I. BIDDITTU (1), P. F. CASSOLI (1), F. RADICATI di BROZOLO (2),
A. G. SEGRE (1), E. SEGRE NALDINI (1), I. VILLA (2)

Anagni, a K-Ar dated Lower and Middle Pleistocene Site, Central Italy: Preliminary Report

The Anagni basin is closer to the Latial volcano group than the other Sacco-Liri valley middle Pleistocene basins (Biddittu, Segre 1976). This wide valley between Cassino and Valmontone is called also Valle Latina. These morphologic depressions of neotectonic establishement, were filled successively by pyroclastic, tuffitic and fresh water and continental deposits. A few stratigraphic profiles, correlated among themselves allow the reconstruction of the lower and middle Pleistocene series. Of them, three are valley sides (S. Giacomo, Colle Marino, Valle Vico), one is exposed because of « pozzolana » quarries (Ranuccio site (3) and the fifth on the opposite side of the Sacco river Valley is exposed because of deep furrows (Villamagna site). For this zone the geologic cartography and literature is very scarce and inadeguate, particularly for the Quaternary (Beneo, Crema 1939; Alberti *et al.* 1975). The stratigraphic sketch is shown in fig. 2. The stratigraphic sequence is about 70 m deep, from the medium-lower Villafranchian to all of the Mindel. The « tufo litoide » of the Roman Campagna (fig. 2; tl2) is the upper limit of the Ranuccio site series. It is slightely younger than the pyroclastic sand found below (LS4 : 366,000 years). Therefore it could be considered still as final Mindel, rather than Mindel-Riss.

The underlying higher part of the Ranuccio site series include 3 well distinguished layers and it is totally 4 m thick (fig. 2: n. 3; 4; 5). The uppermost is composed by a soliflucted, may be cryoturbated paleosol and an earthy lower part with scattered fragmentary bones and silex industry. This rests on a very fine cyneritic dust layer 1 m thick, with a well preserved temperate flora, originated from some of the near by Ernici Volcanoes of which the K-Ar age is comprised between 400.000 and 540.000 years (Basilone, Civetta 1975). A pa-

(1) Istituto Italiano di Paleontologia Umana, Roma.
(2) Laboratorio di Geocronologia e Geochimica Isotopica. CNR - Pisa.
(3) By chance this zone attracted the attention of Mr. Anzellotti; Mr. Bruni collected some bones.

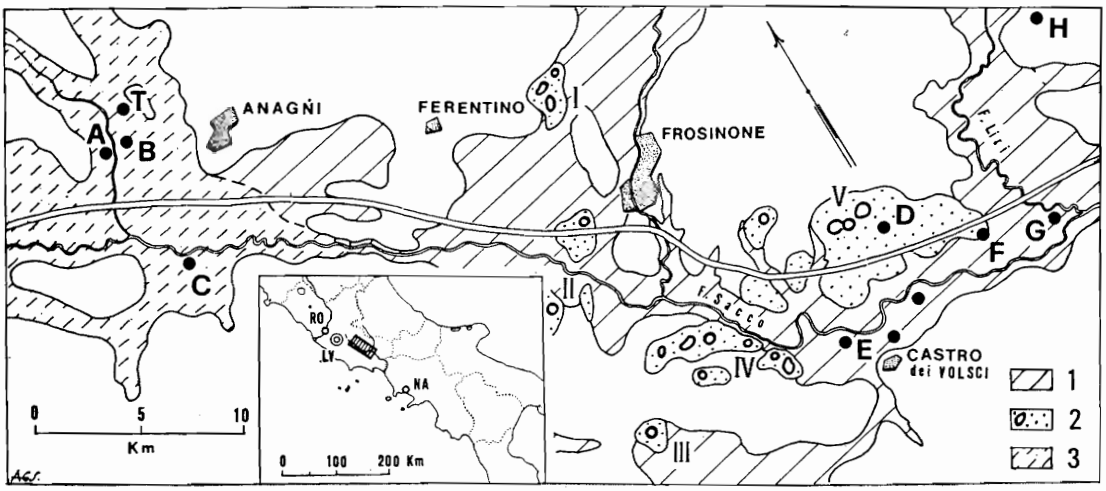

FIG. 1. — Pleistocene sites of Sacco river valley. 1, Quaternary deposits; 2, Sacco valley volcaniclastic; 3, Latial Volcano pyroclastics. A, St. Giacomo Villafranchian site; B, Ranuccio middle-Pleistocene site; C, Villamagna site; D, Pofi middle-Pleistocene site; E, Castro dei Volsci choppers site; F, Colle Avarone Acheulean site; G, Isoletta Acheulean lacustrine layers; H, Arce chopper site; T, Vico Valley travertine and gravels. Ernici volcanoes: I, Tecchiena; II, Patrica; III, Giuliano; IV, Ceccano; V. Pofi. Position Sketch: Ro, Rome; Na, Naples; Lv, Latial volcano.

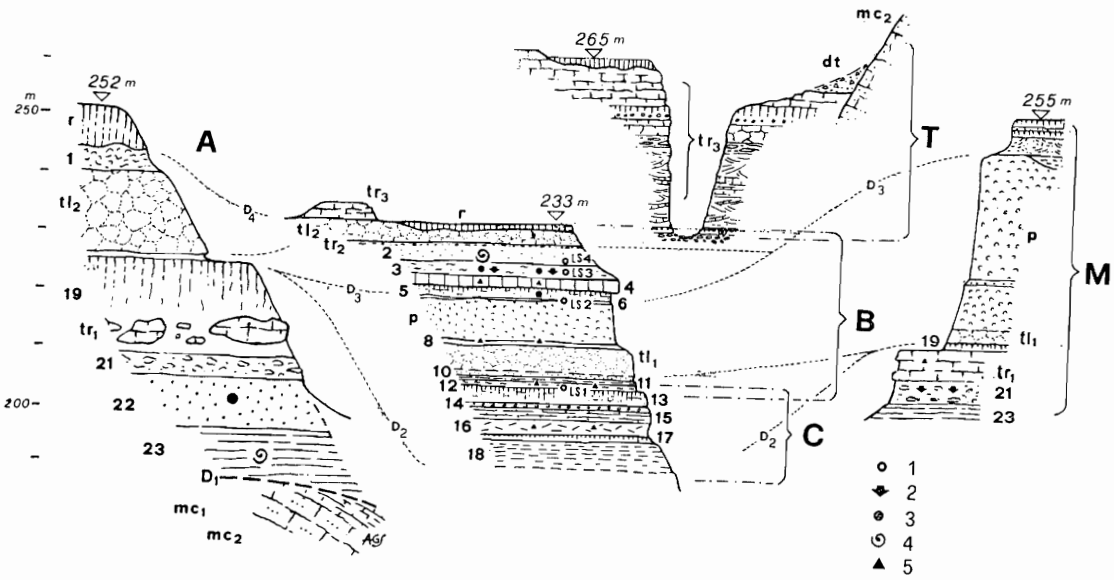

FIG. 2. — Simplified stratigraphical correlation of the pleistocenic crops near Anagni. Sites: A, St. Giacomo; B, Ranuccio; M, Colle Marino; C, Villamagna; T. Vico Valley. Symbols: 1, K-Ar tephrochronology; 2, lithic and bone industry; 3, vertebrate fossils; 4, freshwater or terrestrial shells; 5, fossil flora. Stratigraphy: dt, recent colluvial deposits; r. paleopedogenic dark red clay; tr3, upper travertine; a, fresh water silt; g, gravel; l, scoriae agglomerate; tl2, « litoide superiore », i.e. tephra flow tuff high level; tr2, calcareous concretions horizon; 2, tuffite with terrestrial molluscs; 3, archaeological layer with ferricrusts and solifluction marks; 4, cinerite layer; 5. paleosol and tephra levels; 6, leucite cristals thin layer; 7, « pozzolana », i.e. pyroclastic flow; 8, contact lateritized paleosol; tl1, « litoide inferiore », i.e. tephra flow tuff, lower level; 10, pyroclastic sands; 11, paleosol and tuffite; 12, tuffitic limnosol; 13 uniform dark paleosol layer; 14, pisolitic tuffite; 15, layered silicified tuffite; 17, paleosol; 18, tuffite; 19, pedogenized pyroclastic; tr1, lower travertine; 21, limy clay horizon with calcareous concretions. Villafranchian: 22, yellow silt with bones; 23, grey clay with fresh water molluscs. Miocene: mc1, Messinian clay; mc2, Tortonian sandstone; D_1-D_4, unconformityes. Altimetry in m on sea level.

