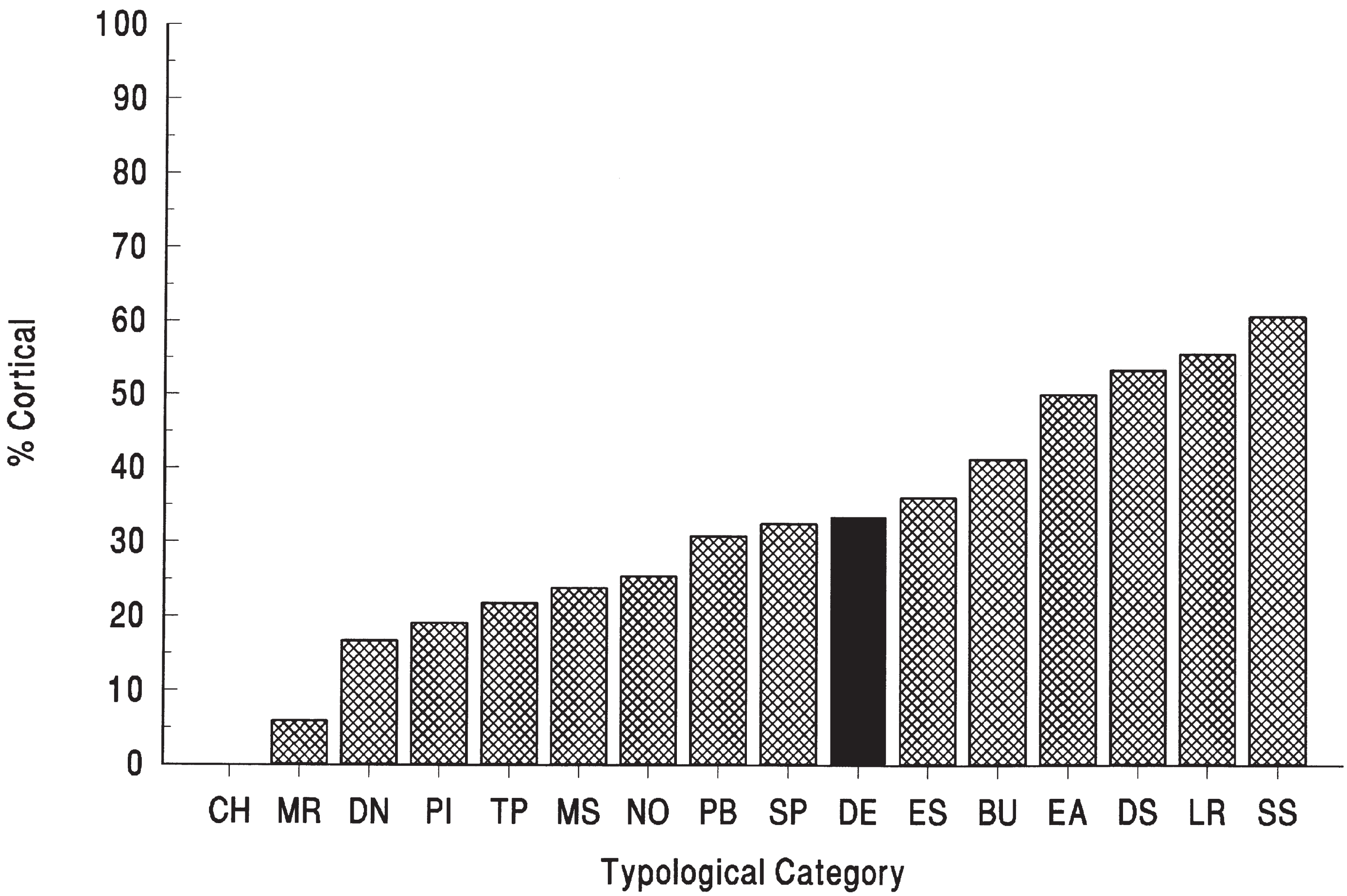

Figure 12-12. Frequency polygon of the occurrence of cortex on different categories of lithic artifacts from Les Tambourets. BU: burins; CH: Châtelperron points; DE: unretouched débitage products; DN: denticulates; DS: discoidal scrapers; EA: end-and-side-scrapers; ES: end-scrapers; LR: pieces lightly retouched across an extremity; MR: marginally retouched pieces; MS: miscellaneously retouched pieces; NO: notched pieces; PB: perforators and becs; PI: pieces with partial and/or irregularly truncated extremities; SP: splintered pieces; SS: side-scrapers; TP: truncated pieces.

CHAPTER 13
FLINT VARIETIES AND SOURCES

INTRODUCTION

It appears obvious from inspection that several different kinds of flint were used as raw material by the Tambourets artificers. Description and codification of this variation was done at the beginning of the Tambourets research project so that information on flint variety could facilitate other tasks (for example, the rejoining of broken pieces) and could be used, eventually, in the investigation of raw material sources exploited by the site's inhabitants. The results of the study of flint varieties at the site and in the surrounding region are summarized in this chapter.

I. FLINT VARIETIES AT LES TAMBOURETS

As part of the analysis of the archaeological materials recovered from the 1973 *sondage*, all flint artifacts were sorted by physical appearance (usually the appearance of the patination), and, as a result, more than one dozen "sorting varieties" were defined and described. The classification of flint varieties was modified very slightly in 1975 based on variation within the much larger sample of excavated flint artifacts from that season. The final form of the classification, which was applied to the materials excavated in 1980 and the modern samples resulting from the source prospecting of 1977 (see Section III, below), is given in Appendix C.

Each flint variety described in Appendix C is designated in three ways: a) a descriptive name, usually a binomial (Volp White, Speckled Gray); b) a short abbreviation of that name (VW, SG); and c) a two-digit code number (11, 34). Use of the classification for sorting thousands of objects, as well as information on modern sources of flint in the region, have indicated that several of the sorting varieties refer to identical or very similar flints and should be grouped for purposes of most analyses. One such group is formed by varieties 11, 12, 13, and 14, and a second contains varieties 21 and 22. Several of the very infrequent varieties (code numbers in the 30's) should perhaps be grouped with each other or with more frequently occurring varieties, but samples are too small to be certain of this. In addition to a miscellaneous category (code number 41) for unique specimens, the classification contains two categories in which flint variety is simply indeterminate because of thermal alteration (code 42) or because the object is nothing but cortex (code 43).

II. FLINT VARIETY DISTRIBUTIONAL DATA

The distribution of flint variety in Area 3:Archaeological Level 1 is shown in Table 13-1. Almost three-quarters of the objects in the sample belong to the variety 11–14 group; the only other flints that are quantitatively important are variety 23 (just over 9%) and the variety 21–22 group (approximately 4%). Nearly 5% of examples cannot be fitted into the classification (assigned to variety 41), and nearly 6% are of indeterminate variety because of thermal damage or cortical composition. The information of Table 13-1 is repeated in Table 13-2 but cross-tabulated with major artifact classes (nuclei, unretouched *débitage* products, and blanks retouched into formal tools); the distribution of flint variety within each is discussed in the paragraphs below.

Almost all flint varieties are represented in the Archaeological Level 1 sample by both nuclei and detached products. The exceptions, for which no nuclei have been recovered from Archaeological Level 1, are the infrequently occurring varieties 32, 35, and 37.[1] There are no significant associations between flint variety and nucleus shape (prismatic, flat, etc.), as tested by Chi-squared. Analysis of variance on a sample of 124 prismatic nuclei from Archaeological Level 1 where flint variety is determinable shows no significant effect of flint variety upon the dimensions of the nuclei.[2]

Among the unretouched *débitage* products, the kind of blank produced—blade or flake—is not significantly associated with flint variety, as tested by Chi-squared. In the sample of unretouched *débitage* flakes, the attribute analysis of which was reported previously (see Chapter 12), a series of analyses of variance and Scheffé tests suggested that blanks of flint variety 23 are the most divergent in their dimensions, which are shown in Table 13-3. Testing of means against the t-distribution confirms that flakes of flint variety 23 are significantly smaller in all three dimensions than flakes of the other major varieties (the 11–14 group or the 21–22 group).[3] The meaning of this difference is quite unclear given that nuclei of variety 23 are *not* smaller than nuclei of other flint.

The distribution of flint varieties of retouched tools is not the same as that of all flint artifacts. With respect to the principal flint varieties (11–14, 21–22, and 23), retouched tools are significantly associated with the 21–22 group, nuclei with the 11–14 group, and unretouched *débitage* products with variety 23.[4] The preferential use of the group 21–22 flint for tools is almost certainly related to the high quality of this flint as a raw material for knapping (as described in Appendix C). A more detailed picture of the relationships among flint variety and tool class is provided by Table 13-4 and Figure 13-1, which emphasize the extent to which a given tool class—for example, burins—makes up a disproportionately high or low percentage of all tools manufactured of a given flint variety or group. For example, in Figure 13-1, burins (BU) are essentially at the global average value in the group 11–14 sample, *over*represented by about 8% in the group 21–22 sample, and *under*represented by about 5% in the variety 23 sample. Tool class frequencies contributing to the largest such deviations show, when cross-tabulated with the three principal flint varieties or groups, that scrapers and splintered pieces occur preferentially on group 11–14 flint, burins occur preferentially on group 21–22 flint, and a combined sample of truncated pieces and marginally retouched pieces (pooled to overcome small cell size) occur preferentially on group 21–22 flint and variety 23 flint.[5] It seems very difficult to interpret the data of Figure 13-1 in terms of global variables like size of nodules or "workability" of the flint; it is more likely that the differences result from different raw material preferences or constraints obtaining during discrete occupational

Table 13-1.--Distribution of flint variety of flint artifacts in Area 3:Archaeological Level 1 (code numbers and abbreviations are explained in Appendix C).

Flint Variety	n	%		n	%
11 VW	2288	53.73			
12 VWW	109	2.56			
13 WTV	616	14.47			
14 TG	102	2.40			
			Subtotal 11-14	3115	73.16
21 WB	84	1.97			
22 MB	88	2.07			
			Subtotal 21-22	172	4.04
23 GT	396	9.30			
			Subtotal 23	396	9.30
31 LG	12	0.28			
32 GP	13	0.31			
33 GB	14	0.33			
34 SG	18	0.42			
35 FC	32	0.75			
36 SB	2	0.05			
37 DH	17	0.40			
38 JC	18	0.42			
			Subtotal 31-38	126	2.96
41 MSY	205	4.81			
			Subtotal 41	205	4.81
42 ITA	186	4.37			
			Subtotal 42	186	4.37
43 IC	58	1.36			
			Subtotal 43	58	1.36
TOTAL	4258	100.00		4258	100.00

episodes represented by the Archaeological Level 1 sample.

The distributional information on flint variety reported in the preceding paragraphs combined with information about nuclei reported previously (see Chapter 11) provides several suggestions about the nature and location of the flint sources used by the Tambourets artificers. These data and their implications may be summarized as follows:

a. aThere was a heavy dependence at Les Tambourets on a limited range of flints—over 73% of the flint artifacts are of the 11–14 group, and over 86% of the artifacts are made of only three groups or varieties (11–14, 21–22, and 23).
b. The much greater use of the 11–14 group than either the 21–22 group or variety 23 suggests that the 11–14 flint was of a higher quality (which seems almost certainly untrue), or that there was more of it available, or that it was available nearer to the site, and/or that it was more easily accessible for some other reason.
c. The comparatively small size of exhausted nuclei suggests that most of the nodules available to the Tambourets artificers were relatively small.
d. The high percentage of *ébauches* in the nucleus sample means that triage at the source was not practiced consistently or, at least, consistently effectively. This could be taken to suggest that because the principal source areas were not very distant from the site, there was no need for extensive testing of nodules at the source.
e. The low frequency of rolled nuclei argues for the collection of flint nodules close to the geologically *in situ* sources of the flint. This would suggest, specifically, that alluvial flint sources were not important or, if they were, that stream action had transported the flint nodules for only very short distances.

These suggestions coming from the study of the archaeological materials may now be evaluated against the data

Table 13-2.--Flint variety cross-tabulated with artifact class of flint objects in Area 3:Archaeological Level 1 (code numbers for flint variey are explained in Appendix C).

	Flint Varieties 11-14		Flint Varieties 21-22		Flint Variety 23		Flint Varieties 31-38		Flint Variety 41	
	n	%	n	%	n	%	n	%	n	%
Nuclei	179	5.75	10	5.81	10	2.53	12	9.52	14	6.83
Unret. débitage products	2247	72.13	102	59.30	308	77.78	88	69.84	171	83.41
Retouched tools	689	22.12	60	34.88	78	19.70	26	20.63	20	9.76
TOTAL	3115	100.00	172	99.99	396	100.01	126	99.99	205	100.00

Table 13-3.--Blank dimensions cross-tabulated with flint variety of unretouched *débitage* flakes* in Area 3:Archaeological Level 1.

	Flint Varieties: 11-14	21-22	23	31-38	41
n	236	25	49	9	17
Blank Length (NS4) in mm					
$\bar{X}$	29.41	30.52	24.67	32.44	32.24
s	11.05	12.71	12.88	10.61	15.92
Blank Width (NS5) in mm					
$\bar{X}$	26.77	27.96	23.06	32.22	28.59
s	9.71	11.41	9.56	14.83	13.43
Blank Thickness (NS6) in mm					
$\bar{X}$	8.77	10.20	6.29	9.22	9.12
s	4.53	5.63	4.07	3.49	5.45

* NOTE: The sample is composed of all complete flakes of determinable flint variety excavated from Archaeological Level 1 during the 1973 and 1980 seasons; this is the same sample reported in Table 12-1.

Table 13-4.--Flint variety cross-tabulated with retouched tool class of flint objects in Area 3:Archaeological Level 1.

	All Flint Varieties 11-41		Flint Varieties 11-14		Flint Varieties 21-22		Flint Variety 23		Fl.Vars. 31-38	Fl.Var. 41
	n	%	n	%	n	%	n	%	n	n
SC*	164	18.79	136	19.74	5	8.33	14	17.95	4	5
BK	60	6.87	47	6.82	4	6.67	6	7.69	2	1
BU	122	13.97	96	13.93	13	21.67	7	8.97	4	2
TR	53	6.07	39	5.66	5	8.33	6	7.69	2	1
MR	42	4.81	27	3.92	4	6.67	9	11.54	1	1
PB	27	3.09	22	3.19	1	1.67	2	2.56	0	2
ND	178	20.39	139	20.17	13	21.67	16	20.51	6	4
SP	71	8.13	60	8.71	5	8.33	2	2.56	3	1
CO	10	1.15	7	1.02	1	1.67	2	2.56	0	0
OT	2	0.23	1	0.15	0	0	0	0	0	1
MI	144	16.49	115	16.69	9	15.00	14	17.95	4	2
	873	99.99	689	100.00	60	100.01	78	99.98	26	20

* NOTE: SC = scrapers of all kinds; BK = backed tools of all kinds; BU = all burins and spalls; TR = truncated pieces and pieces related to truncated pieces; MR = marginally retouched pieces; PB = perforators and *becs*; ND = notched pieces and denticulates; SP = splintered pieces; CO = combination tools; OT = other retouched tools; MI = miscellaneous retouched pieces

concerning present-day flint sources in the region surrounding Les Tambourets.

