Coll. Antropol. **28** (2004) 1: 41–54
UCD 903:56"632/634"(450)
Original scientific paper

Inorganic Raw Materials Economy and Provenance of Chipped Industry in Some Stone Age Sites of Northern and Central Italy

Amilcare Bietti[1], Giovanni Boschian[2], Gino Mirocle Crisci[3], Ermanno Danese[4], Anna Maria De Francesco[3], Mario Dini[2], Federica Fontana[5], Alessandra Giampietri[2], Renata Grifoni[2], Antonio Guerreschi[5], Jérémie Liagre[5], Fabio Negrino[2], Giovanna Radi[2], Carlo Tozzi[2] and Robert Tykot[6]

[1] Department of Animal and Human Biology, University of Rome »La Sapienza«, Rome, Italy
[2] Department of Archeology, University of Pisa, Pisa, Italy
[3] Department of Geology, University of Calabria, Calabria, Italy
[4] Department of Geology, University of Pisa, Pisa, Italy
[5] Department of Natural and Cultural Resources, University of Ferrara, Ferrara, Italy
[6] Department of Anthropology, University of South Florida, USA

ABSTRACT

An opportunistic and local choice of raw materials is typically attested in the Lower and Middle Paleolithic industries throughout Italy. The quality of the raw material usually affected the flaking technology and quality of the products. In the Upper Paleolithic and the Mesolithic, raw material procurement strategies were more complex. Flint was exploited both locally, in areas where abundant outcrops of raw materials were available (such as the Lessini mountains), and in distant localities, after which it was transported or exchanged over medium/long distances. Different routes of exchange were thus followed in the various periods; good reconstruction of these routes have been provided by a study of the Garfagnana sites in Northern Tuscany, and the Mesolithic deposit of Mondeval de Sora (Dolomites). An interesting example of a Late Upper Paleolithic flint quarry and workshop were found in Abruzzo, in the San Bartolomeo shelter. The extended trade of obsidian from Lipari, Palmarola and Sardinia to the Italian Peninsula is attested in the Neolithic, with some differences concerning the age and different areas.

Key words: *raw material procurement and economy, Paleolithic, Italy*

Received for publication September 12, 2003

Lower and Middle Paleolithic

Trieste Karst: Figure 1, n. 1
(G. Boschian, F. Negrino, C. Tozzi)

Several provenance areas have been identified for the Lower – Middle Paleolithic tool assemblages of the Trieste Karst. At the Visogliano Lower Paleolithic site, the local flint is finely banded black to grey, and crops out a few kilometers from the site; its quality is very poor because fractures strongly bias the detachment of the flakes. As a consequence, large quantities of pebbles and cobbles of greyish to blackish fine micritic limestone were knapped during the older frequentation phase (levels 39–45), and occasionally during the others. The shape of the raw material »nodules« shows that these were collected from *terra rossa*-like soil profiles of the nearby area.

Flint pebbles, usually bluish grey, light grey or greenish, may come from altered river sediments from the Sežana–Divača area in the Slovenia Karst, not far from the Italian border and about 20 km away from Visogliano.

It can be difficult to ascertain the provenance of the exotic raw materials, because the tools were often made up from river pebbles. Moreover, flint from old geological formations was often reworked and embedded in the late Cretaceous-Tertiary formations of the alpine molasses belt, and then again reworked by Quaternary river activity., It should be noted that the neotectonic activity of the Friuli area was very strong, and greatly affected the depositional trends of the rivers.

Pebbles of a greyish to greenish rhyolite are rather common throughout the sequence, mainly in the upper and middle levels. These rocks (Vulcaniti di Riofreddo) crop out in the Dreiländereck region (North-eastern Friuli, Northwestern Slovenia, Southern Austria), but were probably reworked by the rivers and transported to the South; their southernmost occurrence is presently located inside the Fella river gravels at the latitude of Amaro (between the Northern Friuli plain and the Alpine fringe), but it is very likely that the situation differed remarkably during the Middle Pleistocene.

Green, fine-grained tufa and other pyroclastics sometimes occur within the upper levels of the sequence. These rocks crop out in the Idrica valley (South-western Slovenia), and are easily transported into the Isonzo valley then to the South-eastern Friuli plain.

Small pebbles of a glossy black vitreous flint are frequent, and may also come from the eastern Friuli plain; the white, dull flint is common but its provenance is enigmatic, even if very few altered nodules were found in the nearby area.

At the Mousterian site of Caverna degli Orsi, a limestone industry is documented by two artifacts; one of them is made up of a pebble cap. The provenance of the flint is still under study, but some hypotheses inferred for Visogliano are probably valid also for this site. The use of coarse-grained flint or quartzite of unknown provenance is documented.

Toirano Caves: Figure 1, n. 2
(G. Boschian, A. Giampietri,
F. Negrino, C. Tozzi)

The bulk of the large-size Lower Paleolithic artifacts of Grotta del Colombo and Middle Paleolithic artifacts of Grotta di Santa Lucia Superiore are made up of local coarse-grained quartzite, collected from outcrops and river sediments of the nearby area (a few hundred meters to some kilometers). The quartz was exploited only by the Middle Pleistocene groups, and may come from veins cutting the quartzites and other metamorphic formations; nevertheless, detritic elements, were preferred, such as small pebbles of river origin.

Fine-grained quartzite was widely exploited by the Mousterian groups, even if it can be found also in the Middle Pleistocene levels. It was available as pebbles of small size (4–12 cm), but the procurement sites are still unknown.