leosol with rear scattered bone fragments, lies in a mild depression on the « pozzolana » layer (fig. 2; p). This is a pyroclastic agglomerate flow of non welded black and red scoria mixed with some non frequent little and medium sized leucit-melilite lava fragments used later by man for tools (fig. 2, level 3). This did arise in a fluidized state from some buried fissure vents under the external Latial Volcano « caldera » wall (Maino, Motta, Segre 1969), and extending till

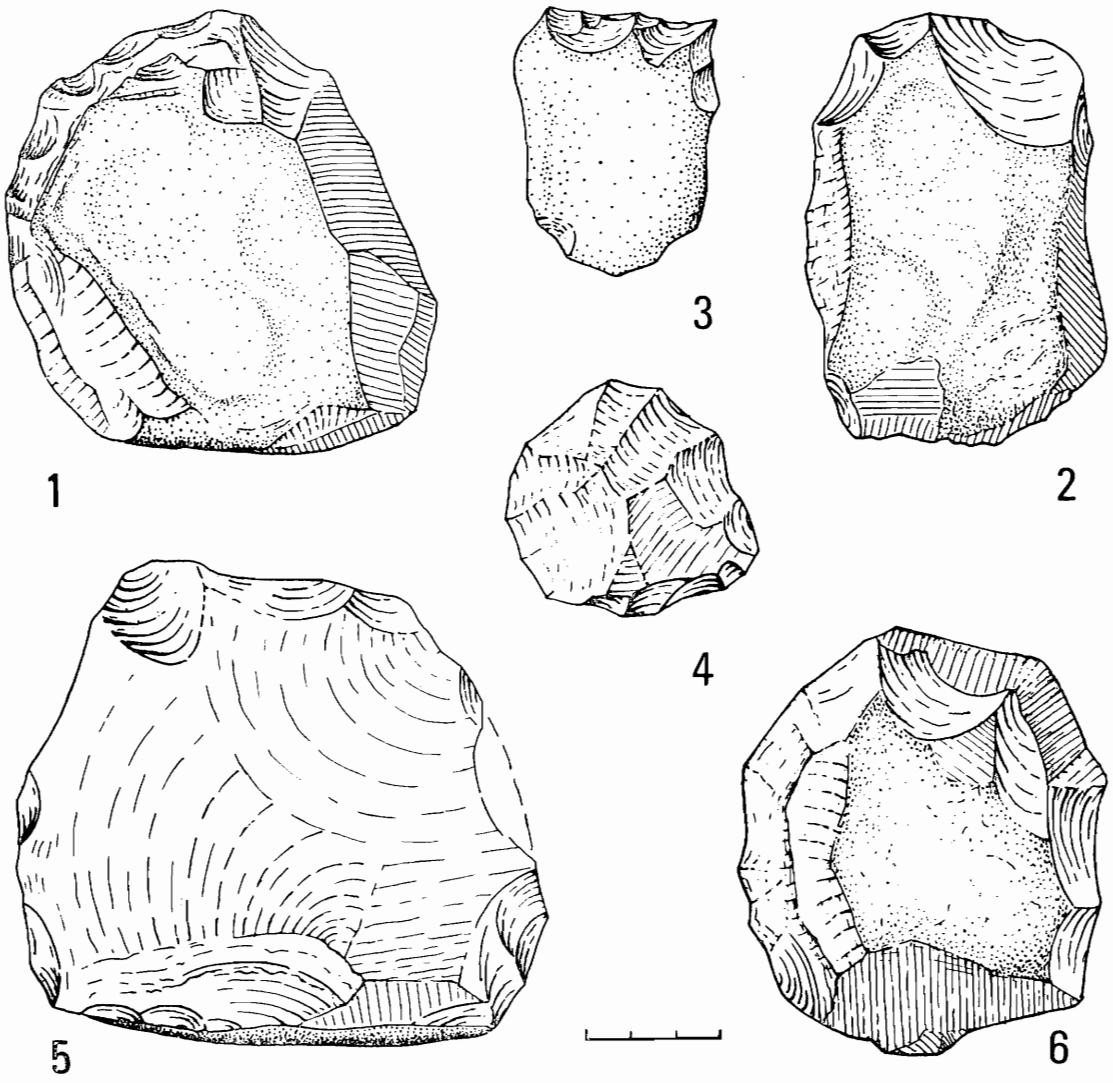

FIG. 3. — Colle Marino site (Anagni) lithic artifacts: 1, 2, bifacial choppers; 3, pebble scraper; 4, 6, polyhedrons; 5, flake scraper. Scale bar in cm.

about 20 Km far from his origin. It must have behaved like a kind of viscous fluid: the temperature should have been very hot in the Anagni country since no mark of preserved organisms exist in it. This « pozzolana » layer is of variable thikness from 5 to 20 m, adapted to the underneath buried topography: in it large quarries are open for economic exploitation. The lower part of this stratigraphy older than LS-I (528.000 years) of well stratified limno-continental tuffitic facies,

crops out at Ranuccio and Villamagna sites. Particularly at Villamagna a deep silicified grey tuffite includes a very well preserved coniferous flora, may be Mindel M1 or a little older if the correlation is correct. All these above mentioned layers are more recent than the lower Pleistocene series of St. Giacomo and Colle Marino sites. Those (fig. 2: n. 19; tr 1; 21) are composed by fresh water Typha limestone of travertine facies. A calcareous clay with a very rough lower paleolithic industry (fig. 3) underlies the travertine. The basal levels of this series are composed by slity yellow sand with middle Villafranchian fauna and underlying clay level with fresh water molluscs (Pisidium). The Vico Valley site series (fig. 2; T) essentially travertine facies (tr3) follow as the more recent of all the reported stratigraphic features.

The Colle Marino site, a pebble tool industry

This industry is obtained from pebbles and mesozoic (upper Cretaceus) limestone fragments. Within this industry, mono and bifacial choppers, polyhedrons (scarcer), flake and pebble scrapers and flakes with well preserved bulb are peculiar (fig. 3; fig. 2: n. 21).

The Ranuccio lower palaeolithic site

It comes all from the layer n. 3 (fig. 2). Three groups of tools are noticeable within it: silex tools, infrequent lava tools among which two bifaces (one whole and the other fragmentary). Several tools and bone flakes are included in the third tools group. They constitute more than 50% of all implements.

The lithic industry

The flake tools are in total 44, of which 41 are of silex, and 3 of lava. Typology:

— convex simple scrapers	n. 3	— retouched notches	n. 6
— double concave-convex scrapers	» 1	— denticulates, 1 of lava	» 8
— transverse scrapers	» 4	— various	» 8
— alternate retouched scrapers	» 1	— flakes, 2 of lava	» 13

Moreover one chopper scraper LD, five nuclei (2 of lava) and one lava anvil are also present.