III. FLINT SOURCES NEAR LES TAMBOURETS

Systematic treatment of the sources of the flint used at Les Tambourets and other sites in the region (primarily Haute-Garonne and Ariège) began during the Second World War with the report by Louis Méroc (1943–1944) on the prehistorically used flint sources of the Petites-Pyrénées mountain chain. Méroc's work was greatly extended by Robert Simonnet (1981, 1993, 1994, 1999, 2002),[6] and I did some limited prospecting and field verification focused specifically on Les Tambourets in 1977 (Appendix D). As a result of these three investigations, it seems likely—even though mineralogical work has not yet been done—that the majority of flint used at Les Tambourets was obtained within a very few kilometers of the site.

The western end of the Petites-Pyrénées chain is rich in sources of flint suitable for stone-tool manufacture (Figure 13-2). This is particularly true of the 30km stretch that is bisected at nearly a right angle by the Garonne River, flowing here from southwest to northeast. The Petites-Pyrénées in this region are expressed topographically as an alternating series of limestone ridges and sandy or marly valleys (Carte géologique 1971, 1977). In terms of the bedrock structure, the limestone ridges are the highly inclined flanks of anticlines and synclines. In the ca. 15km stretch of the Petites-Pyrénées east of the Garonne, the chain is formed by the Plagne anticline, on the north, and the Cassagne syncline, to the south. West of the Garonne, the chain is structurally more complex, being composed of—from north to south—the Aurignac anticlinal dome, the Bouzin syncline, the Saint-Marcet-Saint-Martory anticline, and the Latoue-Sepx syncline (1971: 2; Carte géologique 1974: 16). Three calcareous formations included in these structures contain flint of high enough quality to have served as raw material for chipped lithic artifacts.

The oldest of the flint-bearing formations is the Nankin Limestone (*calcaire nankin*), formation C7b of the relevant geologic map (Carte géologique 1971).[7] Its age is Maestrichtian, the latest stage of the Cretaceous Period of the Mesozoic Era. The limestone was formed in a marine environment, but vertebrate fossils it contains indicate that it is a relatively near-shore facies (1971: 12). The flint nodules contained in the Nankin Limestone are reported by Méroc (1943–1944: 239) to vary from blond to brown in base color,

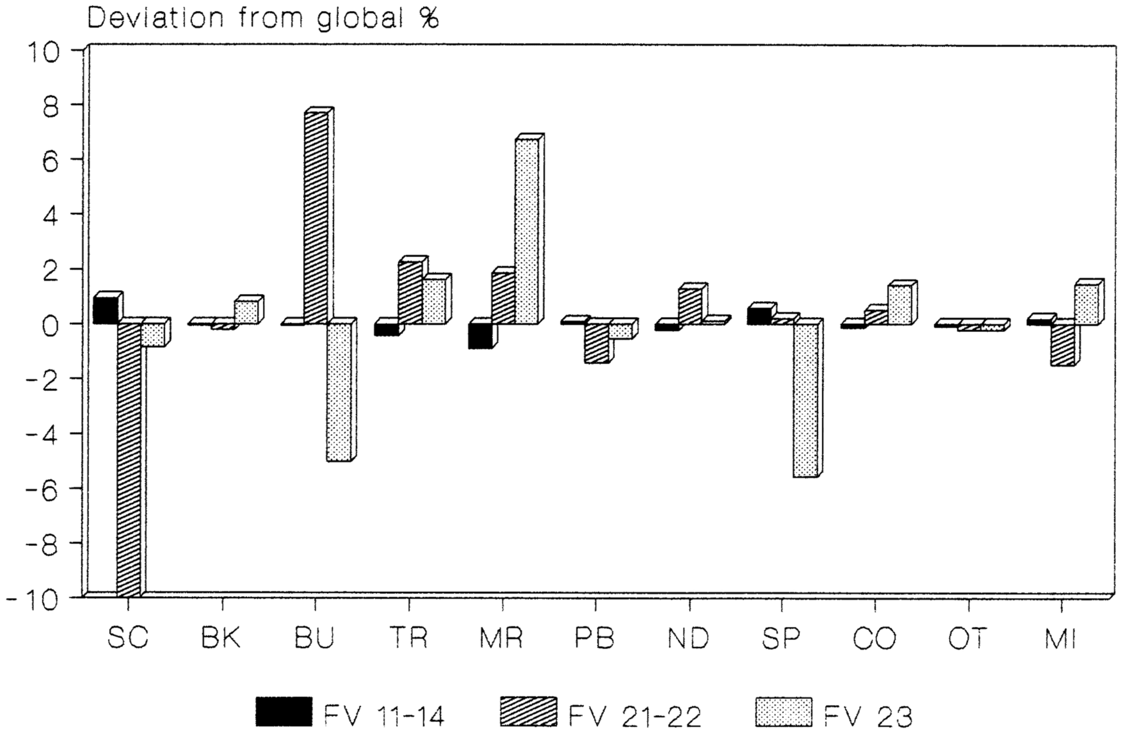

Figure 13-1. Diagram of the relative frequencies of the principal flint varieties (grouped as 11–14, 21–22, and 23) used for major categories of chipped lithic artifacts in Archaeological Level 1 in Area 3 at Les Tambourets. For each artifact category, the frequency of each of the three raw material categories is shown as its percentage deviation from the global percentage of that raw material category in the entire Archaeological Level 1 assemblage sample, as discussed in the text. SC: scrapers; BK: backed tools; BU: burins and spalls; TR: truncated pieces and pieces related to truncated pieces; MR: marginally retouched pieces; PB: perforators and becs; ND: notched pieces and denticulates; CO: combination tools; OT: other retouched lithic tools; MI: miscellaneous retouched pieces.

to patinate to "...a creamy or earthy white, dirty looking in spite of washing", and to be of generally excellent quality.

Stratigraphically above the Nankin Limestone are two formations representing the Danian stage (known formerly as the Dano-Montian), the earliest subdivision of the Paleocene Epoch, which begins the Tertiary Period and the Cenozoic Era.[8] The older of the two Danian formations, designated "e1D" on the geologic map of most relevance to the flint sources of Les Tambourets (Carte géologique 1971), is a white chalky dolomite or dolomitic limestone that formed in lagoonal or continental environments (1971: 11; Simonnet 1994: 100). This formation contains flint nodules. The younger, overlying Danian formation, "e1C" on the geological map (Carte géologique 1971), is known traditionally as the Sublithographic Limestone (*calcaire sublithographique*), a marine limestone of shallow-water estuarine or lagoonal facies.[9] This formation too contains nodules of flint.

Because both Danian formations contain flint nodules of sufficient size and quality to have been used by prehistoric artificers, it has not always been clear which formation provided the raw material for Palaeolithic artifacts. In the older literature (for example, Méroc 1943–1944), the source of the most common kind of flint used prehistorically is said to be the Sublithographic Limestone (e1C). In later literature, based on additional fieldwork, it is the basal Danian dolomitic formation, e1D, that is identified as the relevant flint source (Simonnet 1994: 100, 1999: 75). Fortunately, however, this stratigraphic uncertainty (if indeed there is one) has no great relevance for the investigation of the flint sources of Les Tambourets. Where the two Danian formations underlie or crop out on the flanks of the anticlines, synclines, and domes of the Petites-Pyrénées, both are present within a very restricted lateral distance (Carte géologique 1971, 1974). *The same source localities are at issue whether the flint came from e1D or e1C.* Accordingly, then, we refer here to "Danian flint" in an inclusive sense.

Danian flint was the lithic raw material most often employed by artificers of the region throughout the entire Middle and Upper Palaeolithic. This is true specifically of Les Tambourets, as documented here, and the nearby Mousterian site of Mauran (Simonnet 1994). The Danian formations contain numerous but generally small nodules of flint, described as follows by Méroc (1943–1944: 243):

> "...it is a flint most often chalcedonic and translucent, sometimes marbled and opaque, sometimes colorless, sometimes bluish, but assuming sometimes the most varied colors. ... It develops a sparkling porcelaneous white patination. Of very varied quality, one finds the worst side-by-side with the best; in general, it knaps badly and breaks into small flakes, but the careful choice of suitable samples permitted the manufacture of large pieces..."

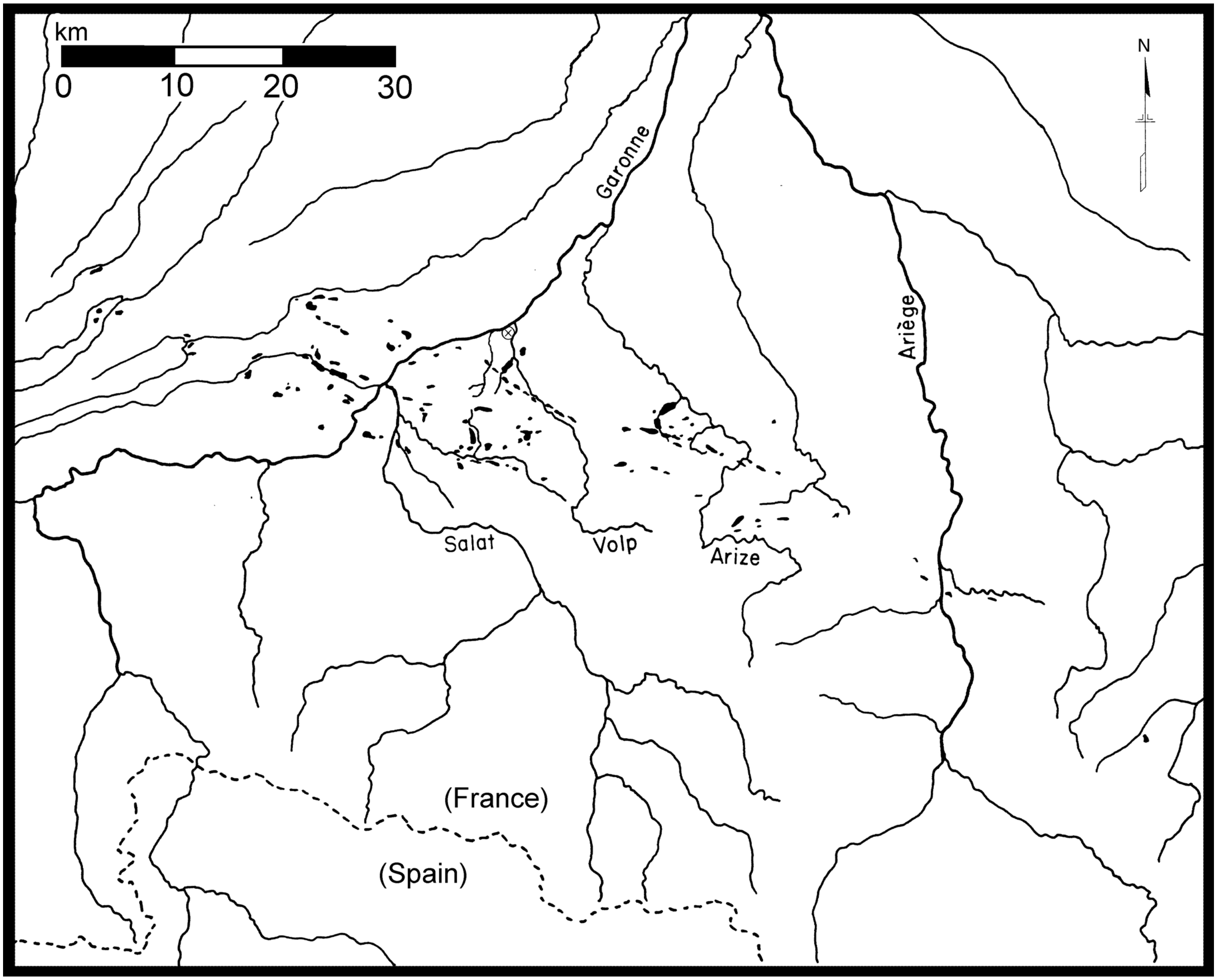

Figure 13-2. Present-day occurrences of flint (locations shown as irregular black shapes) in the Petites-Pyrénées montane foothills of southwestern France (redrawn after Simonnet 1981: 313, Figure 1). The circled "X" just southwest of the confluence of the Volp and Garonne Rivers marks the location of Les Tambourets.

Simonnet (1981: 312) describes this flint, the most common flint of the region as "...translucent, blue-gray ... or smoky gray flint [that sometimes] has, at the periphery of a block an orange-brown stain that can be deceptive if one is dealing only with flakes coming from that part of the block". This, according to Simonnet, is the general kind of flint that local inhabitants call "*le bleu*." Speaking of all flint found in the Petites-Pyrénées (not just that from the Danian formations), Simonnet (1981: 310) confirms that nodules are generally small and that the largest blades that can be produced from these sources are much smaller than Palaeolithic blades produced on flints from more favored areas like, for example, the Périgord.

Flint sources from the Nankin Limestone, the dolomitic beds of the basal Danian, the overlying Sublithographic Limestone, or from all three, crop out and/or contribute to colluvial or alluvial deposits on the flanks of all of the geological structures mentioned above. For example, the flints of the Quère Valley (locus 1 on Figure 13-3) and the Tounis Valley (locus 2) come from the northern flank of the Plagne anticline. The southern flank of that anticline (or the northern flank of the Cassagne syncline) produces the flint of Ausseing (locus 3). The Montsaunès flint (locus 4) is associated with the southern flank of the Cassagne syncline. West of the Garonne, the flints of Tucauou (locus 5) and La Lave (locus 6) come from the edges of the Aurignac anticlinal dome. The northern flank of the Saint-Marcet-Saint-Martory anticline (or the southern flank of the Bouzin syncline) produces the flints of Paillon (locus 7) and Auzas (locus 8), and the southern flank of that anticline (or the northern flank of the Latoue-Sepx syncline) produces the flint of Latoue (locus 9).