Flint is rather rare, and occurs almost exclusively in the Mousterian levels. It is a poor quality material resembling the findings of I Ciotti, near Ventimiglia (French-Italian border) at a distance of about 100 km. Some jasper artifacts come from the Emilian or Tuscan Apennines area, at a distance beyond 100 km[1].

In the deeper levels of the Grotta del Colombo and Grotta di Santa Lucia Su-

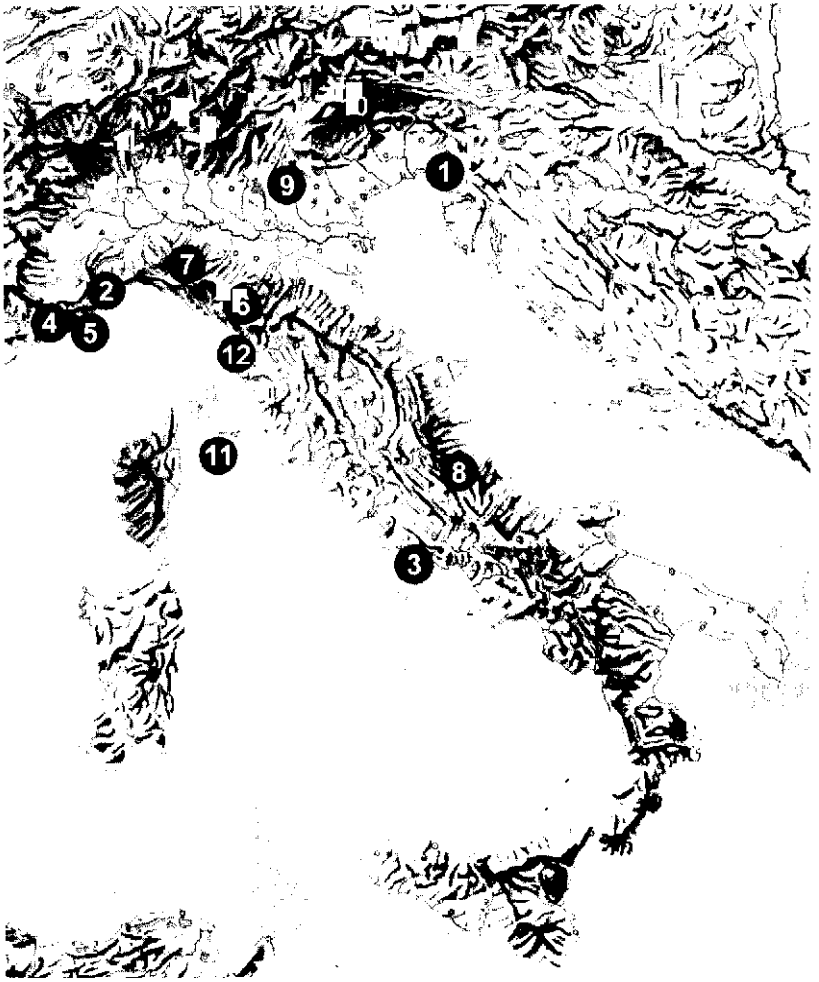

Fig. 1. Localization of the sites mentioned in the paper: 1. Visogliano; 2. Toirano caves (Grotta del Colombo, Grotta di Santa Lucia Superiore); 3. Circeo sites (Grotta Breuil); 4. Riparo Mochi (Balzi Rossi, Ventimiglia); 5. Via San Francesco (Sanremo); 6. Garfagnana sites (Pontecosi); 7. Monte di Lama; 8. Abruzzo sites (San Bartolomeo, Santo Stefano, Settefonti); 9. Riparo Tagliente (Verona); 10. Mondeval de Sora (Belluno); 11. Pianosa Island (Cala Giovanna); 12. Casa Querciolaia.

periore, raw materials are mostly in the form of pebbles of coarse-grained quartzite and quartz experimentation has shown that the cortex offers the most usefully resistant surface to *débitage*. Nevertheless, artifacts with no sign of *débitage* are somewhat frequent: fragments of blocks, naturally reduced (usually with rectangular or trihedral cross-section) were used and retouched. The cores appear to be exploited mostly with discoid technique: flakes have large butts, usually plain or corticated, with detachment angles of 110–120°. These kinds of products do not usually show any further retouch; they were probably used directly, exploiting their sharp edges[1].

Fine-grained quartzite is the most widely used material in the upper Pleistocene levels, though it was already exploited during the middle Pleistocene. The cortex often covers the whole flake surface – primary flakes – or parts of it: this means that the *débitage* was probably performed inside the cave, even though no refitting flakes were found. The cores were mostly processed with discoid technique, but there are also some Levallois cores in the upper levels of Santa. Lucia. Centripetal recurrent Levallois *débitage* was commonly used, as we can infer from the shape of core residues and from the occurrence of flakes with facetted butt and centripetal negative scars.

Middle and Early Upper Paleolithic
(A. Bietti, F. Negrino)

Grotta Breuil (San Felice Circeo, Latium, Late Mousterian): Figure 1, n. 3

Various reports on the field seasons at Grotta Breuil have already been published, with preliminary analyses of the results up to the 1994 excavations, concerning both faunal remains and lithic industries[2-4].

The excavations were carried out in 1996 and 1998, and an extended monograph of the results so far obtained is currently in preparation.

At the end of the 1998 field season the surface excavated was 16 square meters, and 8 stratigraphical units had been identified. An extended analysis on the spatial distributions of the archaeological remains is in progress.