Tools and flakes are generally of small sizes. The average tools length, width and thikness are respectively 23.4 mm; 20.2; 10.1. The average sizes for

flakes are respectively 21.7 mm; 21.5; 6.4. The retouches of the tools are in four instances raised and scalariform, in seven instances simple and deep, and seldom, ripid deep or marginal; scarce the flat retouch. 20 striking platforms are

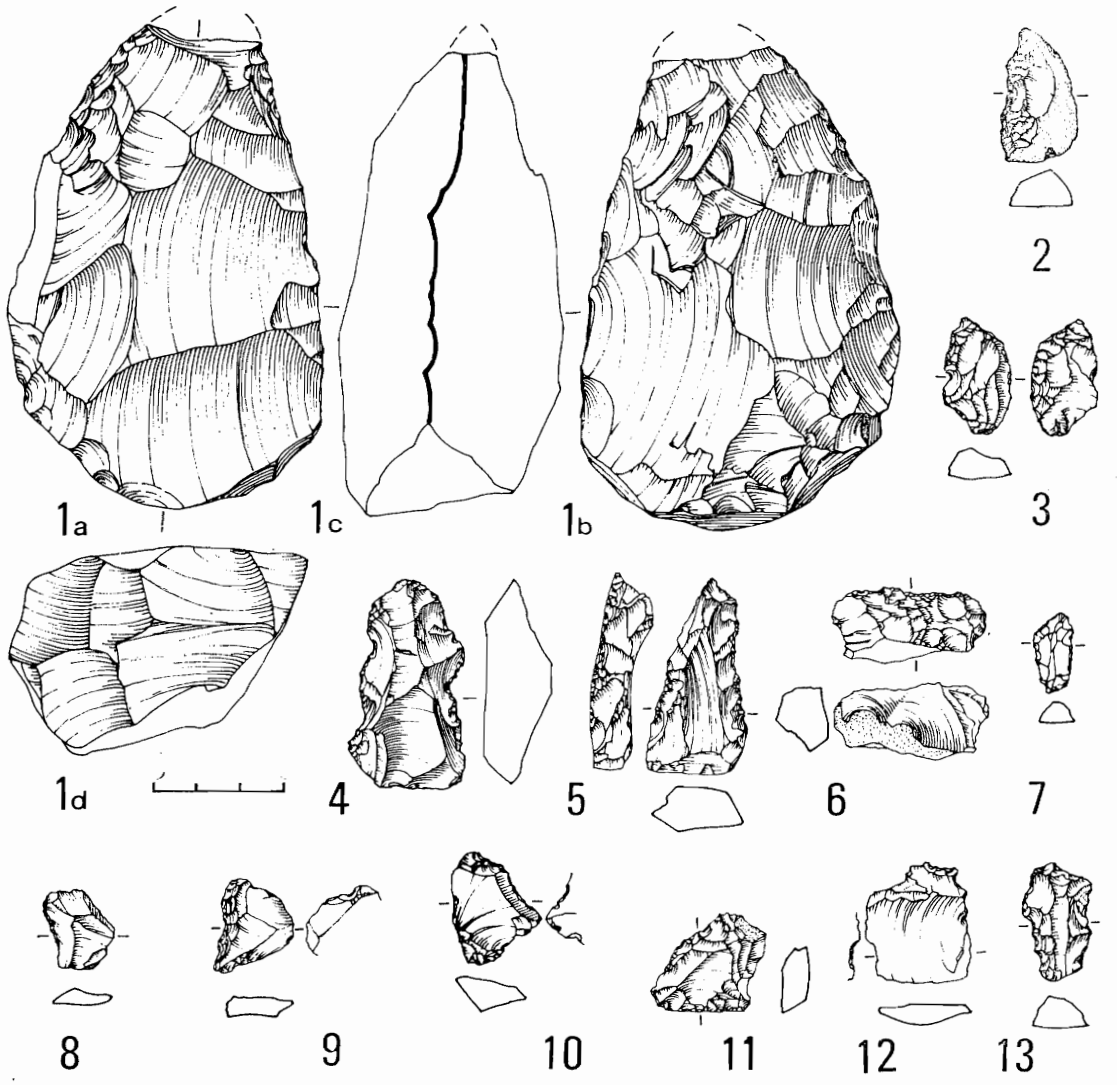

FIG. 4. — Ranuccio site, Anagni lithic artifacts: 1, lava biface; 2, convex simple scraper on flake with preserved cortex; 3, alternate retouched scraper; 4, 9, 13, denticulates; 5, concave-convex double scraper; 6, transverse-convex scraper; 7, flake with periferical marginal retouch; 8, notches on flake; 10, fragment of little core with marginal retouch; 11, transverse-convex scraper; 12, retouched notche on little flake. Scale bar in cm.

evident among the tools, of which 13 are smooth on the detachement, one smooth on the fracture, one dihedral, three on cortex, and two are punctiform. Concerning flakes, of 13 observed striking platforms, 11 are smooth on the detachement, one punctiform and one smooth on the fracture. The surface of the striking platforms is generally obtuse angle with the ventral face. The Levallois technique is absent. The average of dorsal detachements in 3.5%. Very rough is the

use of the available raw material, and therefore it can be concluded that it was very rare in the region. This hypotesis is suggested by the high frequency of tools (34) and the low quantity of flakes (13). Moreover this is confirmed by the high percentage of bone tools and bones used.

One of the two bifaces is the extremity of a smooth and unfinished tool. The other (fig. 4;. 1a) is a lava biface with jagged margins; the large primary detachments are retouched on one of the two sides (fig. 4: 1c). The base shows a flat retouched surface that makes obtuse angle with the two lateral sides (fig. 4; 1d): there is to remark the great unfrequency of bifaces relatively to the explored area.

The bone industry

The bone utilization is one of the more important characters of this outcrop. The following tools may be distinguished:

— diaphysis fragments that show wear and striping marks caused by a long use;

— cutted flakes on which the characters of lithic flakes are observed (fig. 6: n. 3);

— retouched diaphysis fragments and flakes (fig. 6: n. 2);

— choppers (fig. 6: n. 4);

— bifacies (fig. 5: n. 3a-c);

— sharp edge tools obtained with broad bifacial detachments (fig. 5: n. 1a-c and fig, 6: n. 1a-b);

— long bone tools with preserved articular apophysis (fig. 6: n. 5);

— diaphysis fragments regularly cutted and probably used as handles (fig. 5: n. 4).

A so wide bone utilization with a great shape variety represents a new aspect of the lower italian palaeolithic. The utilized bone presence in Acheulean and pre-Acheulean Latial outcrops was already known (Biddittu, Cassoli 1969; Biddittu 1972b; Biddittu, Segre 1976; Biddittu, Piperno 1979) and in southern Italy at Venosa (Segre 1978). But only in this Anagni outcrop takes a comparable meaning that in other places takes the lithic industry. A similar archaeological situation is that of lower Pleistocene of Bugiulesti, Romania (Fridrich 1976). Bone tools are also known in other European countries as in the Acheulean of Torralba and Ambrona in Spain (Biberson 1964; 1965; 1968) of Terra Amata, Nice France (de Lumley and *al.* 1976). They are also known at St. Symphorien, Belgium (Cubuck 1976) and Bilzingsleben, Erfurt, E Germany (Mania 1977) whose lithic industry shows many resemblances with our one.