It is clear from Figures 13-2 and 13-3 that Les Tambourets is very well situated with respect to flint sources. Figure 13-4 shows explicitly that Les Tambourets is located just northeast of the center of the flint-bearing zone of the

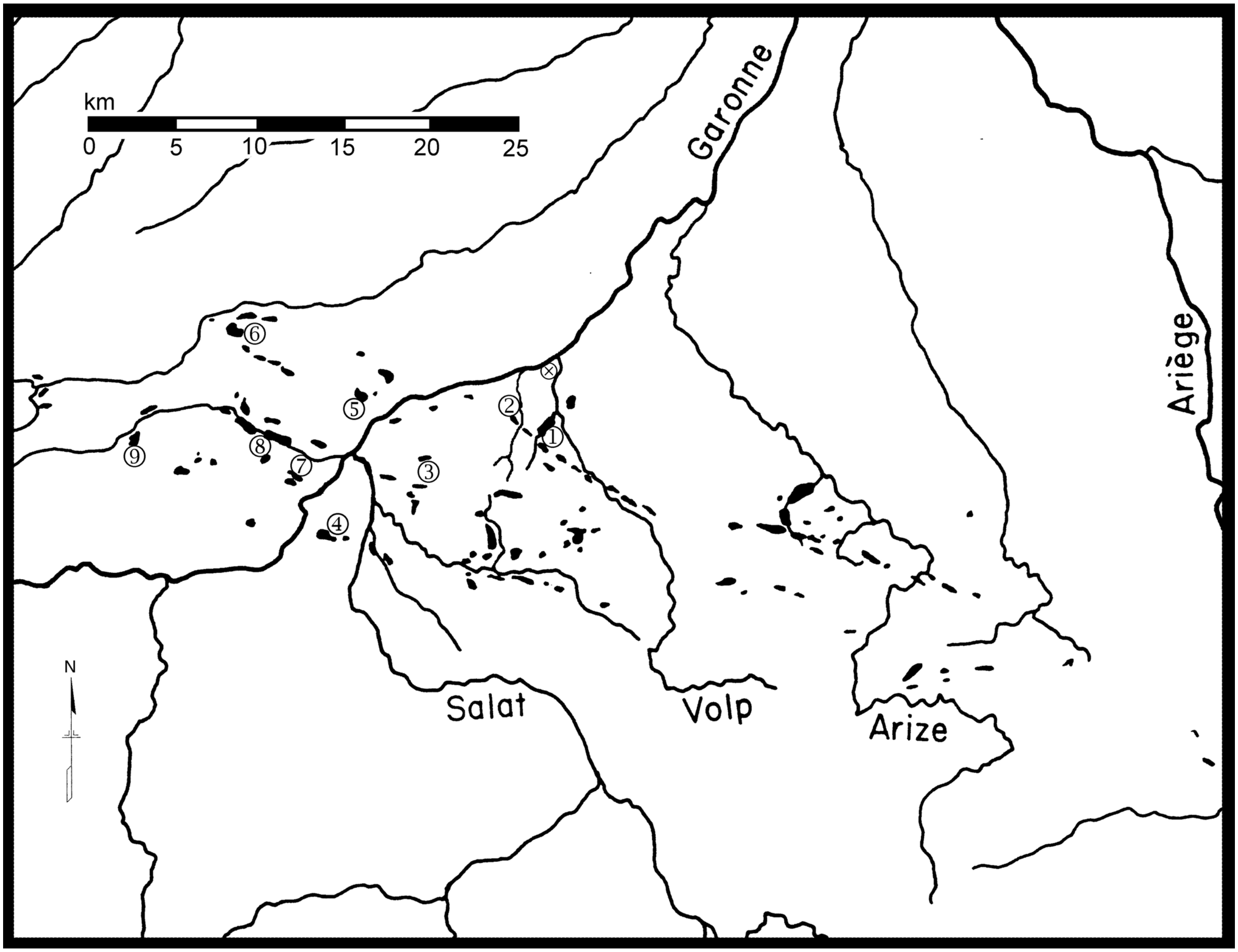

Figure 13-3. Enlarged detail of the Figure 13-2 flint occurrence map showing (with circled numbers) the locations of nine known or possible sources of flint used for the manufacture of artifacts found at Les Tambourets. The nine sources are named and discussed in the text. The location of Les Tambourets is indicated by the circled "X."

Petites-Pyrénées and that almost all known flint sources of that region are located less than 30km from the site. In the paragraphs that follow, flint sources believed to be of particular relevance to Les Tambourets are discussed in greater detail.

Much of the flint used at Les Tambourets probably came from the Danian formations exposed in the northern flank of the Plagne anticline (Appendix D). In his unpublished notes on Les Tambourets,[10] Méroc stated that, in general, the flint used for the Châtelperronian industry had been brought to the site from the Petites-Pyrénées just 2km or 3km distant "...and, more particularly, from the *calcaire lithographique* [i.e., the Danian-age bedrock] that is very abundant at the northern foot of Mont Saint-Michel". Mont Saint-Michel is the local name for what is known to drafters of government maps as Mont Saboth, a topographic high on the Plagne anticline located northwest of the village of Saint-Michel. Much of the bedrock of the hill itself is Nankin Limestone, but my 1977 reconnaissance found no flint on the hill itself. Outcrops of the Danian formations occur at the northern foot of Mont Saboth and along a line trending southeast from the northern outskirts of the village of Saint-Michel. The principal drainage in this area is the Quère Creek (see Figure 13-3, locus 1), a tributary of the Volp River. My attempts to collect flint samples from the alluvial load of the lowermost reaches of the Quère in June 1977 and again in November 1990 were rendered unsuccessful by high water levels. Examination in November 1990 of the load of the middle Quère, due east of the village of Saint-Michel and just at the foot of the topographic high associated with the northern flank of the Plagne anticline, showed that it was composed exclusively of the Nankin Limestone and that flint of any kind was completely absent. However, field surveys done by Simonnet (1981: 311 and personal communication, 10 November 1990) have documented the abundant occurrence of flint in the alluvial load of the Quère; Simonnet recovered various kinds of "*le bleu*," including very specifically flint variety 13, which he calls "le mixte de Saint-Michel". At the bridge of Le Luquet, ca. 800m downstream from where the Quère enters

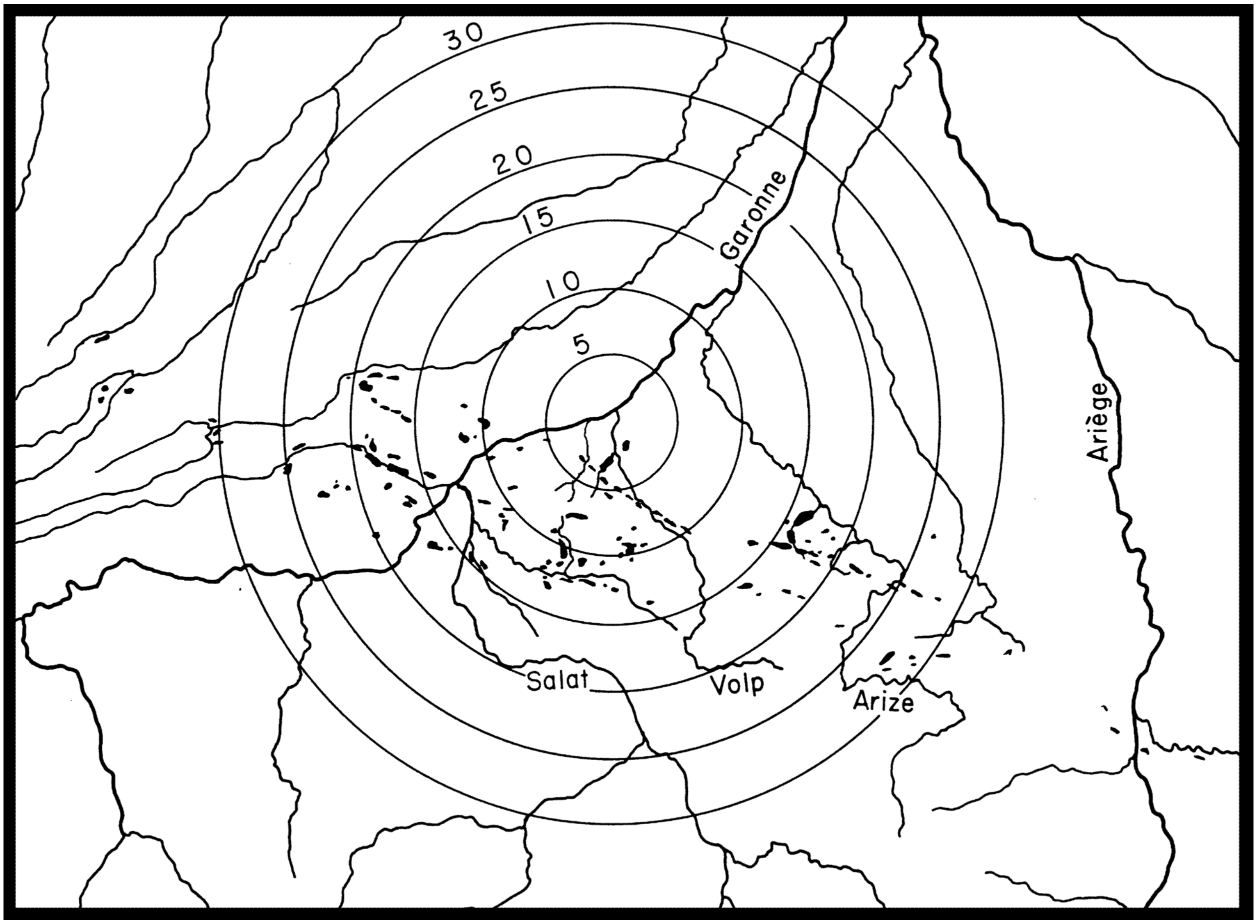

Figure 13-4. Portion of the Figure 13-2 flint occurrence map. The circles, with radii of 5, 10, 15, 20, 25, and 30km, are centered on the site of Les Tambourets, near the confluence of the Volp and Garonne Rivers.

the Volp and ca. 1800m upstream from Les Tambourets, Simonnet has documented the presence of the same kinds of flint that he found in the Quère. Given these data and the earlier observations of Méroc, there is every reason to believe that the alluvial flint of the Quère/Volp drainage was a quantitatively important source of flint variety 11 (Volp White) and related flint varieties at Les Tambourets.

Another probable alluvial source of flint from the Plagne anticline is the valley of the Tounis Creek (see Figure 13-3, locus 2), which flows northward across the anticline from near the village of Plagne to its confluence with the Garonne River just west of Couladère. In the middle part of its course, at the northwestern foot of Mont Saboth and about 4km southwest of Les Tambourets, the Tounis cuts a gorge through the Danian and other formations. A dam built in this gorge about 50 years ago creates the Lac de Tounis, centerpiece of a small recreational center. In June 1977 I collected flint samples from the limestone walls of the gorge along the lake (Appendix D). These *in situ* samples included definite specimens of what at Les Tambourets were called flint varieties 13 (White-and-Tan-Variegated) and 14 (Translucent Gray). Several pieces of flint variety 12 (Volp White Waterstained) were collected from the surface at the foot of the wall of the gorge. Most of what would have been the most relevant part of the bed of the Tounis Creek for prehistoric collectors of flint nodules is now at the bottom of the artificial lake, but there seems little doubt that the valley of the Tounis would have been an important prehistoric source of the flint most commonly used at Les Tambourets—the group composed of flint varieties 11, 12, 13, and 14.

Several flint samples collected from the modern ground surface at the Lac de Tounis are unlike the flint known to have come from the Danian formations at that locality. The flint has a warm-hue, dirty-cream patination similar to that designated flint variety 23 (Gray-Tan) at Les Tambourets. This may be another kind of Danian flint, or it may have come from the Nankin Limestone, through which the Tounis cuts its valley just upstream (south) of the lake.

Another possibly relevant source of flint for Les Tambourets is located on the southern flank of the Plagne, near the village of Ausseing (see Figure 13-3, locus 3). Following information published by Méroc (1943–1944: 238), I collected flint samples in June 1977 from the southwest spur of a hill called "Le Fageal," just north of Ausseing village (Appendix D). Although my samples were taken from the surface rather than prised from the bedrock, the geology and topography of the locality are such that the flint must be from the Nankin Limestone, which underlies the collection spot and all higher ground in the immediate area. The flint collected has a warm-hue, pinkish-brown, opaque, matte base color; it patinates to a warm buff or brown, sometimes mottled. With these characteristics, the flint of Ausseing is very similar to flint varieties 21 (Warm Buff) and 22 (Mottled Brown) at Les Tambourets. The work of Simonnet (personal communication, 10 November 1990) provides support for this association; flint variety 22 is what he calls the "Ausseing/Montsaunès" flint.

Flint samples coming without question from the Nankin Limestone were collected by me in 1977 in the quarry at Montsaunès (see Figure 13-3, locus 4). The quarry exploits only the Nankin Limestone, and the samples were prised out of the enclosing rock (Appendix D). The base color of the flint in question is a translucent gray-brown with a slightly pinkish cast—definitely a warm hue. Because such a base color has not been recorded at Les Tambourets and because all the Montsaunès samples are completely unpatinated, further comparisons are not possible.

There is no reason to believe that flint sources west of the Garonne were quantitatively important to the Châtelperronian inhabitants of Les Tambourets, but a few of the rarer flint varieties at the site may have come from the western area.[11] Simonnet (1981: 309) reports abundant flint and evidence for its prehistoric exploitation at the hill of Tucauou, west of Martres-Tolosane (see Figure 13-3, locus 5); this flint, which belongs to what Simonnet calls "*le bleu*" (personal communication, 10 November 1990), must come from a Danian formation exposed on the southeastern flank of the Aurignac dome. It is just about the closest potential source of flint for Les Tambourets west of the Garonne—ca. 10km distant—but there is no evidence that it was actually used as such.

Based on information from the geologic map (Carte géologique 1974), I sampled a colluvial source of high quality flint near the farm of La Lave (see Figure 13-3, locus 6), on the northwestern flank of the Aurignac dome and north of the town of Aurignac (Appendix D). Flint nodules and flakes occur in the soil at a place where the bedrock is the Danian e1D formation, Sublithographic Limestone.[12] The flint itself, also encountered by Simonnet (1981: 320), has a translucent, dark brown base color with lighter colored (buff or cream) opaque mottling. It patinates to a warm-hue, creamy tan, usually with a glossy surface. This kind of flint is found rarely, if at all, at Les Tambourets; a few pieces of it may have been included as flint variety 23 (Gray-Tan).