We point out that a preliminary absolute date of 36.6 ± 2.7 ky was obtained by the ESR technique[2] for an undetermined upper layer (most probably 3 or 4), while a subsequent series of dates for layers 4–7 gave results ranging from about 27 to 37 ky, with an average of 33 ± 4 ky for layer 7. These dates were obtained using the linear Uranium uptake model, but the ones obtained by the early uptake model coincide within one standard deviation.

As far as the lithic industry is concerned, preliminary results up to layer 5 have already been reported[2,4]; the presence of a Mousterian *facies* has been recognized with essentially two reduction sequences, i.e. a more customary Levallois technique, and a technique more of Upper Paleolithic type with »pseudoprismatic« cores. In many instances the *débitage* products are therefore elongated in shape, even if not so regular and standardized as the classical Upper Paleolithic blades (especially Gravettian and Epigravettian). Generally speaking, as regards layers 3–5, the centripetal cores more typical of the Levallois technique (even recurrent) are much less common than the pseudoprismatic ones, which attain percentages (often exceeding 20%) similar to the unidirectional ones.

The raw materials employed derive almost exclusively from local flint pebbles, found in conglomerates, presently buried at a depth of about 10 m from the surface, and largely exposed by erosion at that time. A local flint of very poor quality, coming from the ridge of Monte Circeo, is

very seldom present, while it is impossible to establish if some larger flakes without cortex are exotic because of the enormous variety of flint types (some of excellent quality) represented among the pebbles.

The industry of layers 6–8 is presently under study: at first glance the situation appears very similar concerning the raw materials, while for the technological aspects some differences can be noticed. In particular, the utilization of the percussion on anvil technique (almost unknown in the upper layers) has been recorded, and it is more similar in some respects to the one observed in the nearby sites of Grotta Guattari and Grotta del Fossellone[4] at Monte Circeo. We should bear in mind that, while the Mousterian layers of Grotta del Fossellone are undated, Grotta Guattari has been dated between about 77 ky (layer 5) and about 57 ky (layer 1).

Riparo Mochi (Balzi Rossi, Ventimiglia, Liguria, Mousterian, Aurignacian): Figure 1, n. 4

The excavations in this famous shelter began in 1995 (actually re-excavations, since the site was discovered by A. C. Blanc[5] in 1938 with further campaigns in 1941, 1942, 1949 and 1959) and are still in progress. The archaeological sequence ranges from the Mousterian (layer I), followed by a semi-sterile layer (H), early Aurignacian (G), typical Aurignacian (F), sterile (E), Gravettian (D and C), sterile (B) and Epigravettian (A). The lithic industry collected in the old excavations is currently under study and, in the present note, we will restrict ourselves only to the Upper Mousterian and Aurignacian layers.

A series of radiocarbon dates has recently been obtained: the oldest (37.4 ky) and the youngest (27.23 ky) come from two hearths discovered respectively in 1995 (top of layer F) and 1998 (base of layer G), obtained by beta counting at the Radiocarbon laboratory of the Department of Physics of Rome University, while the others come from charcoals collected in the old excavations dated by AMS at the Oxford laboratory [6]. The sample from the top of layer F was collected when part of the section collapsed in November 2000, after a big storm: a slight contamination from some deposit coming from layer E and the bottom of layer D cannot therefore be excluded. One should however observe that these dates are uncalibrated: it may well be that, in the chronological interval between 26 ky and 35 ky BP (Radiocarbon dates), due to fluctuations in intensity of the earth's magnetic field, the calibrated dates are somewhat closer to the radiocarbon ones (see the discussion in Kuhn and Bietti[7]). In any case, we have only two calibration points for this period, obtained through dating on corals: one at about 26 ky (cal. 30 ky) and one at about 37 ky (cal. 41 ky)[8], corresponding roughly to our oldest date for the hearth at the bottom of layer G. It seems therefore that the early Aurignacian of Riparo Mochi is older than the late Mousterian of Grotta Breuil, previously described.

The industry of the Upper Paleolithic deposits (old excavations, from layer H upwards) was published in 1977 by G. Laplace according to the strict typological perspective of his »analytical typology«[9]. More modern studies (based more on raw material economy problems) are under way, after preliminary work on the Mousterian and Aurignacian industries of the old excavations analyzed by S. Kuhn[10]. We are presently studying the flint assemblages (old and new excavations) in greater detail as regards both technology and, in particular, the raw material provenance, which gives us very promising preliminary results.

Starting with the Mousterian, the new excavations yielded very scarce flakes and *débris*. The raw materials employed

are almost exclusively local: flint, coming from an Eocene conglomerate (I Ciotti) situated on the top of the cliffs just above Balzi Rossi, limestone, silicified limestone, and quartzite coming from conglomerates located in the town of San Remo, less than 15 km eastward. The only exotic material (almost negligible in percentage) comes from the Esterel formation in France, just a few km west of the town of Cannes.

As regards technology, according to a preliminary analysis by S. Kuhn[10] based on the old excavations, the Levallois technique is better represented in the lower part of the deposit, with various blades, whereas in the upper part the reduction technique appears more approximative with very rare blades, and there is a considerable increase in denticulate tools. One should be aware, however, that denticulates are often only irregularly retouched or simply used blades and flakes; this is particularly true when one deals with materials such as limestone and quartzite, as we will see later for the San Francesco site.

We will here mention just briefly the semi-sterile layer H: S. Kuhn[10], who observed that the scarce lithic industry found during the old excavation was essentially a mixture of pieces of the underlying (I) and overlying (G) layers. In fact, in 1998 we discovered a well-structured Aurignacian hearth in layer H: the above mixture therefore seems perfectly reasonable.