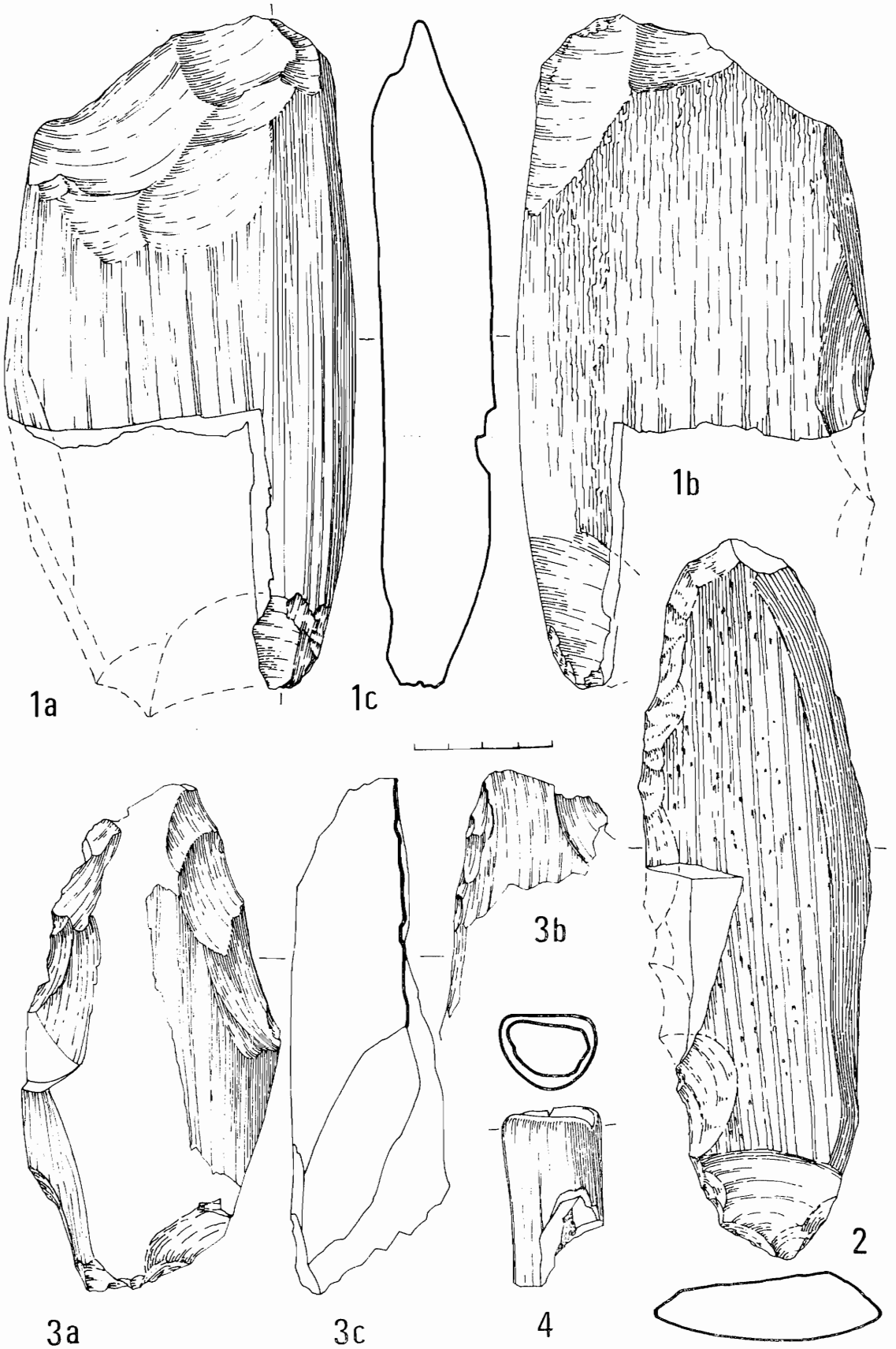

FIG. 5. — Ranuccio site, Anagni: bone utilization. 1a-c, Elephant bone diaphysis fragment with sharp margin obtained with large bifacial flaking. The opposit margin must be retouched as the entire; 2, Elephant diaphysis fragment with a retouched margin; 3a-c, biface made from a very massive Elephant bone fragment; 4, tibia fragment of Cervide with a intentional breack smoothed by long utilization: the spongy tissue is removed for space increase for handle use. Scale bar in cm.

The Colle Marino site

The Colle Marino site lithic industry does not seem to be assignable to the late Cromerian or Anglian (Roe 1976) for remarkable roughness, and for that, is more primitive than the known Günz-Mindel industries of Central Europe and Italy (Venosa).

It might be approached to the Irsina tool, Venosa basin (Segre 1978) from a conglomerate horizon older than the Melfi volcanics dated 850.000 years (Cor-

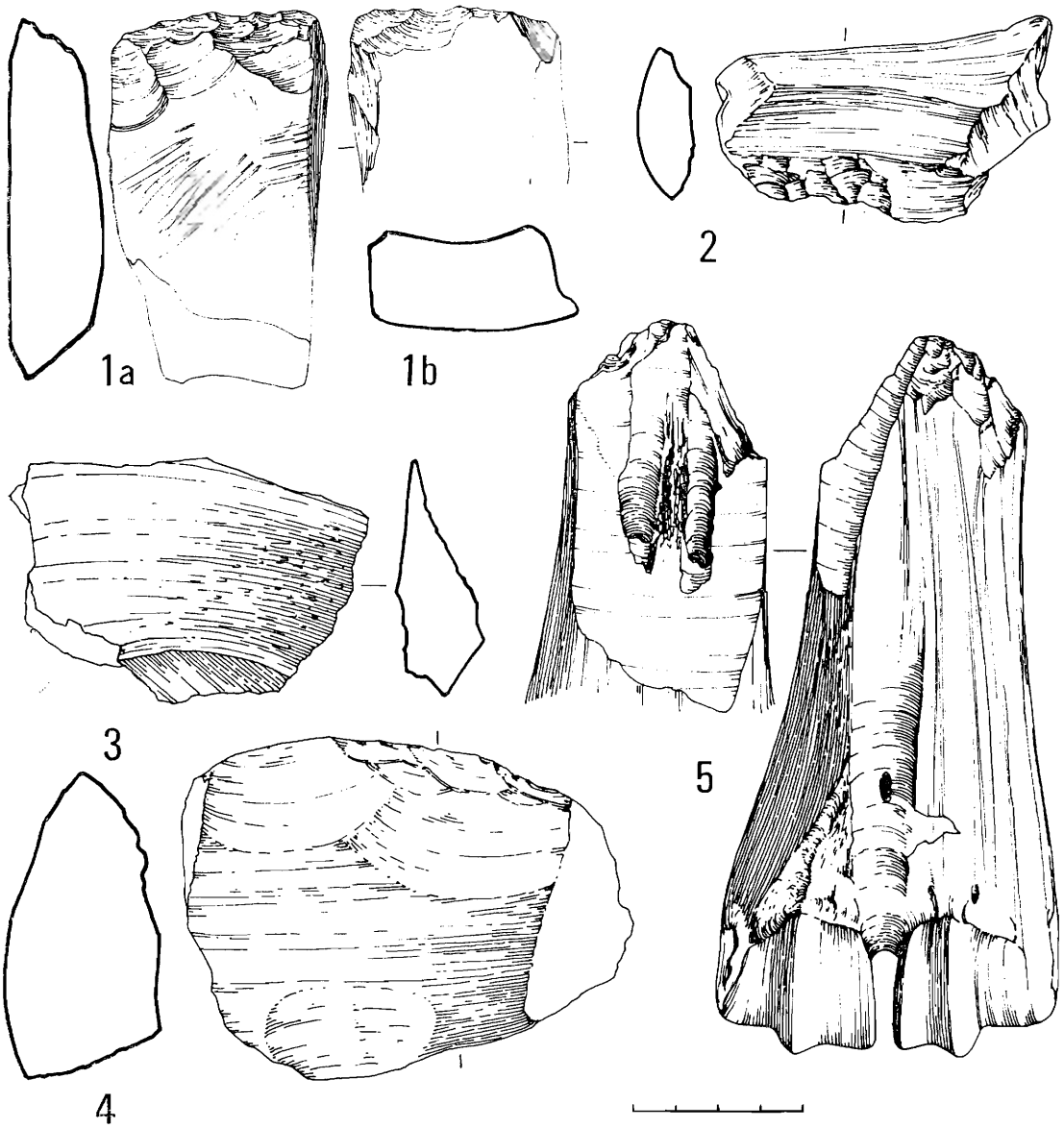

FIG. 6. — Ranuccio site, Anagni: bone utilization. 1a-b, diaphysis fragment (Elephas?) with a sharp margin obtained with bifacial retouch; 2, scraper; 3, bone flake with striking platform that form a blunt angle with the ventral face; 4, bifacies chopper from a thich Elephant bone fragment; 5, bovide metacarpal with broken and retouched articular apophysis. Scale bar in cm.

tini 1975). From a chronostratigraphic point of view may be approachable to the Vallonet industry (de Lumley and *al.* 1976) and to Monte Peglia (Piperno 1972). The only more significant comparison is possible with the Arce and Fontana Liri lithic industry (Biddittu 1972) where many choppers, unfrequent scrapers, flakes and some polyhedrons are present. Their stratigraphic position must be referred probably to the Günz. Furthermore the Colle Marino site lithic industry recalls meaningfully the oldowan industry of the lower levels of Olduvai reviewed by Leakey (1971).