Another well known flint source west of the Garonne may have supplied a very few nodules to the Tambourets artificers. Unmodified flint nodules, as well as nuclei and flakes, occur in a colluvial context at the farm of Paillon (see Figure 13-3, locus 7), northwest of Saint-Martory (Méroc 1943–1944: 239–241; Simonnet 1981: 310). Because Paillon flint has never been discovered in enclosing bedrock, its geological provenience is unclear. The bedrock at the locality where the flint occurs in colluvial deposits is a marl of Maestrichtian age that underlies the Nankin Limestone. The Nankin Limestone forms the bedrock of topographically higher ground ca. 200m distant from the Paillon farm. Both the marl and the limestone are possible sources of Paillon flint (Appendix D). The flint is generally of a dark (reddish-brown, brown, to nearly black) and opaque base color, patinating to a dark mottled state or, occasionally, to a porcelaneous white. According to Méroc,[13] Paillon flint was used to make a scraper found by him at Les Tambourets. Flint samples that I collected from Paillon in 1977[14] make it clear, however, that Paillon flint is extremely rare at Les Tambourets; I know, in fact, of no examples. Flint varieties 36 (Solid Black) and 37 (Dark Honey) are not of Paillon flint, because they are translucent rather than opaque.

Finally, a second locality on the northern flank of the Saint-Marcet-Saint-Martory anticline may have been a very minor source of flint used at Les Tambourets. Simonnet (1981: 312) reports that a gray banded flint occurs near Auzas (see Figure 13-3, locus 8), just northeast of the Paillon locality, apparently from the Danian formations in the south wall of the Noue Valley. Although I did not collect samples from this locality, the flint as described sounds very similar to flint variety 31 (Laminated Gray) at Les Tambourets.

IV. SUMMARY AND CONCLUSIONS

Les Tambourets, the largest and by far the most artifact-rich Châtelperronian site in the entire sub-Pyrenean zone, is located at the center of a region in which flint resources are abundant. The kind of flint used most frequently for toolmaking at Les Tambourets, accounting for 73% of all flint artifacts in Archaeological Level 1 (see Table 13-1), is represented by the closely related flint varieties 11, 12, 13, and 14. Such flint occurs in the Paleocene Danian formations; it is present in both primary outcrops and alluvial contexts (the valleys of the Quère and the Tounis) less than 5km from the site. The source or sources of the next most frequently used kind of flint, variety 23 (9%), cannot be specified precisely; such flint may come from Danian formations at localities near Les Tambourets, but this has not been satisfactorily demonstrated. The only other kind of flint used in nontrivial frequency (4%) is the group represented by flint varieties 21 and 22; flint of this kind occurs in a colluvial context at Ausseing, ca. 10km from Les Tambourets, where it is weathering out of the Cretaceous Nankin Limestone. Sources for the very rare flint varieties are unknown except for variety 31, which may come from near Auzas, located between 15km and 20km from Les Tambourets.

The study of flint variety of the nuclei, tools, and unretouched *débitage* products of Archaeological Level 1 led to the framing of five implications or suggestions (see Section II, above), some of which may now be evaluated against the geological data on flint sources in the Petites-Pyrénées.

The reason for the much greater use of the 11–14 group may now be specified with greater confidence (suggestion "b," above). It is not the highest quality flint available in the region, but it is the flint available closest to the site. The suggestion ("c," above) from the Tambourets nuclei about the small size of available nodules is confirmed by the extensive fieldwork of Simonnet (1981, 1994, 1999). The further suggestion ("d," above) from the high frequency of *ébauches* in the nucleus sample that the principal flint sources were quite close to the site seems to be confirmed.

Although the reason for the low frequency of rolled nuclei ("e," above) remains undemonstrated, the new data make it highly probable that alluvial sources were indeed important to the Tambourets artificers but that the transport of the flint as stream load had been for short distances only.

Finally, one of the most interesting results of the study of flint sources used at Les Tambourets is the story not told. At least at the present state of research (without physicochemical or paleontological sourcing techniques), the distribution of raw material sources does not force us to look beyond the immediate vicinity of the site—the most distant likely sources are less than 20km distant, and it appears that an entirely trivial amount of flint came from more than 10km distant. We do not have here—at least not yet—the wherewithal to investigate patterns of human mobility and resource exploitation within a larger region.

ENDNOTES

1. Two nuclei of variety 37 were found, in what is almost certainly secondary context, in the upper part of couche B in Area 3.
2. For nucleus length (NU10), F=0.65, df=4 and 119, P(1-tailed)>0.20; for width (NU11), F=1.22, df=4 and 119, P(1-tailed)>0.20; for thickness (NU12), F=2.05, df=4 and 119, P(1-tailed)=0.09.
3. For variety 23 vs. 11–14, testing length, width, and thickness, respectively, the results are: t=2.653, df=283, P(1-tailed)=0.004; t=2.440, df=283, P(1-tailed)=0.007; t=3.551, df=283, P(1-tailed)<0.001. The corresponding values for variety 23 vs. 21–22 are: t=1.856, df=72, P(1-tailed)=0.032; t=1.952, df=72, P(1-tailed)=0.026; t=3.426, df=72, P(1-tailed)=0.001.
4. Chi-squared=25.808, df=4. P<0.0001).
5. Chi-squared=18.247, df=6, P=0.006.
6. In November 1990, Monsieur Robert Simonnet, then Conservateur du Musée d'Aurignac, met with me in Toulouse to discuss the possible sources of the flint used at Les Tambourets. He had for some years been doing field and laboratory research on the prehistorically exploited flint sources of the Petites-Pyrénées, and he very kindly shared with me all the relevant information at his disposal. I am extremely grateful to Monsieur Simonnet for his generosity with the results of his research, many of which were unpublished at the time.
7. The limestone formation received its name because it is the color of *nankin*, a French word referring to a kind of buff, reddish-buff, or yellowish-buff cotton cloth originally manufactured in the Chinese city of Nanjing (formerly written Nankin or Nanking) and imported into France and other European countries (Méroc 1943–1944: 238; Carte géologique 1971: 11). The English-language name for the cloth is either "nankeen" or "nankin."
8. In an alternative scheme regarded as more authoritative by some geologists, the Paleocene Epoch begins the Paleogene Period of the Cenozoic Era.
9. Further to the east, beyond the area of primary concern to Les Tambourets, the depositional environment of the limestone changes from marine lagoonal to fresh-water, and the limestone becomes much more fine-grained. As explained by Méroc (1943–1944: 242), "...because of the fineness of its grain, people have tried on several occasions, unsuccessfully, to use it as a lithographic stone", for which reason the eastern facies is known as *calcaire lithographique*. In the region closer to the Garonne Valley, where the limestone is not so fine-grained, it is called *sub*lithographic.
10. Méroc dossier, document 103.
11. This is the same situation reported by Simonnet (1994: 100–101) for the Mousterian site of Mauran, located just a few kilometers upstream from Les Tambourets and on the same side of the Garonne.
12. On this map (Carte géologique 1974), the lower, dolomitic Danian formation is called "e1a", but it is the same as the "e1D" of the quad to the south (Carte géologique 1971).
13. Méroc dossier, document 103.
14. My collection of samples of Paillon flint was made with the authorization and assistance of Mme Jean Frossard, owner of the terrain in question, who, in addition, very kindly allowed me to examine her collection of fossils and prehistoric artifacts from the site.

CHAPTER 14
NONFLINT LITHIC ARTIFACTS

INTRODUCTION

There are at Les Tambourets a very small number of lithic artifacts of stone other than flint, chert, chalcedony, etc. For the most part, these are water-rolled cobbles, originally part of the alluvial load of some stream, that have been modified by use as various kinds of implements. In a few cases, they have been modified *for* use and subsequently modified further *by* use. Various functions have been attributed to such artifacts, most often involving some sort of percussion, and various names have been used, most often some sort of hammer, anvil, flaking tool, or pestle. The most detailed typology applicable to these objects in the French Palaeolithic is that of Sophie de Beaune (1989, 2000). Her work is based not only on the study of numerous archaeological assemblages, but also on both ethnographic research and experimental replication. The work of Beaune underlies the description of the small sample of nonflint lithics from Les Tambourets, but her terminology is not applied rigorously here, and, in one case, the conclusions of this study depart from hers.

No attribute analysis of the nonflint lithics was carried out, and no attribute sets for these artifacts appear in Appendix B. Those objects excavated from Archaeological Level 1 are inventoried in Table 14-1 and described briefly in the paragraphs that follow. A fuller treatment is provided for the so-called specialized hammers, a distinctive kind of artifact at Les Tambourets.

I. HEAVILY MODIFIED HAMMERSTONES (PERCUTEURS)

Eight modified cobbles can be confidently classified as hammerstones. No two are alike in size or shape, but all bear contusion and crushing on the narrow ends (Figure 14-2, #5532) or, in the case of a triangular piece (Figure 14-1, #1807), on two of its three corners. In several cases, the hammerstone shattered, presumably during use (see Figure 14-1, #4579), and some otherwise indeterminate fragments of utilized cobbles are probably portions of such hammers.

II. HEAVILY MODIFIED HAMMERSTONES USED ALSO AS ANVILS (PERCUTEURS-ENCLUMES)

Two complete pieces (see Figures 14-2, #5401; Figure 14-3, #6191) and one fragment have been used in two different ways. At the narrow ends, they have the contusion damage and crushing indicating heavy-duty percussion. In this way, they are like the heavily modified hammerstones discussed in the previous paragraph. In addition, however, one or both flat surfaces bear the pock-marked damage traces that are characteristic of use as a stone anvil. In one case (see Figure 14-3, #6191), the pitting is deep on both top and bottom surfaces. This appears to be a more extreme example of the sort of use-damage seen on Figure 14-2, #5401. It is, however, what Beaune (2000: 65–70) recognizes as a separate artifact type, a cobble with a pecked cup-like depression (*galet à cupule piquetée*), an implement with a number of different ethnographically documented uses.[1] In the case of Les Tambourets, what might have been rested

Table 14-1.--Nonflint lithic artifacts in Archaeological Level 1.

Heavily modified hammerstones (*percuteurs*)	8
Heavily modified hammerstones with heavy damage from use as anvils (*percuteurs-enclumes*)	3
Lightly modified hammerstones (*retouchoirs*)	2
"Specialized hammers", with ground facets	10
Possible "specialized hammers"	3
Indeterminate fragments, probably of hammerstones	4
Limonite crayon	1
Rock fragment with highly polished surfaces	1

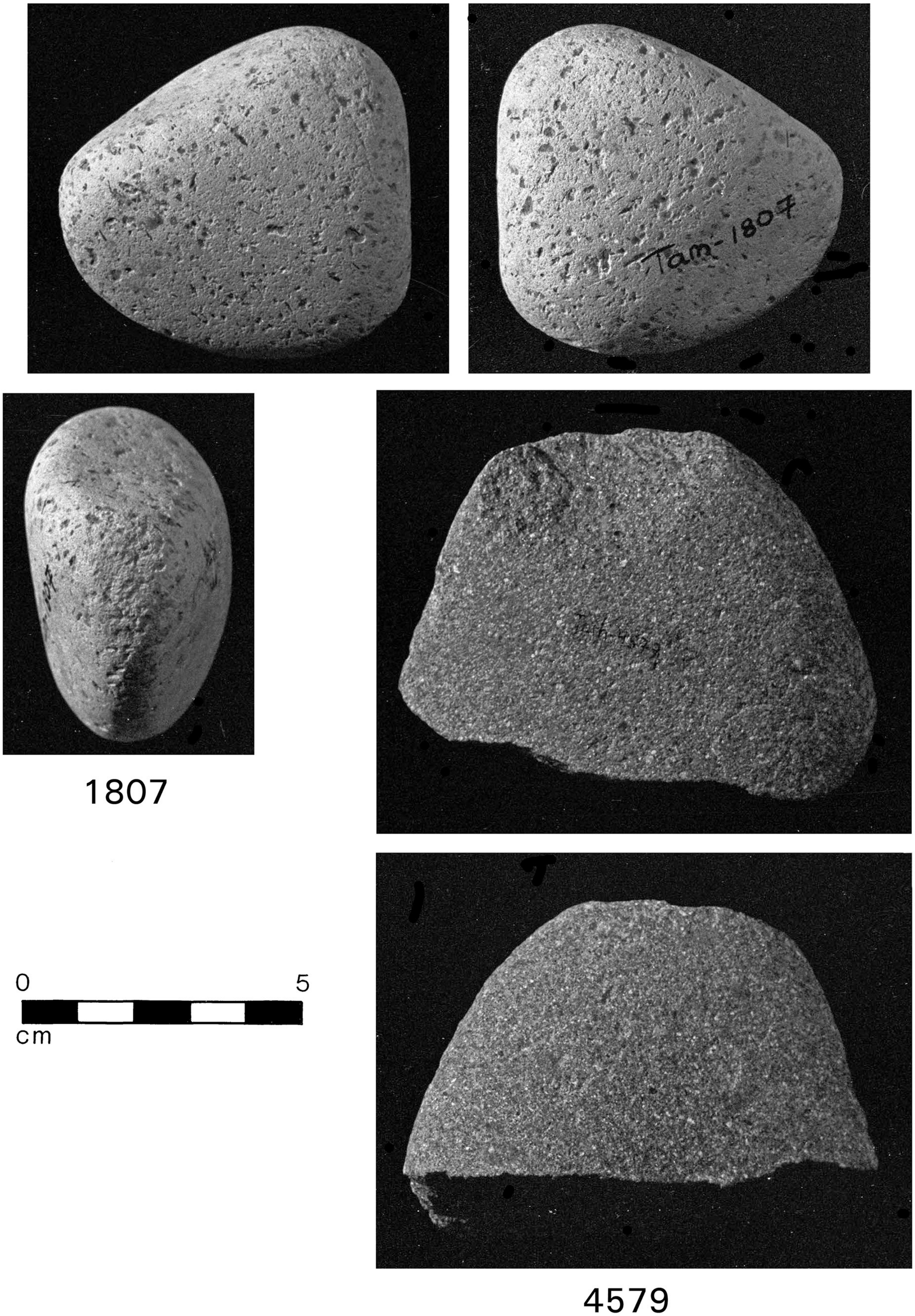

Figure 14-1. Heavily modified hammerstones from Archaeological Level 1 in Area 3 at Les Tambourets.