In the Aurignacian (layer G), the situation changes abruptly: the Ciotti flint is always abundant, but quartzite and limestone decrease sharply and a series of exotic flint types appears, even in considerable percentages. Indeed, besides some undetermined type (**S**), there are occurrences of excellent quality flints from the Cretaceous and Oligocene formations in Vaucluse, near Avignon in France, other flint types from Provence and, from the Eastern side, chalcedony probably from the province of Savona, radiolarites (jaspers) from Eastern Liguria and the Emilian-Ligurian Apennine, and even (though in a very small quantity) flints from the »scaglia« of the Adriatic side of the Peninsula, at a distance of more than 400 km!

As regards technology, it is very interesting to note the distribution of these raw materials among the various *débitage* products: the cores are almost exclusively in local Ciotti flint (in the old excavations only one core in jasper and one in a probable French white flint have been observed), while the formal tools, such as end-scrapers, burins, retouched blades show a bigger incidence of exotic raw materials: this may indicate that these artifacts were introduced to the site (probably through reciprocity exchange) as fully-retouched or prepared blanks, flakes and blades. On the other hand, the bloodlust, most of them retouched (the typical »Dufour«), are mainly made from local Ciotti flint: their size and profile suggests that they were detached from pyramidal prismatic cores, and they show the narrow, elongated butt characteristic of a technique of direct percussion with a soft hammer. There is practically no example of twisted bladelets, or of the »Roc de Combe« type[11], more characteristic of carinated cores and/or end-scrapers.

The overlying typical Aurignacian level F does not show significant differences as regards raw material: there is, in addition, the presence of hyaline quartz. The Dufour bladelets are still present, even if in lower quantity, and the technique is practically the same as the one observed for layer G.

Via San Francesco (Sanremo, Liguria, Late Mousterian): Figure 1, n. 5

The site of Via San Francesco was discovered in 1960 in the middle of the town of San Remo, during the building of new houses. The site is located at the bottom

of a hill of Pliocene conglomerates, not very far from the present seashore. A stratigraphic test trench revealed a single layer with faunal remains (red deer, megaceros, roe deer, horse and rhino) together with a large quantity of lithic artifacts, more than 5400, containing 241 cores and 479 formal tools. The first analyses of this material, unfortunately undated, were performed by G. Isetti[12] and H. de Lumley[13], and subsequently by A. Tavoso[14].

A new study of this lithic industry is under way, but we can provide some preliminary results here. The raw material consists mainly of limestone and quartzite from local Eocene formations, often collected as large pebbles from the edges of the local rivers or on the seashore. The percentage of flint implements, such as some flakes of the Ciotti type at Balzi Rossi (see above) is extremely low, and there is only one artifact on a flint that resembles the Vaucluse varieties.

As regards technology and typology, the San. Francesco industry shows very peculiar features: a large number of blades (almost 35%) derived mostly from bidirectional (less commonly unidirectional) recurrent Levallois cores, but also from prismatic cores (37 out of 241), more characteristic of the Upper Paleolithic and, in particular, the Aurignacian. There also several Levallois flakes and »eclats débordants« like the naturally backed knives, some with irregular denticulate retouch, and a few crested blades. It is interesting to note that the scarcity of centripetal cores and the noticeable percentage of local limestone are in contrast with the situation of the presumably older (stage 5) nearby site of Madonna dell'Arma[15].

Some particular tool types derived from large blades are the ones named »San Remo knives« by the old Authors, i.e. partially backed knives (or convex obliquely truncated blades), which are also present in French Mousterian of Acheulian tradition B, or in »transition« industries such as the Châtelperronian[11], where there is also a blade-like technology similar to that of San. Francesco. On the other hand, these features (laminarity, backed knives, etc.) are practically unknown in Italian transition industries, such as the Uluzzian.

The »transition« industry of Via San Francesco has been classified in the past as a »Denticulate Mousterian« only on typological grounds. This attribution has already been questioned by other Authors[7]: we wish to stress here again that there is only a limited number of such tools, mostly with irregular retouches, and that the main »new« and »evolved« character of this industry lies in the particular backed knives already described and, more importantly, in the large number of blades, together with the reduction processes employed for their production. This technique differs in many respects from the ones observed at Madonna dell' Arma, and also from the ones found at the Balzi Rossi at Barma Grande[16] and at Grotte du Prince, levels E and D[17,18].

Upper Paleolithic and Mesolithic

The Aurignacian sites of Pontecosi and Monte di Lama: Figure 1, n. 6 and 7 (M. Dini, F. Negrino, C. Tozzi)

Pontecosi is a workshop site where blade blanks and backed tools were knapped; the raw materials are of good quality, and their origin is apparently related to a wide territory, thus suggesting a marked seasonal nomadism. The lithic industry comes from a deposit located 320 meters a.s.l. on a terrace of the River Serchio (Northern Tuscany), formed by sandy loams lying above a deposit of river pebbles. The Aurignacian is represented by a peculiar *facies* featuring microlithic points and deep, unipolar backed tools; Dufour bladelets are absent[19]. The raw

materials employed for backed tools, cores, and unretouched artifacts are those coming from the carbonatic-siliceous formations of Falda Toscana (class A), 10 km from the site. A large percentage (9%) of the total is represented by flint pebbles from Pleistocene yellow sands (class E) coming from the southern borders of the Po Plain, around 80 km from Pontecosi. The tools employed for subsistence activities, such as the processing of vegetal or animal resources, were made out of these pebbles and non-local flints.

Certain lithotypes from the Ligurian Units (Class C), the Metamorphic Units of Apuane (class B, about 10 km away) and the Cervarola-Falterona Unit (Class D, about 30 km away) are absent; they were probably unsuitable for blade preparation because of their poor quality. In fact, class D was widely used in Late-glacial and Post-glacial sites; therefore we can infer that the Aurignacian groups followed different routes[20].