The Ranuccio site

The Ranuccio site industry is distinguished by the high rate of bone tools, by the rarity of the bifaces, by the smallness of the silex tools, and by the lava utilization. A part from the bifaces presence, remarquable analogy is evident with the Pofi site (fig. 1; D) as well for his chronologic position. The « pozzolane » of Pofi volcanic group, a scoriaceous lapilli agglomerate with lava bombs, underlies a lava flow dated about 400.000 y.rs K-Ar (Basilone, Civetta 1975) and include scarce small silex industry but aboundant lava tools as scrapers, choppers, denticulates, flakes, some bone implements and some fragments of human lower limbs and *Elephant* sp., *Megaceros* cfr. *solilhacus, Macaca* (Biddittu, Segre 1978). Other comparative observations will be developed in coming reports.

THE FOSSIL FAUNAS

Two are the recovered fossil faunas: the oldest one layes in the lower horizon of the St. Giacomo site series that precedes all regional volcanic activity. The higher fauna together with lithic and bone industry layes immediately above the Ranuccio site volcaniclastic series.

The Villafranchian layers

The following species are contained in a yellow silty sand (fig. 2: 22):

— *Anancus arvernensis* Cr. and Job.: a complete and one fragmentary molar, both of them very used.

— *Archidiskodon meridionalis* Nesti: a molar fragment with non yet used chewing surface, with the laminae arrangement clearly evident.

— *Equus stenonis* Cocchi: the more aboundant remains up to day collected, particularly teeth for wich typical characters is assigned to this species.

— *Dicerorhinus* cfr. *etruscus* Falc.: a complete right inferior premolar and some other teeth fragments.

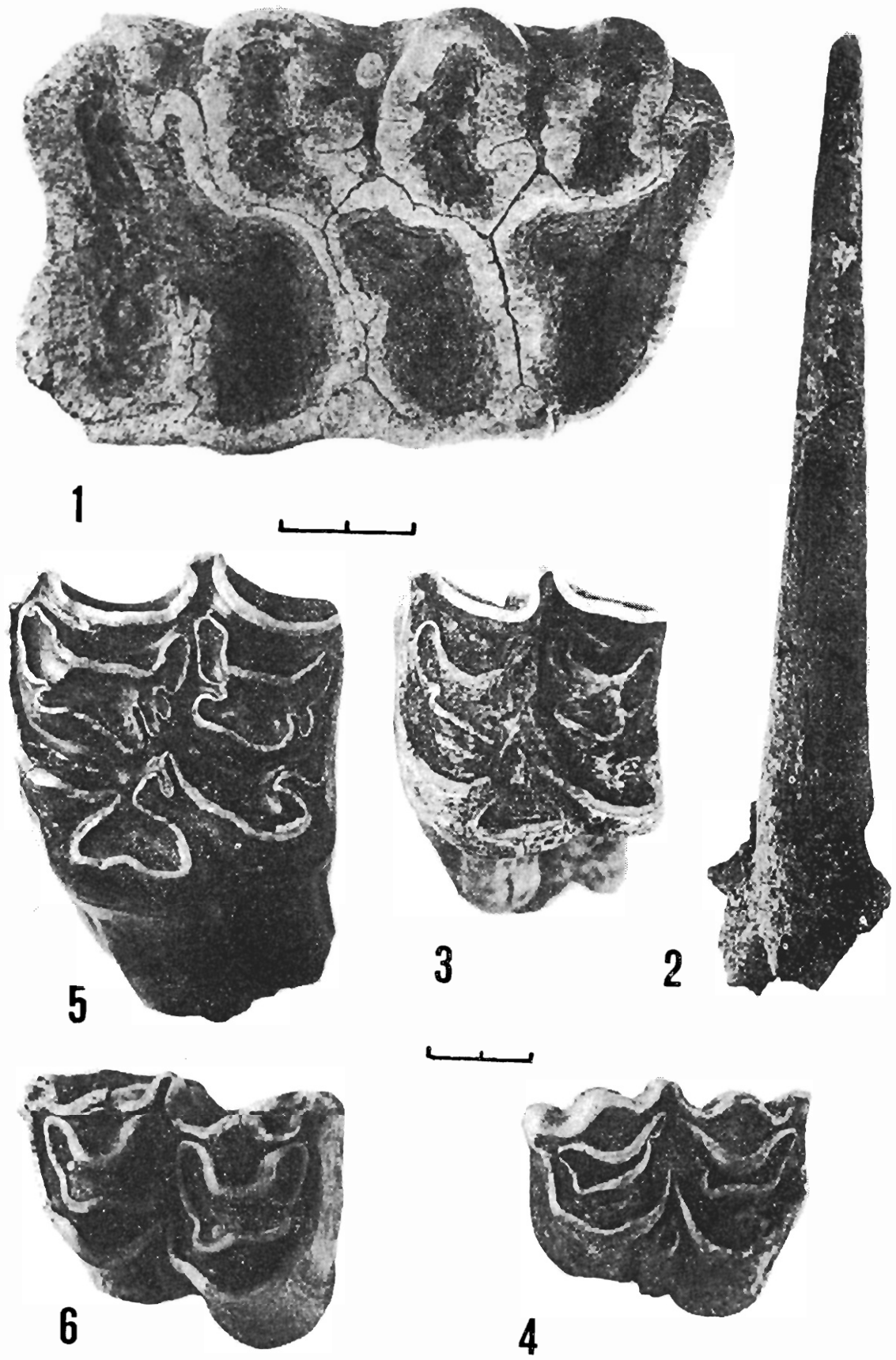

FIG. 7. — St. Giacomo and Ranuccio sites fauna: Middle Villafranchian: 1, Anancus arvernensis Cr. and Job.; 2, Gazella borbonica Dep.; 3, Equus stenonis Cocchi; 4, Leptobos sp. Anthropozoic level: 5, Equus cfr. moosbachensis v. Reich.; 6, Bos sp. Scale bar in cm.

— *Leptobos* sp.: to this are assigned some right and left M3, some radius and humerus fragments and two phalanges.

— *Cervidae*: three species are recognizable between the many very fragmental teeth, limb bones and antlers remains. One of them of little size may be assigned to *Croizetoceros ramosus* Cr. and Job.; the teeth sizes stay in the variability field known for the Montopoli-Valdarno *C. ramosus* (De Giuli, Heintz 1974). A greater size species comparable with *Cervus philisi* Schaub of this are present some superior molars and among some limbs remains, a distal humerus apophysis, a radius without the distal epiphysis because not yet joined, a scapula, some heel fragments, a tharsus-metatarsus and two cubo-naviculars. The third species, much bigger is a *Eucladoceros* sp. represented by some inferior and superior molars and some limb bones: three astragali, heels, radius fragments and scapula.

— *Gazella borbonica* Dep., is represented by a complete horn in a frontal skull fragment, some superior left teeth (M1; M2; M3; P), two phalanges comparable with the same Montopoli species remains (De Giuli, Heintz 1974). Other antelopine teeth and phalanges of a bigger species than *Gazella borbonica* is not yet identifiable.

— *Sus*: a left M3 fragment and a deciduous tooth that for size and morphology are well comparable with the Olivola (Tuscany) *Sus strozzii* Fors. Major (Azzaroli 1954, pl. 13).

— *Hyaena* sp.: only a large number of coprolithes, a right Pm4 and an atlas fragment are present.

— *Canidae* are present with *Canis* cfr. *etruscus* Fors. Major (a M1 right fragment) and *Canis* cfr. *alopecoides* Fors. Major (a Pm4 left tooth); a coprolite very different from those of *Hyaena* may be referred to *Canidae*.

— A big sized felid is present with a distal left humerus diaphysis fragment with a well developed olecranic bridge: the size is of a *Macairodontidae*.

— *Primates*: one incomplete inferior incisor and a molar tooth of a large sized ape are documented for the first time in Villafranchian italian layers. *Cercopitecidae* remains are known from lower to superior Villafranchian in Spain at Cova Bonica, in France at Senèze and Vialette, and in Romania at Giaunceanu and Malusteni. This is the *Paradolichopithecus arvernensis* Dep., species to which may be referred these teeth.

— *Testudo*: many plastron and carapace fragments of a Testudo are also present.