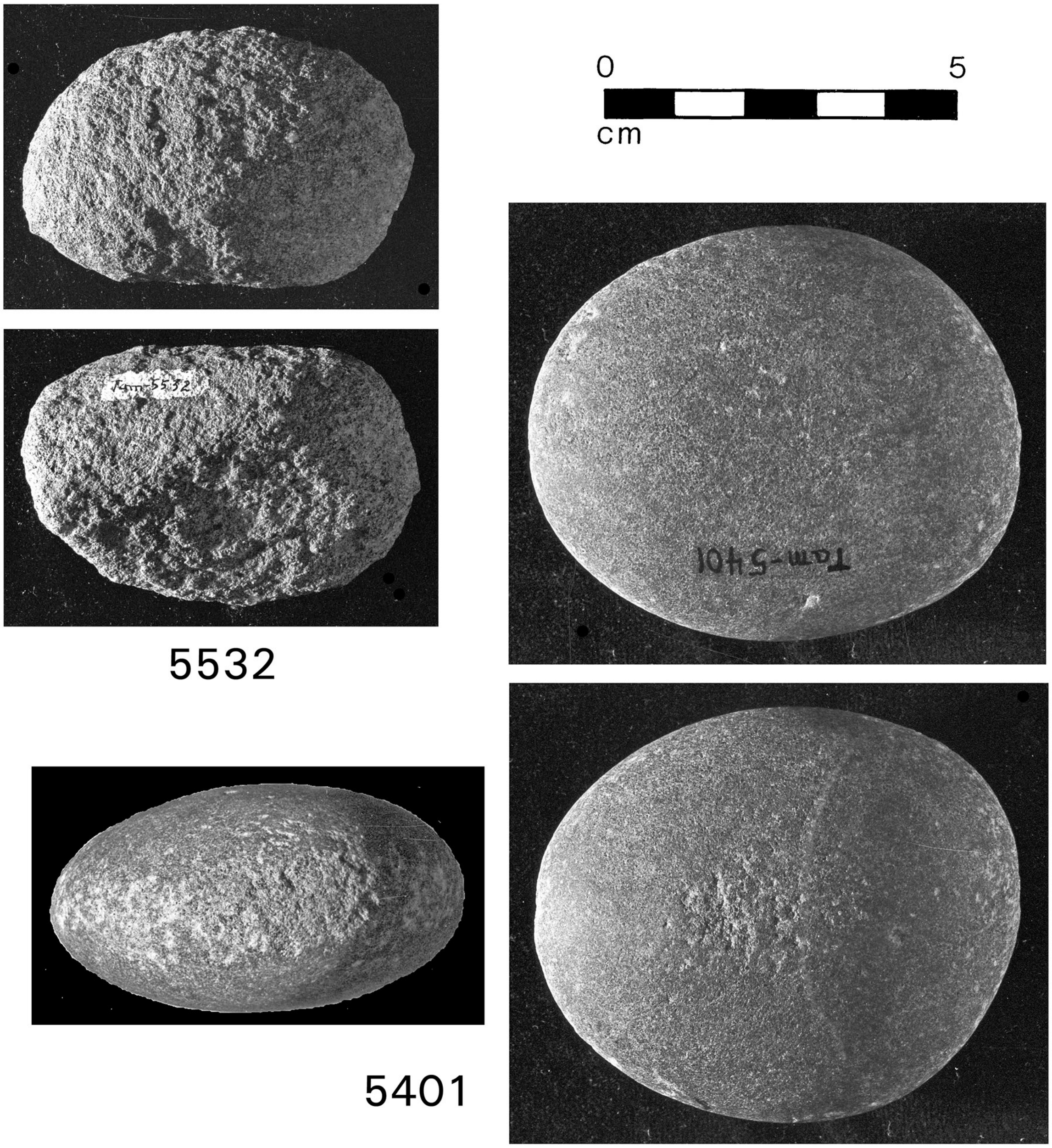

Figure 14-2. Heavily modified hammerstones from Archaeological Level 1 in Area 3 at Les Tambourets.

on such anvil stones while being struck is not known; the chipped flint industry of Les Tambourets is *not* characterized by bipolar flaking of the sort frequently involving the use of an anvil.

Although no formal attribute analysis was performed, some complete specimens were weighed. A combined sample of complete heavily modified hammerstones, with and without anvil damage, ranged in weight from 168g to 428g, with a mean of 271g.[2]

III. LIGHTLY MODIFIED HAMMERSTONES (RETOUCHOIRS)

A different sort of tool is represented by two pieces, one complete and one fragmentary (see Figure 14-3, #4844). A rather thin, roughly oval cobble has extensive pitting on both upper and lower surfaces at both ends. The pitting is much less heavy than on the hammerstones described above, and it is not concentrated on the ends themselves. The use-damage was caused by percussion, but it was primarily the flat of the hammer that contacted the object being struck, and the operation involved less force than used with the heavily modified hammerstones. This sort of implement has often been called a retouching tool (*retouchoir*), implying that it was used in the later stages of chipped tool manufacture rather than those of initial shaping and blank removal.

IV. "SPECIALIZED HAMMERS," WITH GROUND FACETS

The very distinctively patterned artifacts referred to here

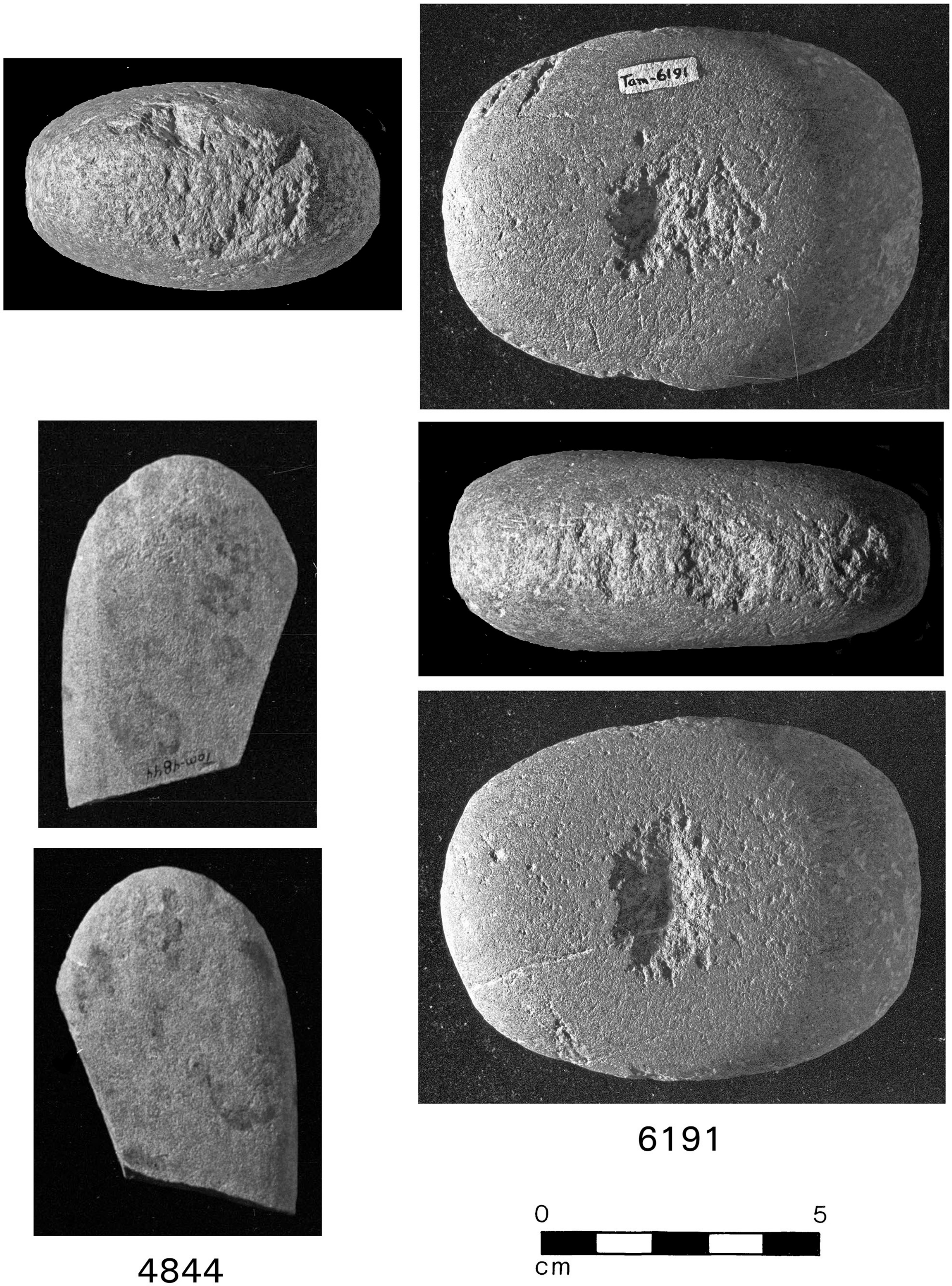

Figure 14-3. Hammerstones from Archaeological Level 1 in Area 3 at Les Tambourets. #4844: lightly modified hammerstone; #6191: heavily modified hammerstone used also as an anvil.

and in previous reports as "specialized hammers" (Figures 14-4, 14-5, 14-6, 14-7, and 14-8) are represented in the assemblage sample from Archaeological Level 1 by ten definite and three possible examples (see Table 14-1), and one undoubted but fragmentary example was found in a disturbed context in couche B. That they functioned as hammerstones is clearly indicated by the contusions, pitting, and flaking resulting from percussion, which is visible on various edges and surfaces. They are, however, different from the classic, heavily modified hammerstones in that they are much lighter objects; the weight of complete specialized hammers ranges from 87g to 126g, with a mean of 105g.[3] They are made on thin, almost flat cobbles of ovoid or subrectangular shape (see Figure 14-4), much thinner for their length and width than the classic hammerstones. Some of the cobbles are compact, fine-grained stone (see Figures 14-4, #4797, and 14-7, #5924), but others are a much coarser-grained material (see Figures 14-6, #5641, and 14-8, #5573). The specialized hammers resemble the lightly modified hammerstones or *retouchoirs* by having pitting damage on their flat surfaces, but they differ from the latter by having flat, ground facets at one or both ends. It is the facets that make the specialized hammers distinctively different.

The most complete study of the specialized hammers from Les Tambourets was made by Harvey Bricker and Stephen Sieracki following the 1980 excavation season and reported in a paper presented at the 48th Annual Meeting of the Society for American Archaeology in 1983 (Bricker and Sieracki n.d.; TDoc04). The following four paragraphs, which describe the major modifications to the original flat cobbles, are quoted from the 1983 report (n.d.: 3–4), except that the illustration references are to the newly prepared graphics in this monograph rather than to the slides of the oral presentation:

> "The first major kind of modification, seen on all...examples, is deliberate grinding *before use* that has created one or more flattened facets at the narrow end or ends of the piece. These facets are oriented obliquely with respect to the long axis, and they are canted with respect to the faces of the piece [for example, Figure 14-6, #1842]. With such a tool lying flat on the table, the facets, if any, in the top right and bottom left corners are canted toward the upper face; those at the other two diagonal corners are canted toward the lower face [see Figures 14-4, #4797 (facet at corner II destroyed by subsequent damage), and 14-6, #5641, left end]. Because of this canting, each facet intersects with one face of the cobble along what we may call a "high edge" and with the other face along a "low edge."
>
> The second major kind of modification is use damage along the high edge of the ground facet; the damage occurs as small flakes removed from the face immediately below the high edge and originating from it [see Figures 14-5b and d, 14-6, #5641 and #1842, and 14-8, #5573]. The plane of these flake scars is generally very close to the plane of the face on which it appears, suggesting that the force that produced it was applied in much the same plane—that is to say, with the tool held in a nearly vertical position. There is also often small-scale crushing and contusion damage along much of the high edge [see Figures 14-7, #5077, and 14-8, #5573]. Except for the high edge, the surface of the facet itself bears little or no wear damage [see Figures 14-5c, 14-6, #1842, and 14-7, #5077].
>
> The third kind of modification—again, damage resulting from use—is heavy pitting wear occurring in concentrated zones on the faces of the cobbles [see Figure 14-7, #5663 and #5077]. The zones of pitting are often located asymmetrically on the face, just below the high edge of the bevelled facet [for example, Figure 14-5c]. This kind of wear does not appear on the surfaces of the facets.
>
> Minor modifications—less frequent and less patterned—include transverse scratches and deep cuts on the long or lateral edges of the cobbles [see Figures 14-4, #4797, and 14-6, #5641], isolated pitting and linear scratching on the faces outside the heavily pitted zones [see Figures 14-7, #5924, and 14-8, #5573], and occasional cuts or scratches on the surface of the facets."

The artifacts described in the preceding paragraphs have the most complexly patterned modifications of any of the nonflint lithics, and the most distinctive kind of modification is the presence of one or more ground or abraded facets. In our study of these objects (Bricker and Sieracki n.d. [TDoc04]), we concluded from very detailed physical examination that the facets had been created before the chipping, crushing, and pitting damage that intersected the facets had occurred. Based on this conclusion, we considered the grinding of the facets to be modification *for* use. It was for this reason that we classified these artifacts as specialized hammers rather than smoothers (*lissoirs*), polishers, or abrading tools. (As discussed below, this interpretation differs from the conclusions reached in the studies by Sophie de Beaune of similar tools from other sites.)

A program of replicative experimentation was carried out, principally by Stephen Sieracki, to investigate the possible function of the artifacts if they were indeed specialized hammers. The experiments, described in more detail in TDoc04, were guided by two specific hypotheses (Bricker and Sieracki n.d.: 4–5):

> "1. Flakes and blades generally similar to those found at Les Tambourets, particularly with respect to the characteristics of their striking platforms, could be produced using modern hammer-stones that were close replicas of the Tambourets objects in question.
>
> 2. If the platform of the core were struck with the high edge of the previously prepared facet on the replica hammer, and if the rectification of the platform/core-face junction between successful removals were accomplished using the face of the hammer, the kinds of modification on the replica would be similar to those found on the Tambourets objects."