The site of Ronco del Gatto on Monte di Lama (Bardi) on the Parma Apennines (1,150 meters a.s.l.) is a raw material extraction and workshop site, lying on an outcrop of good quality glassy radiolarite exploited during the Würm Interpleniglacial and the Holocene.

The excavation sequence is composed of a bottom level with rich Mousterian industry, followed by a loess and colluvium layers with Aurignacian lithic industries, topped by a surface layer corresponding to a Copper age workshop, close to the jasper extraction niches.

The Monte di Lama jasper is easily recognizable by macroscopic examination; it had a wide diffusion during the Aurignacian, reaching even the Riparo Mochi in Liguria to the West[21], and Pontecosi to the Southeast.

Epigravettian and Mesolithic sites of Northern Tuscany: Figure 1, n. 6 (M. Dini, F. Negrino, C. Tozzi)

The analysis of several sites along the Serchio river valley and the Tuscan-Emilian Apennines shows that Epigravettian and Mesolithic human groups adopted flint procurement strategies that differed from those of the Aurignacian groups.

The flint came straight from their outcrops in the Falda Toscana, the Ligurian Units and Monte Cervarola Units; the quality was poorer as the distance between settlement and flint source grew shorter. The top-quality flint was collected from river beds and from Pleistocene yellow sands (class E) of the southern Po Plain, sometimes more than 80 km away.

These materials were replaced every so often with those collected during seasonal nomadism between the Serchio river valley and the Po plain[22].

San Bartolomeo shelter (western slopes of the Maiella, Abruzzo): Figure 1, n. 8 (G. Boschian)

As the San Bartolomeo or Ermanno de Pompeis shelter is a flint-quarrying site, it is not surprising that most of the raw material found there is the dark brown to blackish flint cropping out from the shelter wall[23,24]. The nodules are 5–20 cm wide, with a thick white cortex; they frequently present limestone inclusions and fracturing. This material is rather fine but not vitreous, dull to glossy, and rather hard. It is noteworthy that other raw materials were also exploited. Cobbles and pebbles of very hard, whitish to greyish granular chert were collected from the nearby river sediments; these cobbles are up to 25–30 cm wide, and were roughly flaked to produce mainly heavy duty tools, such as picks and wedges. Lower Paleolithic artifacts were often collected from nearby sites 100–300 m away and re-flaked in the shelter. Sometimes, ex-

otic flint types (*Scaglia Rossa*) coming from formations up to 30–80 km away were brought to the site, mainly as finished tools.

The flint nodules that crop out from the bottom wall of the shelter were extracted from the rock by large limestone hammer-cobbles and by flint picks and wedges. These tools were found at the foot of the wall, inside a 15 m^2 flint workshop where the quarried nodules were processed. The quality of the freshly extracted nodules was tested by knapping one or two flakes from a striking platform obtained by the detachment of a cap. The unsuitable nodules were thrown away into the detritus heap, while the good ones were processed further.

The lithic technology of the *Epigravettiano italiano* sequence of the Ermanno de Pompeis shelter is well known because good information was collected from the flint workshop found in the site; the whole *chaîne opératoire*, from extraction to the finished tool, was reconstructed through a study of the tools, debris and refittings, and of their area distribution[23,24].

Epigravettian and Mesolithic sites of the Veneto area (A. Guerreschi, F. Fontana, J. Liagre)

Analysis of procurement strategies within two sites of the Veneto area (North-Eastern Italy) shows different behavioral patterns, which appear to be strictly linked to the availability of outcrops of lithic sources in the surrounding areas.

In the Epigravettian layers of Riparo Tagliente rock-shelter on the Lessini Mountains, the intensity of knapping activities resulting in the presence of great masses of lithic waste products and tools appears closely linked to the abundance of local flints coming from different geological formations outcropping in the area.

A different exploitation pattern has been detected in the Mesolithic site of Mondeval de Sora, situated at an altitude of over 2,100 m a.s.l. in the Italian Dolomites. The use of lithic sources collected on the Piave valley-bottom in both primary and secondary positions allows the routes of the human groups moving from winter locations to high altitude seasonal camps to be identified.

Riparo Tagliente: Figure 1, n. 9

Typological analysis of the Epigravettian sequence of Riparo Tagliente has allowed two phases to be distinguished: one pre-Bølling, corresponding to layers 16–11, the other belonging to the interstadial stages (Bølling/Alleröd) and corresponding to layers 10–4[25]. The datings available suggest that the sequence is collocated in the final phase of the Epigravettian (see Guerreschi[25]).

The strategies employed for provisioning raw materials at Riparo Tagliente were simple and logical. The materials exploited were many, and all available locally: in fact, the Lessini Mountains comprise several geological formations containing flint nodules of varying physical nature, homogeneity and color. Within a range of 10 km from the shelter, outcrops of *Biancone, Scaglia Variegata, Rosso Ammonitico, Scaglia Rossa* and *Formazione di Tenno* (organogenic flint) can be found. Some flints are good quality, and are present in great amounts in the site, while others are infrequent and little used, even though available in the area around the shelter (Scaglia Rossa and Tenno). A study of the patinas and cortexes has revealed that almost all the cores come from blocks found in secondary position, i.e. from the detritus situated in the surroundings of the primary outcrops and more rarely from the floods of the Valpantena, not far from the site itself (S. Bertola, pers. comm.).