From this preliminary study this fauna resembles to one of Montopoli. The distribution area of *Gazella borbonica* with this new finding is much more southward extended in Europe than to date known. The *Cercopitecidae* presence, also if the remains are not certainly determinable as *Paradolichopithecus arvernensis* is extended to Italy in the lower Pleistocene. Therefore these Primates

bigger than Macaca, only genus known before for these layers, are also present in the Villafranchian. This Anagni fauna association may be referred to middle Villafranchian age for the presence of *Gazella borbonica* which has never been found in more recent levels than those of European middle Villafranchian and also for the occurrence of *Equus stenonis* whose first presence is documented starting from this period.

The Ranuccio site fauna

The Ranuccio site fauna, included between LS2 and LS4 dated K-Ar levels (487.000 and 366.000 y.rs) is extremely fragmentary. These are the identified species:

— *Palaeoloxodon* cfr. *antiquus*: incomplete molars, mandibles and tusks fragments; pelvis, anterior limbs and feet bones.

— *Rhinoceros* sp.: molar and premolars and one incomplete ulna.

— *Hippopotamus* sp.: only a tusk fragment.

— *Sus scrofa ferus* L.: a M3 tooth.

— *Bos* sp.: some molars and premolar, limb bones fragments, distal metatarsal and metacarpal apophysis, a nearly complete massive horn whose elliptical orthogonal section diameters are 12,3 and 9,1 cm, 10 cm from the cranial junction. The horn length is 60 cm with a gentle elicoidal torsion. All these bones are one third smaller than the correspondent upper Pleistocene *Bos primigenius* Boj, bones; therefore they show a shorter Bovide form, probably more arcaic than *B. primigenius*.

— *Bison* sp.: an inferior and superior molar tooth.

— *Equus* cfr. *moosbachensis* v. Reichenau: fifteen jaw teeth for size and some characters of the triturant surface approach to this species.

— *Cervidae*: a skull fragment with well preserved frontal suture and the lower part of a big sized antler; the initial position of this antler is of Megaceros character and particularly alike to *Verticornis* group. To the same are referred two teeth and a cubo-navicular fragment.

— *Cervus elaphus* L.: some teeth, antlers, limb bones and metacarpalia fragments are frequent. The slightly smaller size as regard to the tipical würmian and post-glacial elaphus fall within the variability range of this species. A third fragmental bones group (astragalus, cubonavicular, scapulae, humerus, etc.) pertain certainly to a smaller species, at present of problematic attribution. To the *Dama* group may be approached an ulna fragment of really very small size.

— *Ursus deningeri* v. Reichmann: a well preserved M1 that for the size, for the breath/length ratio and for the morphological caracters falls within this species (Bonifay 1971, p. 219, f. 49).

— *Cuon* cfr. *alpinus*: a canine, a Pm2 and a metatarsal fragment of a canide may be attributed to this species.

— *Castor fiber* L.: two superior M and M3 of a beaver a little larger than that admitted for the living *C. fiber.*

— *Lepus capensis* L.: a tibia distal apophysis, that for size and morphology may be well approached to this species.

— *Primates*: they are certainly present with a deciduous M2 that dont allow a specific attribution, but the layer age and the faunal association led to ascribe it to *Macaca florentinus* Cocchi.

— *Homo*: one inferior incisor with complete root testify for the man presence in the Ranuccio Site. We consider this a very interesting finding, but insufficent for a more specific attribution.

— *Aves*: *Anser fabalis* Lk., *Anas penelope* L., and *Anas acuta* L., all aquatic species are present. They testify for a temperate swampy environment, or with some lakes not far from this site; identification was made on limbs and body bones fragments.

K-Ar AGE DETERMINATION (R. di B. F. and V. I.)

Four leucite separates (see fig. 2 for localization) were analyzed for K and Ar. K was measured by A. A. spectrophotometry. The Ar analytical procedure differs from the one previously used in this laboratory and will be briefly described here.

The samples are stored in an arm of the vacuum system and subsequently dropped in a Mo crucible for the fusion. This procedure causes the system to remain under vacuum conditions for long periods of time, which improves the blank level. More importantly the crucible can be outgassed before the sample run, and low reproducible blanks can be measured ($\sim 1.8 \times 10^{-8}$ ccSTP at 1500°C).

The extraction line is a simplified version of the apparatus used previously in this laboratory (Borsi and al. 1967). It does not have the Cu0 oven nor the zeolite molecular sieves, which reduces significantly the Ar memory of the system. The purification of the noble gases is obtained by exposure of the extracted gases to hot ($\sim$850°C) titanium sponge which is then cooled to room temperature to adsorb H_2. The procedure is repeated with exposure to a SAES getter to eliminate the last residues of active gases.

This purification tchnique has proved to be adequate even for relatively large ($\sim$1 g) samples of H_20-rich minerals (e.g. amphibole).

The gases remaining after purification are then collected in a second charcoal finger and introduced in the VARIANMAT 240 Mass spectrometer.

The mass spectrometer is equipped with programmable magnetic field for

peak switching and digitalized data output. The data are processed by an on-line computer with the usual extrapolation of peaks and peak ratios to the gas inlet time. The Ar isotopes were measured on the Faraday collector by means of a D.C. amplifier with input resistor of 10^{11} Ω.

The mass spectrometer discrimination was monitored frequently, measuring pipettes of atmospheric argon. The discrimination was found to be approximately 0.35% per a.m.u. favouring the light masses, and to be practically constant over a period of several months. The discrimination is assumed to vary linearly with mass.

The ^{38}Ar spike (Clusius, Zürich) was monitored with periodic measurements of LP-6 standard biotite (Engels and Ingamells, 1977). The spike uncertainty is calculated to be $= 0.52\%$ ($1\ \sigma$) almost all of which comes from the published uncertainty in the $^{40}Ar/K$ ratio of LP-6.

The analytical results are given in table 1. Errors are $1\ \sigma$ calculated according to Cox and Dalrymple (1967), with a standard deviation of 1% for the K analysis and the above mentioned value for the spike calibration.

Sample	K%	^{40}Ar%	^{40}Ar tot mlSTPxlO^{-7}	AGE ± lo (y)
LS-1	16.46	87.2	4.798	528,000 ± 6,000
LS-2	16.37	57.6	4.342	487,000 ± 7,500
LS-3	17.14	72.9	4.253	458,000 ± 5,700
LS-4	17.18	86.3	2.330	366,000 ± 4,500

Conclusions

The preservation of the lower palaeolithic calcareous arcaic industry of Colle Marino site, is due to the rather rare circumstance to be found buried in limnic limy clay sediment. If this industry would have been exposed for a long time, it would have been weathered because of the easiness to be chemically attached: in this case it would not have been recognisable any more. The end of the limnic condition has later originated the thick and uniform travertine Typha layer, that protected the underneath lacustrine clay. On the age of this industry the following consideration can be gathered. It does not seem possible to estimate it as Cromerian (Günz-Mindel) because the earliest Latial Volcano activity lies between 680.000 and 706.000 years (Evernden, Curtis 1965). Since no volcanic minerals or volcaniclasts can be found in these layers originated from this volcanic group the age should be earlier: at least Günz. The layered leucite lenses few cm thick, of Ranuccio site, have been used for dating purpose (Radicati, Villa, in this pap.): they have been deposited directly by the volcanic explosive

activity. Let now examine the sedimentation ratio years/millimeters as computed for the layers delimited by the dated K-Ar levels. The tephra beds of direct volcanic deposition must be substracted because of their very rapid formation: in this case are the « cinerite », the « pozzolana » and the « tufo litoide », fig. 2 (4; p; Tl1). We find for the time space LS4-LS3, 77 yr/mm; for LS3-LS2, 13yr/mm and for LS2-LS1, 9 yr/mm. In spite of these rough averages, the difference between the great sedimentation slowness of the anthropozoic layers, and on the contrary the sedimentation acceleration for the underlying layers, is clearly evident. The lower beds of this series are prevailingly of woody or limny facies that mean humid climate as a whole; on the contrary the layers group with fauna and lithic tools show aridity features in the lower part, but temperate humid, with some pools and basins on the higher level. A comparison with similar italian outcrops is possible only with the Venosa basin. At Venosa the lower bed fossil fauna with lithic industry seems to be of more arcaic character than the Ranuccio site of Anagni, because of the presence of species that preferably distinguish the Günz-Mindel interglacial (Segre 1978; Angelelli and Col. 1978; Durante 1978) but someone else report it to Intermindel (Barral and Col. 1978; Bonifay 1978). For the above mentioned reason, the Ranuccio site layers seem to be not so old as the Venosa one. The Intermindel (between M1 and M2) position of the Ranuccio site high layers, is supported by the fossil fauna, *Ursus deningeri* end *Equus* cfr. *moosbachensis,* which estinguish in the Mindel. The K-Ar geochronology LS3 and LS2 give respectively 458.000 and 487.000 years that are an acceptable value for the admitted chronologic limits of the Mindel. Either in the fauna or in the flora, peculiar species of cold environment are absent: this assemblage shows preferably a temperate palaeoclimatic condition. Instead immediatly on the roof lies a crioturbate zone that may be in accord with the upper Mindel (M2), while the flora of the below cinerite layer may be related to a warmer period of the Intermindel between M1 and M2.