Very briefly summarized, the results of the replicative experiments were these:

- Using the artifacts as hammerstones and the "high edge" of one of the bevelled surfaces as the point of contact with the core, it was quite possible to strike off flakes very similar to the unretouched *débitage*

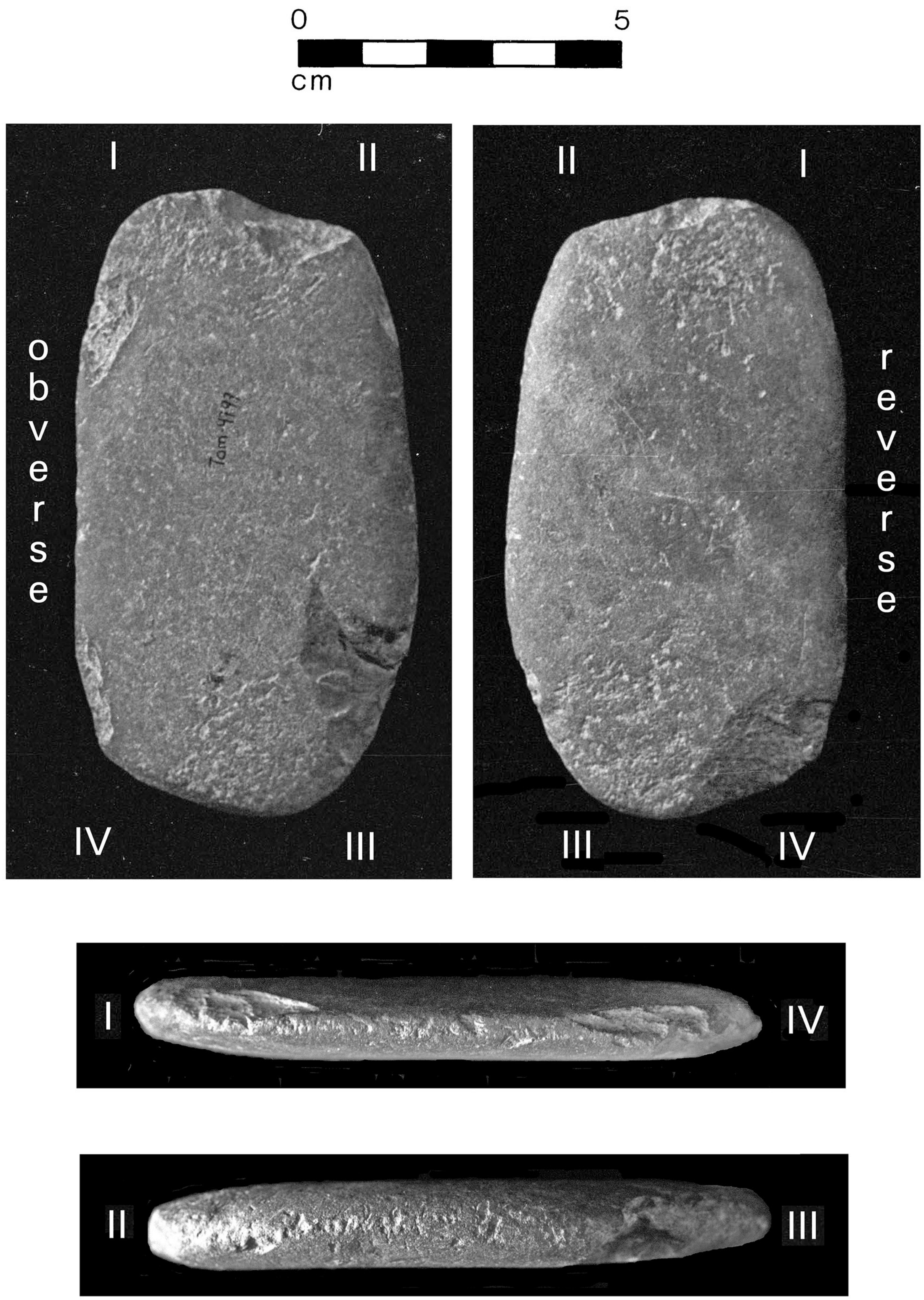

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Figure 14-4. Specialized hammer from Archaeological Level 1 in Area 3 at Les Tambourets.

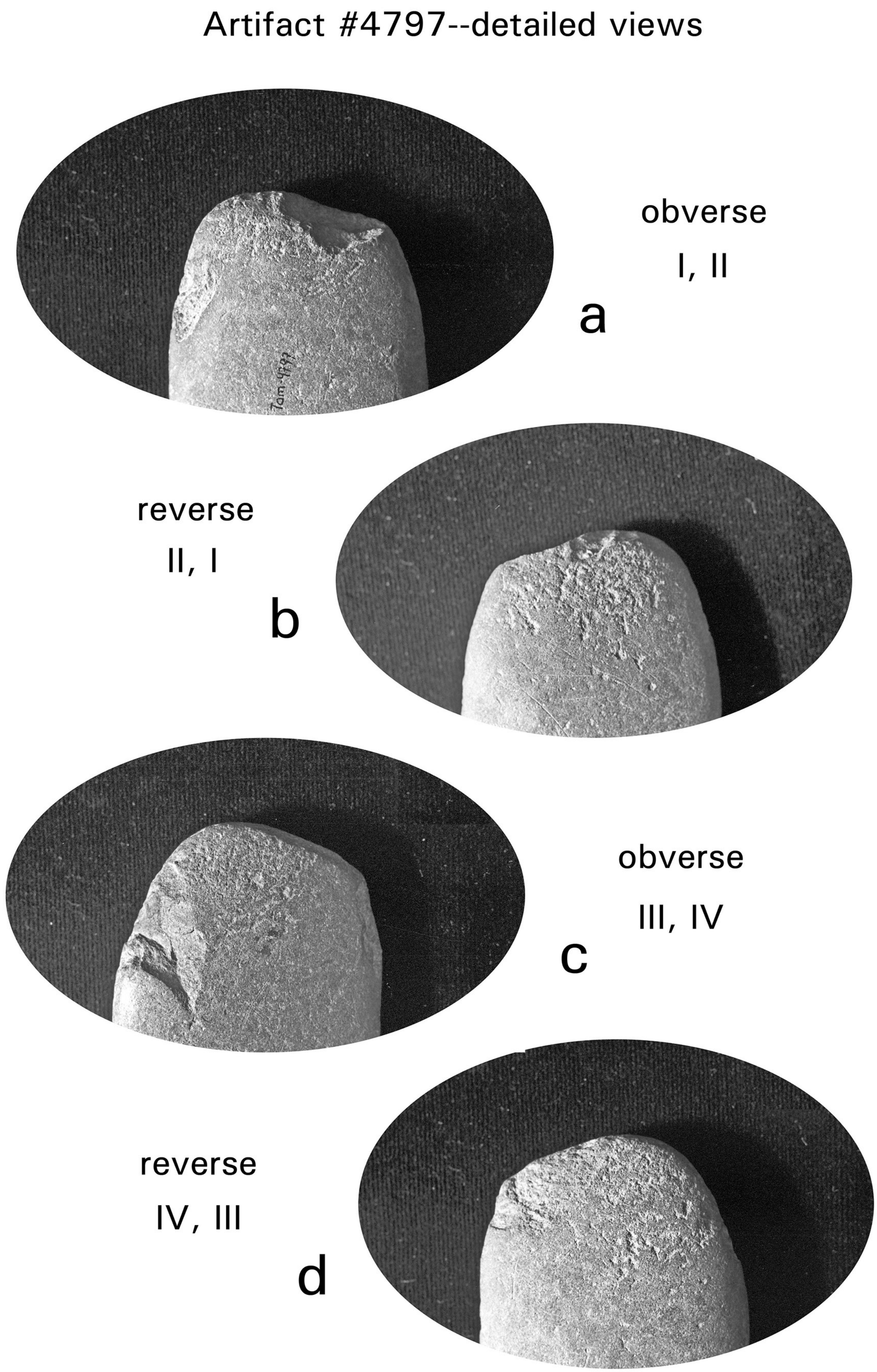


Figure 14-5. Detailed views of the modification and damage to the specialized hammer, #4797, shown in Figure 14-4.

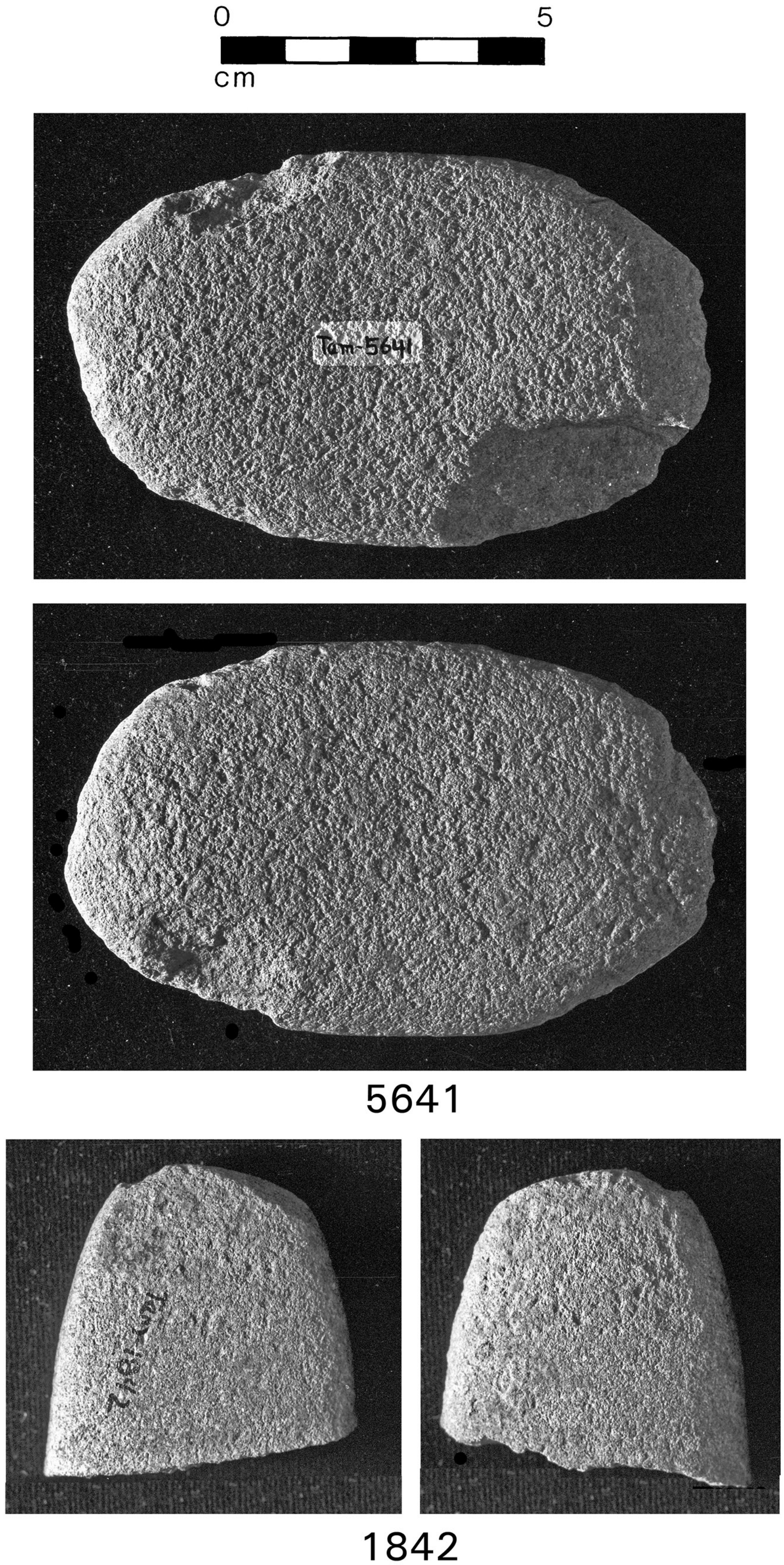


Figure 14-6. Specialized hammers from Area 3 at Les Tambourets. #5641: from Archaeological Level 1; #1842: from Ditch Fill.