From a technological viewpoint, several *chaînes opératoires* are documented; however, the dominant pattern was ori-

ented towards production of a variety of blades and bladelets which were subsequently retouched for the manufacture of backed tools, the morphological characteristics of which varied in relation to the various phases of occupation of the site, the activities performed, and the type of raw material employed. The cores are of different types: blocks exploited following their natural morphology, prepared cores, cores on flakes, burin-shaped cores, and so on. A wide range of knapping methods are attested, varying from one to several striking platforms as well as numerous forms of convexity maintenance during production, and many stages of abandonment of the cores. The presence of long blanks (blades, bladelets, laminar flakes), numerous flakes and other irregularly-shaped, large tools, alongside various artifacts obtained from sub-products of laminar production, testify the remarkable variability in the tools used, as well as a considerable knowledge of the rocks' characteristics in relation to the different flaking methods adopted. The technique most frequently chosen was direct percussion with a hard hammerstone for the initial stages of the *chaîne opératoire* and for convexity maintenance, although a study presently in progress is investigating the possibility of using a soft hammer (wood, bone) or a soft hammerstone to produce *plein débitage* blanks, i.e. blades and bladelets.

From an economic point of view, the settlement of groups of hunter-gatherers at Riparo Tagliente is closely linked to the flint outcrops present in the surrounding environment. The lithic industry is abundant, and the presence of three lithic workshops each characterized by considerable masses of flakes and knapping debris has been detected in the external part of the shelter. The study of these masses is presently in progress. Given the huge amount of knapped flint – surely exceeding the requirements of the group – the question still remains whether the flaking products and prepared cores were used for bartering, or at any rate exported from the site (see Guerreschi[26]).

Mondeval de Sora: Figure 1, n. 10

As far as the Mesolithic is concerned, the most recently acquired data come from site VF1 at Mondeval de Sora (Dolomiti Bellunesi): here, two rather complex stratigraphic series have been brought to light (sectors I and III) under two of the overhanging walls of the large erratic dolomite boulder beneath which the site is located[27,28]. As regards sector I, two layers have been investigated to date: Stratigraphic Unit 8, a living floor which covered a structure identified as a paved area, for which a dating of 9,185±240 BP is available, and S.U. 25, situated directly under the overhang of the boulder.

From a cultural point of view, the lithic industries coming from the two layers studied can be collocated in the final part of the early Sauveterrian/first part of middle Sauveterrian. The study involved the analysis of several thousands of artifacts (over 20,000 from S.U. 8 alone), allowing a series of considerations to be made with regard to the provisioning of raw materials and the technological approaches adopted by the Mesolithic groups, even in spite of the high percentage of elements altered by fire or with patinas (reaching 50% in US 8)[29,30].

As far as the raw materials are concerned, a preliminary study still in progress has shown that the vast majority of these (over 90%) consist of blocks of flint nodules coming from Mesozoic formations of the Prealpine margin, particularly from the *Scaglia Rossa, Scaglia Variegata* and *Biancone*, the first of these by far the most frequent. Also to be noted is the utilization of Alpine flint present in the local outcrops (Livinallongo and Caotico Eterogeneo) and of rock crystal, suggested as coming from the Alpi Aurine. The limited

use of local raw materials as opposed to the importation of Prealpine rocks appears due mainly to the mediocre quality of the lithotypes available locally.

Analysis of the methods of raw material exploitation and a reconstruction of the *chaînes opératoires* have made it possible to note the prevalent utilization of cores obtained from nodule portions or from thick flakes: these were generally knapped on only one face, starting from one or, less frequently, two opposite striking platforms. As regards the shaping out of cores, no evidence was found to testify the utilization of particular preparation techniques; production appears to have been directed towards obtaining bladelets – though always irregularly shaped – laminar flakes and flakes, of which the last two categories are more frequent than the first. The morphology of flaking products appears closely linked to that of retouched artifacts, mainly represented by backed tools, among which the most commonly found are geometric microliths (scalene triangles in particular) or backed points. These, in fact, were generally prepared starting from blanks characterized by irregular shapes, together with transverse portions of flakes, especially in the case of *Sauveterre*-type double-backed points, presumably in relation to the need to obtain sharp, robust microliths (width/thickness ratio equal to 1). The considerable skill required both to prepare microburins – as testified by numerous knapping residues (in equal proportions to those of backed tools) – and to use backed retouch allowed the knapper to prepare satisfactory microliths whatever the original shape of the blanks. Alongside this dominant pattern, which is a constant feature of both layers investigated, there is a less frequent production of regular lamellar blanks, presumably reserved for the production of particular types of artifacts (in the case of US 8, backed truncated blades).

Neolithic

(G. M. Crisci, E. Danese, A. M. De Francesco, R. Grifoni, G. Radi, C. Tozzi, R. Tykot)

The data available at present regard the exploitation of flint and obsidian. New investigations on the obsidian found in the Tuscany and Abruzzo sites have allowed us to obtain a statistically significant picture of its provenance. The methods employed are: x-ray fluorescence spectrometry, fission tracks, plasma mass spectrometry, neutron activation analysis and electron microprobe.

Tuscany

The analyzed samples come from the following sites: Cala Giovanna (Pianosa Island) (Figure 1, site 11), dating back to 6,200–6,000 BP and where Lineare Pottery (Fiorano culture) is associated to few pieces of cardial Impressed Pottery; Casa Querciolaia (Livorno) dated to 6,050±50 BP, with linear pottery of Fiorano cultural *facies* (Figure 1, site 12); several Neolithic surface sites surveyed in the Livorno province[31–33].

A comparison of the new data and those of earlier studies shows that, in both the cardial and linear Pottery *facies*, Sardinian obsidian is almost always associated to the Palmarola and Lipari ones/types, even if these are rather scanty [31–36].