SELECTED REFERENCES

Alberti A.U., Bergomi C. and Coll. (1975), F. 389 « *Anagni* » *Carta Geol. d'It. 1:50.000 e nota ill.va,* Servizio Geol. Min. I.C. Roma.

Angelelli F., Caloi L., Malatesta A., Palombo M.R. (1978), *Fauna quaternaria di Venosa: cenni preliminari.* Atti 20ª Riun. Scient. Ist. Sc. Preist. Protost., pp. 133-140, Firenze.

Angelucci A., Brotzu P. and Coll. (1974). *Il vulcanismo pleistocenico della media Valle Latina, Lazio: caratteristiche petrografiche e geologiche dei principali affioramenti lavici.* « Geol. Rom. », *13,* pp. 83-123, Roma.

Azzaroli A. (1953), *The Deer of the Weyburn Crag and Forest Bed of Norfolk,* « Bull. Brit. Mus. (Nat. Hist.) » Geol., *2* (1), pp. 1-96, London.

—— (1954), *Filogenesi e biologia di Sus strozzii e di Sus minor,* Paleontogr. Ital., *48* (1952-53), pp. 41-76, tt. 9-20, Pisa.

—— (1963), *Rinoceronti pliocenici del Valdarno inferiore,* Ibid., *57* (1962), pp. 11-20, tt. 6-15, Pisa.

—— (1963), *Validità della specie Rhinoceros hemitoechus Falc,* Ibid., *57* (1962), pp. 21-34, tt. 16-20, Pisa.

Barral L., Heinichen Chiappella G., Simone S. (1978), *Datazione relativa del giacimento di Loreto, Venosa,* Atti 20ª Riun. Scient. Ist. It. Preist. Protost., pp. 125-132.

Basilone P., Civetta L. (1975), *Datazione K-Ar dell'attività vulcanica dei Monti Ernici,* « Soc. It. Min. Petr. » *31,* 1 pp. 175-179.

Beneo E., Crema C. (1939), *F. 151 « Alatri » Carta Geol. d'It. 1:100.000 e nota ill.,* R. Uff. Geol., Minist. I.C., Roma.

Biberson P. (1964), *Torralba et Ambrona. Notes sur deux stations acheuléennes de chasseur d'éléphants de la Vieille Castille,* Miscelanea en homenaje al Abate Breuil, Monogr. VI, « Inst. de Prehist. y Arch., Barcelona », pp. 201-248.

—— (1968), *Les gisements acheuléens de Torralba et Ambrona (Espagne). Nouvelles précisions,* « L'Anthropologie », *72,* 3-4, pp. 241-278.

Biberson P., Aguirre E. (1965), *Expériences de taille d'outils préhistoriques dans des os d'éléphants,* « Quaternaria », *7,* pp. 165-183.

Biddittu I., Cassoli P.F. (1969), *Una stazione del Paleolitico inferiore a Pontecorvo in prov. di Frosinone,* « Quaternaria », *10,* pp. 167-197.

Biddittu I. (1972), *Pleistocene e industrie litiche pre-Acheuleane ad Arce e Fontana Liri, Frosinone,* « Quaternaria », *16,* pp. 35-52.

—— (1974), *Giacimento pleistocenico ad amigdale acheuleane nel territorio di Ceprano,* « Mem. Ist. It. Paleont. Umana », *2,* pp. 61-67, Roma.

Biddittu I., Segre A.G. (1976), *Giacimenti preistorici e Quaternario della prov. di Frosinone,* « Boll. Ist. Stor. Arte d. Lazio Merid. », *9,* 1-2, pp. 21-33, Roma.

—— (1978), *Paleolitico inferiore a Cava Pompi presso Pofi, Frosinone,* « Quaderni Centro Studi per l'Archeol. Etrusco-Ital. », *1,* pp. 78-79, Roma.

Bonifay M. F. (1971), *Carnivores quaternaires du Sud-Est de la France,* « Mém. Mus. Hist. Nat. », *21,* (n.s.) pp. 43-377, Paris.

Borsi F., Ferrara G., Tongiorgi E. (1967), *Determinazione con il metodo del K/Ar delle età delle rocce magmatiche della Toscana,* « Boll. Soc. Geol. It. », *86,* pp. 403-410.

Branco W. (1877), *I vulcani Ernici nella valle del F. Sacco,* Atti R. Acc. Naz. Lincei, pp. 801-817, Roma.

Cortini M. (1975), *Età K-Ar del Monte Vulture, Lucania,* « Riv. It. Geofis. Sc. Aff. », *2,* (1) pp. 45-46.

Cox A., Dalrymple G.B. (1967), *Statistical analysis of geomagnetic reversal data and the precision of Potassium-Argon dating,* « Journ. Geophys. Research », 78, (10) pp. 2603-2614.

Cubuk G.A. (1976), *Die Altpaleolitische Basis-Schicht der Fundstelle Carrière Hélin bei St. Simphorien, prov. Heinaut, Belgien,* 9ème Congr. U.I.S.PP., Nice.

De Giuli C., Heintz E. (1974), *Gazella borbonica (Bovidae, Artiodactyla, Mammalia), nouvel*

élément de la faune villafranchienne de Montopoli, Valdarno inférieur, Pisa, Italia, Atti Soc. Tos. Sc. Nat. Mem., s.A, *81,* pp. 227-237, Pisa.

DELSON E. (1971; 1974), *Preliminary review of Cercopithecid distribution in the circum mediterranean Region,* Act. V Cong. Néog. Médit., Lyon 1971 et Mém. Bur. Rech. Géol. Min. France, *78,* pp. 131-135.

—— (1975), *Evolutionary History of the Cercopithecidae,* in: Szalay, Approaches to Primate Paleobiology, *5,* pp. 167-217, Publ. Karger, Basel.

—— (1975), *Paradolichopithecus, a large terrestrial monkey (Cercopitecidae, Primates) from the Pliopleistocene of southern Europe and its importance for mammalian biochronology,* 6th Congr. Reg., Committ. Medit. Neogene Stratigr., pp. 91-96.

DE LUMLEY H., DE LUMLEY M.A., MISKOVSKY J.C., RENAULT-MISKOVSKY J. (1976), *Le site de Terra Amata,* 9ème Congr. U.I.S.PP., Livr. Guide B-1, pp. 15-49; Nice.

DE LUMLEY H., GIRARD M. (1976), *Grotte du Vallonet,* Ibid., pp. 93-103.

DURANTE S., SETTEPASSI F. (1978), *Nota sulle associazioni malacologiche del giacimento fluviolacustre di Loreto, Venosa,* Atti 2ª riunione Scient. Ist. It. Sc. Preist. Protost., pp. 141-135, Firenze.

ENGELS J.C., INGAMELLS C.O. (1977), *Geostandards, a new approach to their production and use,* « Geostandard Newsletter », *1,* (1), pp. 51-60.

EVERNDEN J.F., CURTIS G.H. (1965), *The Potassium-Argon Dating of late cenozoic rocks in E Africa and in Italy,* « Current Anthropology », *6,* pp. 343-364.