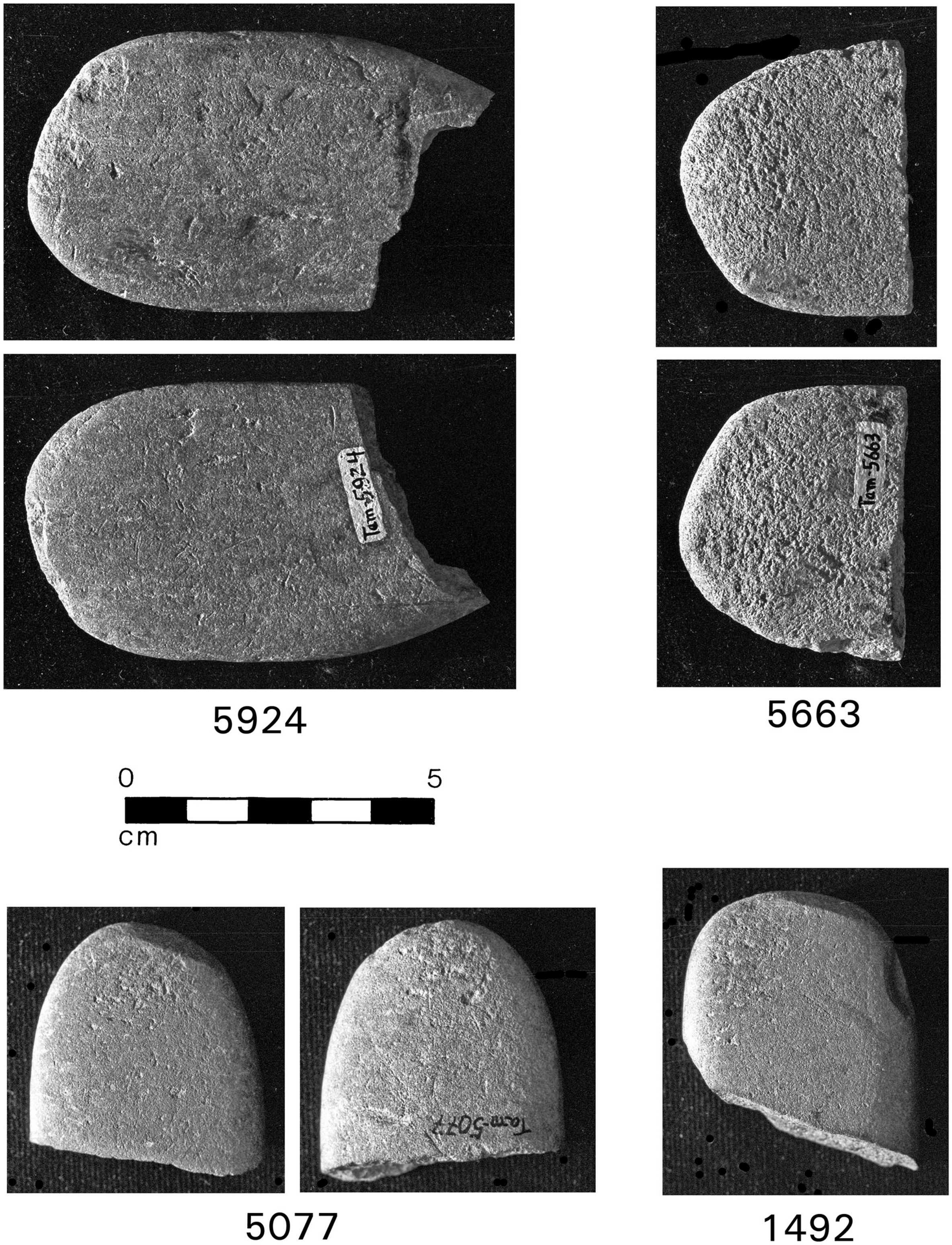
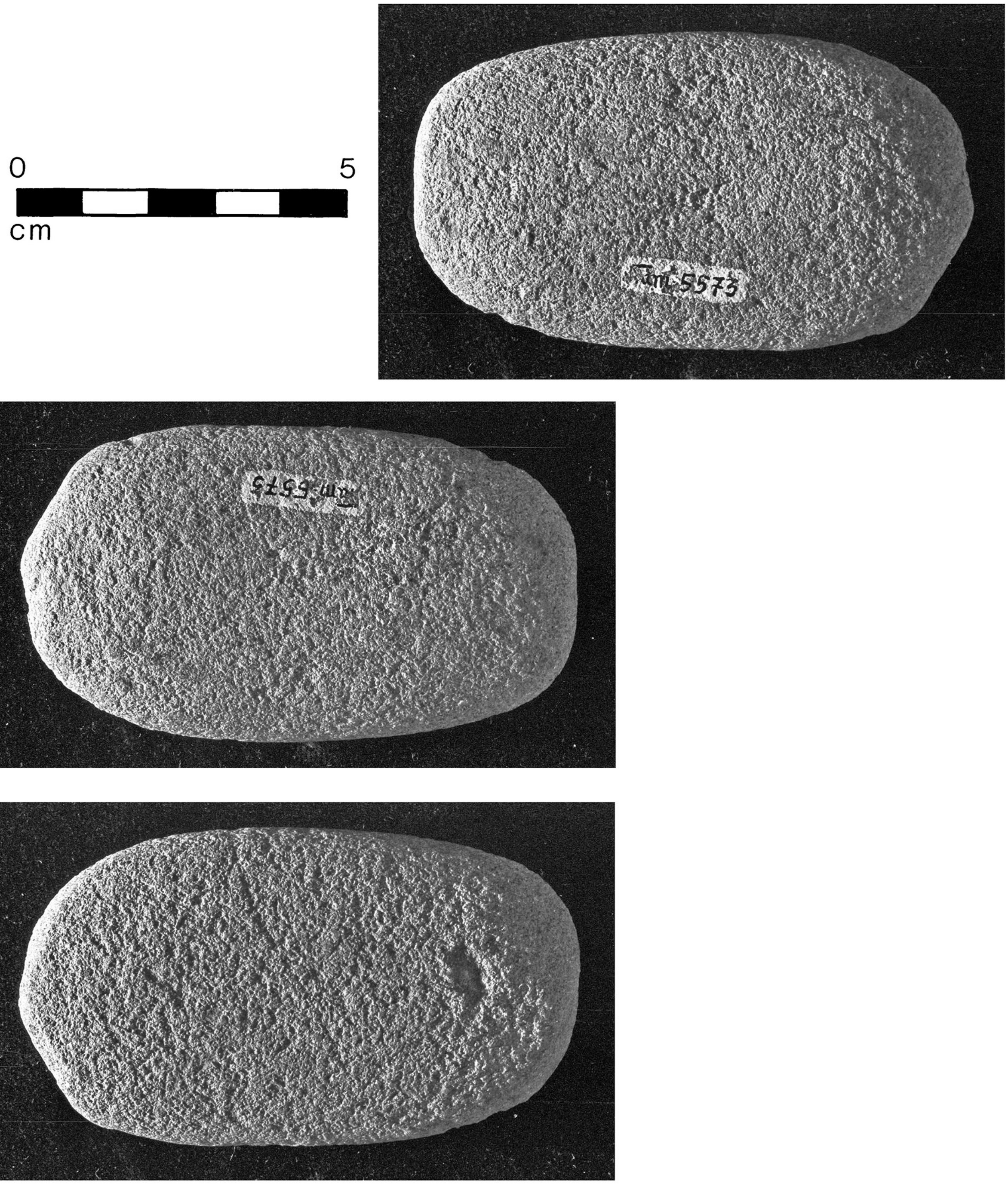


Figure 14-7. Specialized hammers from Area 3 at Les Tambourets. #5077: from couche B; all others: from Archaeological Level 1.



5573

Figure 14-8. Specialized hammer from Archaeological Level 1 in Area 3 at Les Tambourets.

products from Les Tambourets.

- Damage originating from the high edge of the bevel on the replica hammer was very like similarly placed damage on the Tambourets hammers.
- Damage to the face(s) of the replica hammer resulting from the rectification of the platform/core-face junction looked like the pitting damage on the Tambourets hammers and was similarly placed with respect to the bevelled surface.
- Transverse scratches and deep cuts on the lateral edges of some of the Tambourets hammers were *not* replicated by our experiments.

We concluded that the replicative experiments had confirmed in a general way the two hypotheses specified above and that the artifacts classified as specialized hammers could indeed have been used to detach flakes and blades like those found in Archaeological Level 1 at Les Tambourets.

In the 1983 presentation to the Society for American Archaeology, Bricker and Sieracki (n.d.: 8) noted that "... we have not been successful in finding reports of similar objects in the literature of the Upper Palaeolithic." It soon became clear, however, that the search had not been carried out well enough! As early as 1924, Henri Bégouën described and illustrated somewhat similar pieces from Trois-Frères and other Magdalenian sites in the Pyrenean foothills. The objects illustrated have both the canted facets and the percussion damage, but the facets intersect to form a pointed morphology (Bégouën 1924: 349). Bégouën considered these tools to be a kind of hammerstone (*retouchoir de silex*). Another early report of such objects was made by J. Bouyssonie and Delsol (1930) from a Magdalenian site in Dordogne, the abri de Jolivet. One illustrated piece (1930: 373, Figure 5-1) is very similar in its size, shape, arrangement of its multiple ground or abraded facets, and pitting on its flat surfaces to the specialized hammers from Les Tambourets. The objects from Jolivet were identified as "*compresseurs*" (1930: 372), a term implying a role in the retouching of chipped lithics.

In 1989, the first of a series of articles and monographs by Sophie A. de Beaune (1989, 1993, 1997, 2000; Beaune and Buisson 1996) documented the presence of artifacts similar to the Tambourets specialized hammers in various French Upper Palaeolithic sites, from the Aurignacian through the Magdalenian, as well as sites of Palaeolithic and later date elsewhere in Europe and beyond.[4] Various names were given by Beaune to such an object over the years: a kind of *lissoir* (smoother or polisher) (Beaune 1989: 60, 2000: 109–110); *lissoir à facettes* or *polissoir à facettes* (facetted smoother or polisher) (Beaune and Buisson 1996: 132, 135); *broyeur* (grinder or crusher), a designation that emphasizes the facets (Beaune 1997: 82); *maillet* (mallet), a designation that emphasizes the pitting and other percussion damage (1997: 103ff). A term never used by Beaune is *percuteur* (hammerstone). Indeed, citing experimental work by Alain Roussot, Beaune (1997: 92) stated that such artifacts would not be efficacious for the removal of flakes or blades from cores, a conclusion that is clearly not supported by the experimental results of Sieracki (Bricker and Sieracki n.d.).

The most important difference between our treatment of the "specialized hammers" from Les Tambourets and Beaune's treatment of similar objects from other sites is the interpretation of how the ground facets were formed. For Beaune (1997: 78), it is a question of use-wear (*polis d'usure*), the smoothing or polishing of various materials, including soft ones like animal hide or rougher ones like wood or stone. In addition to this function, many show use as what Beaune calls mallets, stones used to strike some intermediary chisel- or punch-like tool that was in direct contact with the material being worked (1997: 103ff, 2000: 110).

Our interpretation, on the other hand, is that the facets were ground deliberately to create a delimited point of impact in preparation for using the tool as a hammerstone in the *débitage* process. In this view, the various kinds of modification to the cobble—the facets and the undoubted use-damage—relate to the same general task, which is the creation of chipped-stone tools. Two characteristics of the pieces in question from Les Tambourets, while not providing proof of our interpretation, argue in its favor. First, when small damage flakes intersect the "high side" of a bevel, they appear to originate from it rather than being cut by it, indicating the order in which the two different kinds of modifications were made. Second, there are among the modified cobbles from Les Tambourets of the relevant size and shape *none* that have the canted ground facets but lack the pitting and other percussion damage, strongly suggesting that the bevelling and the percussion are parts of the same functional complex.

Specialized hammers, prepared by grinding to create a delimited point of impact, *could* be used for the detachment of small blanks, as our experiments have shown. There are, however, other tasks in both the Châtelperronian and other tool-making traditions that might best be performed with small, delimited hammers—for example, the backing of blades and bladelets or the removal of the small bladelets from the fronts of so-called carinate scrapers. Whether or not our functional interpretation is correct, the presence of these distinctive artifacts in Archaeological Level 1 at Les Tambourets extends their temporal range in the French Upper Palaeolithic beyond that previously documented (Aurignacian through Magdalenian), and it provides a clear element of continuity between the Châtelperronian and subsequent tool-making traditions of the Upper Palaeolithic.

V. LIMONITE CRAYON

One small but undoubted crayon of coloring matter was recovered from Archaeological Level 1 (Figure 14-9, #3788). Classified in an earlier unpublished report (TamDoc11) as simply a piece of hard black rock with multiple abraded facets, it was correctly identified by Scandiuzzi (2008: 92, 128) as a crayon of limonite, a kind of iron hydroxide that produces a yellow pigment when powdered and dispersed in a suitable binding agent. The crayon from Les Tambourets measures 38mm in its greatest dimension and weighs 47g. It has been abraded or ground against a rough surface many times, producing thereby 15 to 20 flattened facets meeting at many different angles.

VI. LARGE ROCK FRAGMENT WITH HIGHLY POLISHED SURFACES

A very large fragment of granite broken in such a way as to produce a wedge-shaped object (Figures 14-10 and 14-11, # 3382) is apparently part of the Archaeological Level 1 assemblage. Two highly polished, essentially flat surfaces meet at an angle of about 45°, and this angular junction is itself rounded and somewhat polished. It was considered originally to be a fragment of a boulder with subglacial polish transported from the high Pyrénées rather than an artifact, but it is hard to imagine how natural processes could produce two such flat facets meeting at an acute angle. It was recovered from Archaeological Level 1 with no detectible evidence of stratigraphic disturbance, at the same depth as and intimately associated with undoubted

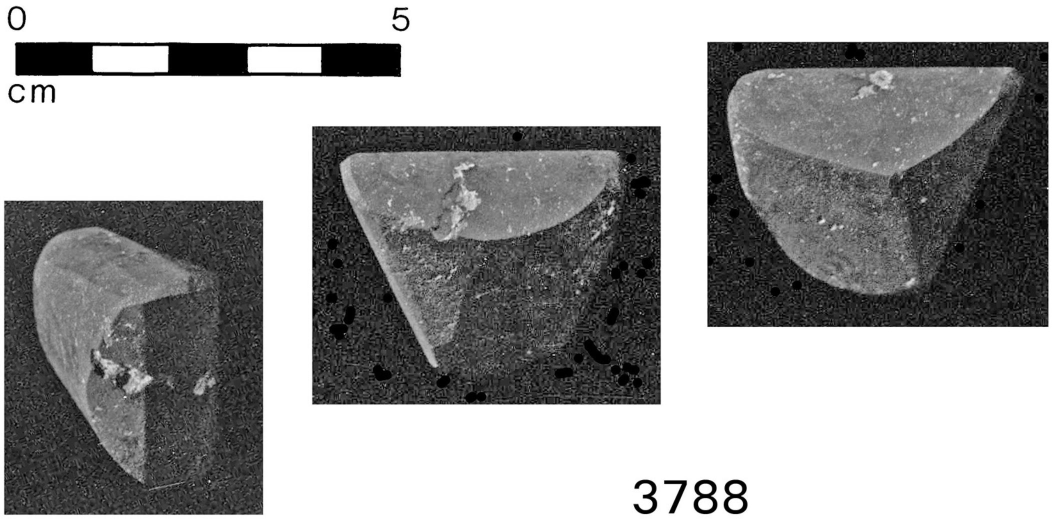
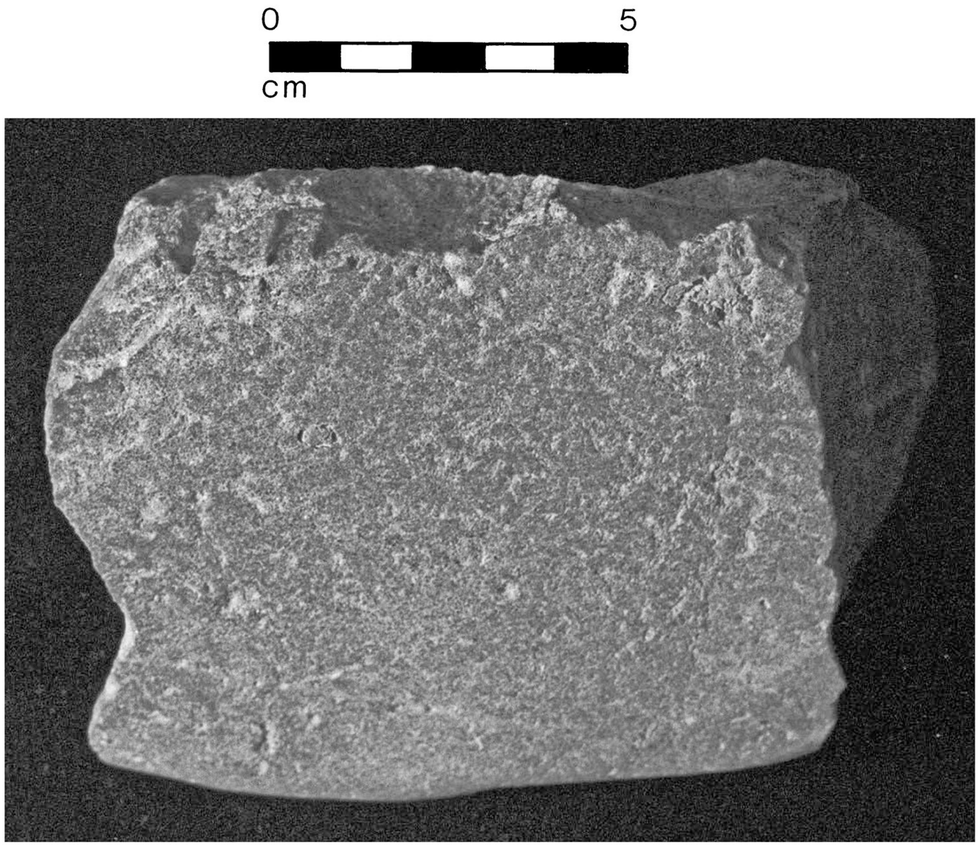


Figure 14-9. Limonite crayon from Archaeological Level 1 in Area 3 at Les Tambourets.