In Tuscany, the sporadic occurrence of sites (Isola del Giglio, Coltano) with Impressed Pottery similar to that of Southern Italy is also recorded; here, the associated obsidian comes only from Lipari and Palmarola. These data could point to the existence of maritime routes apart from Sardinia.

It can be inferred that raw materials coming from Sardinia landed in these coastal areas, where those coming from the South also arrived; from here these

three kinds of obsidian were then redistributed towards the Ligurian coast[35].

The presence of quartz artifacts from Elba (89%) and several kinds of flint and quartzite from the Tuscan coastal areas were recorded in the island of Pianosa together with the obsidian (5.6%); conversely, only two flint artifacts may have a Sardinian origin.

Several flint types were recorded at Casa Querciolaia. An opaque, grey-black type comes from the Apennines; the flint varying from grey to white or yellow color with white spots and cortex comes from the Monti Lessini (Alpine fringe); the jasper is local.

The extraction and distribution of the imported raw materials were controlled by groups of the Northern Italian Linear Pottery culture.

Abruzzo: Figure 1, n. 8

Several sites were studied in this area. The Early Neolithic settlement of Colle Santo Stefano (Ortucchio) is situated in the Fucino lake basin, and dates back to around 6,500 years BP (Impressed Pottery). The village of Catignano (Figure 1, site 8) belongs to the early Painted Pottery culture (6,400–5,900 BP), and is partly contemporary with the Impressed Pottery. The settlement of Settefonti (5,600–5,300 BP) belongs to a late phase of the Ripoli Culture (advanced Painted Pottery).

Data on the provenance of the obsidian show that Lipari and Palmarola were the sources of raw materials, which were probably imported through Latium.

Remarkable variations in the quantity (quantities) of these two kinds of obsidian were noticed throughout the Neolithic: during the early phase (Colle Santo. Stefano) most of the obsidian was imported from Palmarola, but it became scarce during the Catignano Painted Pottery phase and rare in the later Ripoli phase. A large input of Palmarola obsidian (around 50%) was noticed in the late Neolithic phase of Settefonti[36,37].

In the Fucino basin area (and only here) the frequency of obsidian artifacts is quite high (8%) if compared to flint ones in the Early Neolithic lithic assemblages; this area therefore appears as a redistribution center towards the eastern coast, and perhaps also the Marche and Romagna regions.

A preliminary analysis of flints through micro and macroscopic means revealed that the main procurement areas were located not far from the sites. In the Lower Neolithic of the Fucino (Colle Santo Stefano) micro and macroscopic analyses on a significant sample allowed us to identify pink-fawn flints and grey-smoky ones. Both were found in the Monte Genzana layers (around 20 km away), the former in the Late Cretaceous »scaglia« and the latter in the so-called »marne a fucoidi« (fucoid marls).

In the Late Neolithic assemblage of Settefonti, fawn and pink flints were used; these are related to the late Cretaceous and Palaeogene formations of the Gran Sasso mountain (between 10 and 20 km from the site), particularly to the pelagic limestones of the »Scaglia« formation.

Another grey variety can be ascribed to Maiolica lithologies, or to marly-limestone layers of Lias age. One fragment is very peculiar, and can be ascribed to a precise phase of bituminous shales cropping out in the eastern part of these mountains.

REFERENCES

1. CAUCHE, D., C. TOZZI, G. VICINO, H. DE LUMLEY: Actes du Colloque »Pierre et Archéologie«. (Presses Universitaires de Perpignan, 2002). — 2. ALHAIQUE, F., A. BIETTI, L. CAPASSO BARBATO, S. GRIMALDI, T. KOTSAKIS, S. L. KUHN, C. LEMORINI, G. MANZI, A. RECCHI, H. P. SCHWARCZ, M. C. STINER, Atti del XIII Congr. U.I.S.P.P., 6 (I) (1998) 221. — 3. ALHAIQUE, F., A. BIETTI, A. DEL LUCCHESE, S. GRIMALDI, G. MANZI, S. MARTINI, F. NEGRINO, A. RECCHI, Riv. di Antropologia 78 (2000) 105. — 4. BIETTI, A., S. GRIMALDI, Quaternaria Nova 6, (1996) 237. — 5. BLANC, A. C., Rend. Accad. Naz. Dei Lincei, 28 (1938) 107. — 6. HEDGES, R. E. M., R. HOUSLEY, C. B. RAMSEY, G. VAN KLINKEN, Archaeometry, 36 (1994) 337. — 7. KUHN, S., A. BIETTI: The Late Middle and Early Upper Paleolithic in Italy. In: BAR-YOSEF, O., D. PILBEAM (Eds.): The geography of Neandertals in Europe and the Greater Mediterranean (Peabody Museum Bulletin n. 8, Harvard, 2000). — 8. STUIVER, M., P. J. REIMER, E. BARD, J. WARREN BECK, G. S. BURR, K. A. HUGHEN, B. KROMER, G. McCORMACK, J. VAN DER PLICHT, M. SPURK, Radiocarbon, 40 (1998) 1041. — 9. LAPLACE, G., Riv. Sci. Preistoriche, 32 (1977) 3. — 10. KUHN, S. L., M. C. STINER, Quaternaria Nova, 2 (1992) 77. — 11. PELEGRIN, J., Cahiers du Quaternaire, 20 (1995). — 12. ISETTI, G., Riv. Studi Liguri, 28 (1961) 5. — 13. LUMLEY, H. de, Cahiers Ligures de Préhist. et d'Arch., 14 (1965) 5. — 14. TAVOSO, A., L'outillage du gisement de San Francesco à San Remo (Ligurie, Italie). In: KOZLOWSKI, J. K. (Ed.): L' Homme de Néandertal 8 – La Mutation. (ERAUL, Liége, 1988). — 15. ISETTI, H., H. de LUMLEY, J. C. MISKOWSKI, Riv. Studi Liguri, 29 (1962) 5. — 16. BULGARELLI, G. M., Memorie dell' Ist. Ital. di Paleontol. Umana, 2 (1974) 91. — 17. IAWORSKI, G., Bull. Mus. Anthrop. Préhist. Monaco, 8 (1961) 177. — 18. IAWORSKI, G., Bull. Mus. Anthrop. Préhist. Monaco, 9 (1962) 73. — 19. TOZZI, C., F. NEGRINO, Atti XXXIV Riunione Scientifica Istituto Italiano di Preistoria e Protostoria, Firenze 1999. (Firenze, 2001). — 20. BIAGI, P., L. CASTELLETTI, M. CREMASCHI, B. SALA, C. TOZZI, Emilia Preromana, 8 (1980) 13. — 21. KUHN, S. L., M. C. STINER, Current Anthropology, 39 Suppl. (1998) 175. — 22. CIPRIANI, N., M. DINI, M. GHINASSI, F. MARTINI, C. TOZZI, Riv. di Sc. Preist., 51 (2001) 337. — 23. BOSCHIAN, G., Archaeologia Polona, 33 (1995) 31. — 24. BOSCHIAN, G., B. ZAMAGNI, Proceedings (XIII UISPP Congress, Forlì, September 8–14, 1996, Vol. 2, Sect. 6, 1998). — 25. BARTOLOMEI, G., A. BROGLIO, L. CATTANI, M. CREMASCHI, A. GUERRESCHI, E. MANTOVANI, C. PERETTO, B. SALA, Ann. Univ. Ferrara, sez. XV, Paleontologia umana e Paletnologia, 3(1982) 62. — 26. BARTOLOMEI, G., A. BROGLIO, L. CATTANI, M. CREMASCHI, A. GUERRESCHI, P. LEONARDI, C. PERETTO: Paleolitico e Mesolitico. In Il Veneto nell'antichità. Preistoria e Protostoria, vol. II. (Banca Popolare di Verona, 1984). — 27. ALCIATI, G., L. CATTANI, F. FONTANA, E. GERHARDINGER, A. GUERRESCHI, S. MILLIKEN, P. MOZZI, P. ROWLEY-CONWY, Preist. Alp., 28 (1992) 351. — 28. FONTANA, F., A. GUERRESCHI, The Mesolithic mountain campsite of Mondeval de Sora (Italian Dolomites). In: Proceedings. (The XIII U.I.S.P.P. Congress, 1998). — 29. FONTANA, F., Il popolamento delle aree montane nell'Olocene antico. Analisi delle strutture e delle industrie litiche dei livelli sauveterriani di sito di Mondeval de Sora (Dolomiti Bellunesi). PhD Thesis. In Italian. (Anthropological Sciences, University of Bologna, 1997). — 30. FONTANA, F., N. VULLO, Organisation et fonction d'un camp de base saisonnier au coeur des Dolomites: le gisement mésolithique de Mondeval de Sora (Belluno, Italie). Actes du Colloque International Epipaléolithique-Mésolithique »*Les derniers chasseurs de l'Europe occidentale*«, Besançon, 1998. (Besançon, 2000). — 31. BONATO, M., C. TOZZI, B. ZAMAGNI, Atti del Convegno di Studi »La Neolitizzazione tra Oriente e Occidente«, Udine, 1999. (Udine, 2000). — 32. BONATO, M., F. LORENZI, A. NONZA, G. RADI, C. TOZZI, M. C. WEISS, Le nuove ricerche a Pianosa. Gli scavi del 1998. In: TOZZI, C., M. C. WEISS (Eds.): Il primo popolamento olocenico dell'area corso-toscana. (Edizioni ETS, Pisa, 2000) 91. — 33. IACOPINI, A., Nuovi dati sulla ceramica a linee incise in Toscana: Il sito di Casa Querciolaia (LI). In: TOZZI, C., M.-C., WEISS (Eds.): Il primo popolamento olocenico dell'area corso-toscana. (Edizioni ETS, Pisa, 2000). — 34. DE FRANCESCO, A. M., G. M., Crisci, PROVENIENZA DELLE OSSIDIANE DEI SITI ARCHEOLOGICI DI PIANOSA (ARCIPELAGO TOSCANO) E LUMACA (CORSICA) CON IL METODO ANALITICO NON DISTRUTTIVO IN FLUORESCENZA X. IN: TOZZI, C., M. C. WEISS (Eds.): Il primo popolamento olocenico dell'area corso-toscana. (Edizioni ETS, Pisa, 2000). — 35. RADI, G., La distribuzione dell'ossidiana in Toscana nel Neolitico antico. In: TOZZI, C., M. C. WEISS (Eds.): Il primo popolamento olocenico dell'area corso-toscana. (Edizioni ETS, Pisa, 2000). — 36. BIGAZZI, G., G. RADI, XIII UISPP Congress Proceeding, Forlì, 1996. (Forlì, 1998). — 37. BIGAZZI, G., G. RADI, Atti XXXVI Riun. Scient. IIPP in Abruzzo, 2001. (Abruzzo, 2004).

C. Tozzi

Department of Archeology, University of Pisa, Via S. Maria 53, 56126 Pisa, Italy
e-mail: tozzi@arch.unipi.it