Châtelperronian flint artifacts. The original function of this object remains unknown.

ENDNOTES

1. An object in the Musée d'Aquitaine in Bordeaux, nearly identical to artifact #6191 from Les Tambourets, is illustrated by Beaune (2000: 66, Fig. 20-2); it is attributed, with a question mark, to the Châtelperronian level at Pair-non-Pair (Gironde).
2. This agrees well with the study of Scandiuzzi (2008: 89), who reported a weight range of 216–428g for his larger, "ovoid" hammerstones.
3. On a sample of artifacts similar to but not identical with our sample of specialized hammers, Scandiuzzi (2008: 89) reported a weight range of 86g to 142g.
4. After hearing our communication about the Tambourets artifacts at the SAA meetings, Dr. Rose Solecki (in litt., 4 May 1983) sent us descriptions and pictures of facetted cobbles from the Protoneolithic site of Zawi Chemi Shanidar in northern Iraq. These tools, which the Soleckis classified as "rubbers," have ground or abraded facets, but they appear not to have the patterned pitting or other percussion damage. The designation of rubbing stones seems most appropriate.



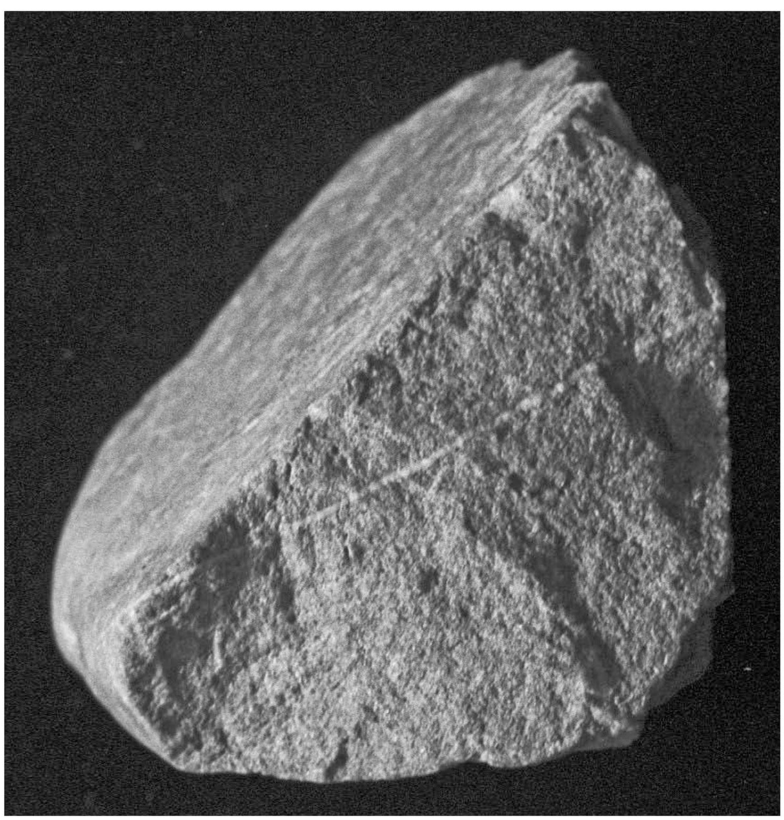


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Figure 14-10. Two views of a large fragment of polished granite from Archaeological Level 1 in Area 3 at Les Tambourets.

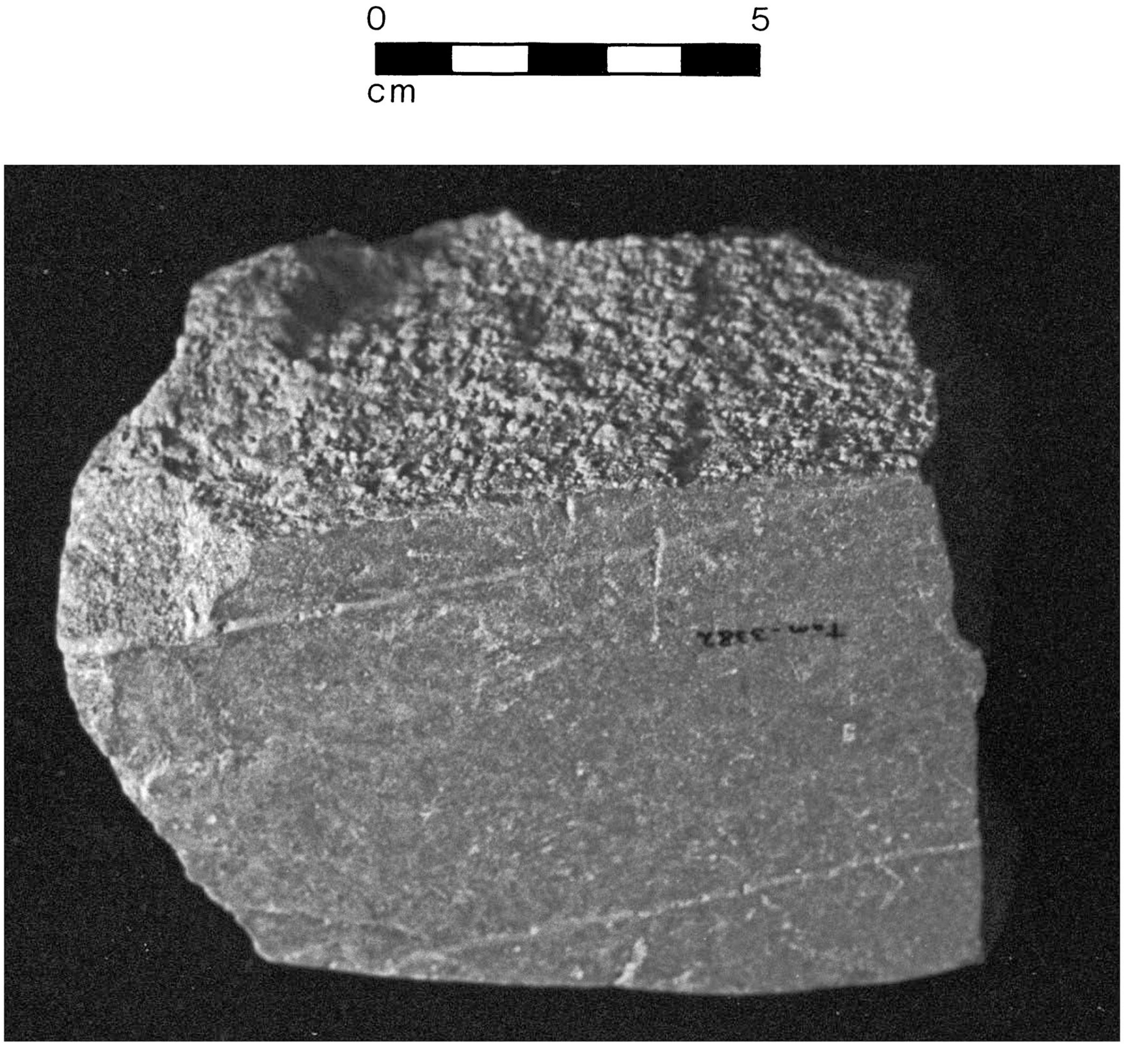

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Figure 14-11. A third view of a large fragment of polished granite from Archaeological Level 1 in Area 3 at Les Tambourets.

AFTERWORD

Specifying the age of the Châtelperronian of Les Tambourets and its typological and technological characteristics is relevant to several of the recently discussed questions and controversies concerning this tool-making tradition. One thing that is not controversial is the origin of the Châtelperronian, which is generally understood to be a development from the latest Mousterian of Acheulian Tradition, the MTA-B.[1] Because Les Tambourets contains one of the most recent manifestations of the Châtelperronian, it is not an important source of information about its *origins*.

If the Mousterian, a product of Neanderthals, was the developmental source of the Châtelperronian, were Neanderthals *its* authors as well? The apparent association of Neanderthal remains with Châtelperronian occupational debris at both the Grotte du Renne and Saint-Césaire has led most scholars to answer this question affirmatively. There is, however, a recent paper (Bar-Yosef and J.-G. Bordes 2010) that has questioned these associations and therefore the Neanderthal authorship of the Châtelperronian. It is probably impossible, even with the tightest stratigraphic associations, to relate with absolute certainty specific skeletal remains to the manufacture of specific artifacts. However, until or unless the bones of modern humans are found in clear association with Châtelperronian artifacts, Neanderthal authorship remains by far the preferred interpretation. Because the Châtelperronian deposits at Les Tambourets contain no bones of any kind, they offer no direct evidence on this question. However, the fact that the lithic raw material sources exploited were so very local—almost none more than 10km distant and many of them much closer—hints at a mobility pattern quite unlike the more extensive movements of modern humans later in the French Upper Palaeolithic.

The sharpest controversy concerning the Châtelperronian in recent decades has been whether its authors developed some characteristics of "modern behavior" independently or whether they adopted them as a result of their contact with the modern human authors of the Aurignacian who were making their first entry into southwestern Europe. An early question, now largely resolved, was whether the Châtelperronians and the Aurignacians (so to speak) did in fact co-exist long enough in southwestern Europe for any adoption of behavioral traits to be possible. It is now clear that the Châtelperronian did indeed have a centuries-long temporal overlap with the Aurignacian in southwestern Europe—both the Proto-Aurignacian and the Early Aurignacian. Documentation of the late end of this period of overlap comes from Quinçay, Grotte du Bison and Grotte du Renne at Arcy-sur-Cure, and Les Tambourets. This is perhaps the most important contribution made by Les Tambourets to a general understanding of the Châtelperronian. Exchange of behavioral traits between Châtelperronian and Aurignacian—in either direction or in both—*could* have occurred. Whether it in fact did is not so clear.

A number of small organic artifacts, including pierced animal teeth and ornaments of ivory, were reported as coming from Châtelperronian levels at the Grotte du Renne. The question has been raised whether these objects may have been derived in some way or other from the Aurignacian level that overlies the Châtelperronian sequence. Very fortunately, the true provenience of the Grotte du Renne ornaments is not crucial to the question of Châtelperronian behavior. The several pierced teeth found in two different Châtelperronian levels at Quinçay, where there is no overlying Aurignacian from which they might have been derived, show that at least very occasionally a Châtelperronian (presumably Neanderthal) artificer may have fashioned necklace ornaments from animal teeth. The impetus for this behavior cannot be known. The Quinçay ornaments were made during a time when Early Aurignacian occupations were present elsewhere in southwestern France, and it is possible that they were manufactured in imitation of Aurignacian beads observed during some episode of contact.[2]

The probable existence of Châtelperronian ornament manufacture at Quinçay (and possibly though not certainly at the Grotte du Renne) provides no real support for the notion that late Châtelperronian Neanderthals achieved "modern behavior" independently, without influence from the newly arriving modern humans. So long as the possibility of imitation exists, as it does here, one cannot simply assert independence. At the same time, however, the case based on body ornaments is equally weak for claiming that late Châtelperronian Neanderthal groups were "acculturated" by Aurignacian modern humans. "Acculturation" is probably too grand a term for a situation in which the sociocultural contexts of the two groups are essentially unknown. The best evidence available to archaeologists concerns subsistence and weaponry. And here the record shows continuity, not change. Late Châtelperronian groups did not adopt Aurignacian weaponry or, insofar as we can judge, Aurignacian hunting practices. The significance of the decision of a few Neanderthals to wear necklaces should not be exaggerated by the reification of the concept of "symbolic behavior."

There is, finally, an additional technological element that could be relevant to the question of cultural transfer from the Aurignacian to the late Châtelperronian. One defining component of the Proto-Aurignacian is very small bladelets, *lamelles*, produced from special cores and retouched, often inversely. A few such objects are present in the late Châtelperronian of Quinçay, and Roussel (2011: 215; 2013), who has made a special study of them, concluded that although the technologies used to produce the bladelets are quite different, the final products are essentially identical. He suggested that this might be a case of stimulus diffusion from Proto-Aurignacian to Châtelperronian—that is, the diffusion of an idea. If Roussel is correct, this would be another result of occasional contact between groups of the two different cultures in one specific area. It is not, however, a general phenomenon. The Châtelperronian of Les Tambourets, of essentially the same age as the later units at Quinçay, does not contain such bladelets. The fact that its large late Châtelperronian sample does *not* show any perceptible Aurignacian influences, with respect to bladelets or other lithic elements, is the other major contribution of Les Tambourets to a general understanding of the Châtelperronian.

In summary, the Châtelperronian is a development from the Mousterian of Acheulian Tradition and, like it, is most probably a product of Neanderthals. Within southwestern Europe, it overlapped chronologically with both the Proto-Aurignacian and the Early Aurignacian, and contact with the modern humans of these archaeological cultures was certainly possible. The results of any such contacts as expressed in material culture were, however, minimal. The Châtelperronian continued to be unmistakably different from any other initial Upper Palaeolithic manifestations, and by the end of the severe cold of the Heinrich Event 4 it had completely disappeared, replaced in its former territory by the Aurignacian.

ENDNOTES

1. In a recent paper, Ofer Bar-Yosef and Jean-Guillaume Bordes (2010: 589) said that they "...question the inferred continuity between the MTA and the Châtelperronian," but they did not develop an argument for this position, which seems quite untenable.
2. It is also possible that they were beads of Aurignacian origin acquired by trade or other means by Neanderthals resident at Quinçay. The technique of manufacture employed differs from most but not all well-provenienced Aurignacian examples. This technological uncertainty is discussed by White (2007: 291) and Roussel (2011: 20).

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