FRIDRICH J. (1976), *The first industries from eastern and south-eastern Central Europe,* 9ème Congr. U.I.S.PP., Colloque 8ème, pp. 8-23, Nice.

KRETZOI M., VERTÉS L. (1965), *Upper Biharian (Intermindel) Pebble-industry Occupation Site in Western Hungary,* « Current Anthropology », *6* (1) pp. 74-86.

KURTEN B. (1968), *Pleistocene Mammals of Europe,* London, Weidenfeld and Nicolson.

LEAKEY M.D. (1971), *Olduvai gorge, excavations in beds I and II, 1960-63,* Cambridge Univ. Press.

MAINO A., MOTTA A., SEGRE A. G. (1969), *Considerazioni tra gravimetria e geomorfologia per il F. 150 « Roma » Vulcano Laziale,* « Boll. Geodes. Sc. Aff. I.G.M. », *28* (2), pp. 173-188, at fig. 8.

MANIA D. (1977), *Die Altpaläolithische Travertinfundstelle von Bilzingsleben Kr. Artern, Erfurt,* « EAZ Ethnogr. Archäol. Z. » *18,* pp. 5-24.

PICHLER H. (1970), *Italienische Vulkan-Gebiete,* 1° Sammlung geologischer Führer, *51,* pp. 109-124.

PIPERNO M. (1972), *The Monte Peglia Lithic Industry,* « Quaternaria », *16,* pp. 53-65.

PIPERNO M., BIDDITTU I. (1979), *Studio tipologico ed interpretazione dell'industria acheuleana e premusteriana dei livelli* m e d *di Torre in Pietra, Roma,* « Quaternaria », *20,* pp. 441-536.

REICHENAU v. W. (1915), *Fossiler Pferde aus deutschen Pleistozän,* « Geol. Abh. Grhr. Hess. Ls. anst. », *7* (1), pp. 155 + 14Pl., Darmstadt.

ROE A. (1976), *The earliest industries in Britain,* 9ème Congr. U.I.S.PP., Coll. 8ème, pp. 76-93, Nice.

SEGRE A. G. (1978), *Il Pleistocene ed il Paleolitico della Basilicata,* Atti 20ª riun. scient. Ist. It. Preist. Protost., pp. 15-39, Firenze.

VÉRTES L. (1975), *The Lower Palaeolithic site of Vertesszöllös, Hungary,* Recent Archaeological Excavations in Europe; London and Boston Rupert B. Mitford.

RIASSUNTO

Il bacino di Anagni della Valle Latina (fig. 1) presenta una serie di depositi piroclastici, tufitici, lacustri e paleosuoli la cui successione è ricostituita in base a varie sezioni tra loro correlate, distribuite in località vicine. Alcune sono esposte da vaste cave di « pozzolana » il cui avanzamento che procede da oltre 30 anni va distruggendo progressivamente i giacimenti quaternari soprastanti (fig. 2). La cartografia geologica ufficiale è particolarmente carente, per il Quaternario talora stratigraficamente errata. Circostanza fortunata è offerta dalla successione di orizzonti ricchi di leucite in sottili interstrati lentiformi, alternati agli strati a resti di vertebrati, flora e industria litica. Essi hanno permesso di datare presso il Laboratorio di Geocronologia e Geochimica Isotopica del CNR, Pisa, ben 4 livelli. L'apparato di estrazione dell'Ar, di struttura diversa da quelli impiegati fino ad ora in questo laboratorio, consente di ottenere « bianchi » di estrazione molto bassi e riproducibili, con ovvio vantaggio per l'affidabilità dei dati.

Le misure isotopiche sono state effettuate con uno spettrometro VARIAN-MAT 240 collegato tramite voltmetro digitale ad un calcolatore per l'acquisizione e l'elaborazione dei dati in tempo reale. Le età ottenute variano dai 528.000 ai 366.000 anni con errori molto ridotti (approssimativamente $\pm$ 6.500 anni, 1 σ) dovuti alla ridotta contaminazione introdotta dalla linea di estrazione ed all'alto contenuto di Ar radiogenico.

Tali età si collocano molto bene nel quadro geocronologico del vulcanismo della regione. La serie stratigrafica, di una ottantina di metri va dalla parte media del Villafranchiano inferiore al Mindel finale; questo poiché il « tufo litoide » del Vulcano Laziale che è il termine superiore (in loc. Ranuccio) subito soprastante all'arenite piroclastica (fig. 2; LS-4) datata K-Ar 366.000 a. In tal modo vengono precisati i limiti cronologici per un orizzonte del Paleolitico inferiore caratterizzato da minuta industria su scheggia in selce, più grossolana su lava, con rarissimi bifacciali poco rifiniti (fig. 4): importante è la presenza di abbondante industria su osso e di ossa comunque utilizzate (figg. 5 e 6). L'età del livello archeologico risulta compresa fra 366.000 e 458.000 anni, e può essere correlato con l'analogo orizzonte di Pofi (Vulc. Ernici compresi fra 400.000 e 540.000 anni; v. bibliogr. cit.). La fauna accompagnante presenta caratteristiche di un Pleistocene medio caldo-umido: *Megaceros verticornis, Palaeoloxodon* cfr. *antiquus, Rhinoceros* sp., *Hippopotamus* sp., *Bos primigenius, Bison, Equus* cfr. *moosbachensis, Ursus deningeri, Macaca florentinus, Castor fiber,* avifauna ad anatidi. Questi strati sono inoltre delimitati superiormente da un orizzonte a soliflussi, probabilmente crioturbazione, e inferiormente da una cinerite grigia di provenienza dai Vulcani Ernici, con flora a carattere mediterraneo caldo, la cui età è di poco inferiore a 487.000 anni: un paleosuolo con rari frammenti d'ossa è delimitato inferiormente da un sottilissimo livello di cristallini di leucite che ha fornito la sopra citata datazione K-Ar.

Un potente banco di « pozzolana » (fig. 2-B;M) passante inferiormente ad una facies consolidata litoide (con spessore variabile da 5 a 20 m ca.) di provenienza dal Vulcano Laziale, è adattato ad una preesistente paleomorfologia; ad una certa distanza sotto la base (fig. 2

n. 12) si ha la datazione K-Ar di 528.000 a. Segue inferiormente una serie limno-continentale tufitica, verso il versante opposto della valle con abbondante flora silicizzata a conifere (Abies), filliti e tronchi. Tutto questo complesso è adattato ad una morfologia modellatasi su di un substrato la cui stratigrafia è la seguente dall'alto al basso (fig. 2-A;M): paleosuolo di spessore variabile con alla base travertino in lenti o in banco compatto al tetto di uno strato di calcare argilloso lacustre con noduli concrezionati e, in alcuni luoghi, con industria a choppers su calcare (fig. 3). Subito al di sotto affiora uno strato di fine sabbia gialla del Villafranchiano medio-inferiore con resti di vertebrati: *Anancus arvernensis, Archidiscodon meridionalis, Dicerorhinus etruscus, Equus stenonis, Leptobos, Croizetoceros ramosus, Cervus philisi, Eucladoceros, Gazella borbonica, Canis* cfr. *etruscus, C.* cfr. *alopecoides, Paradolichopitecus arvernensis.* Al di sotto argille d'acqua dolce a *pisidium* appoggiano sul neomiocene ora marno-argilloso (Messiniano) ora arenaceo (Tortoniano). Poiché mancano totalmente minerali di provenienza dai Vulcani Ernici o Laziali, e la più antica attività eruttiva accertata per quest'ultimo è di almeno 706.000 a. (Evernden, Curtis, oc. cit.), l'industria a choppers di questo livello più basso potrebbe attribuirsi preferibilmente al Günz.

RESUME

Une série de coupes (fig. 2) dans les dépôts piroclastiques, de tufites lacustres et paléosols du bassin pléistocène de Anagni (fig. 1) avec plusieurs niveaux avec faunes, industries, flores, nous a fourni une succession depuis le Villafranchien moyen jusqu'au Mindel final. Des niveaux de sable à cristaux de leucite intercalés, suite d'activité explosive du Volcan Latial ont permis 4 datations K-Ar (Labo. Géochr. et Géochim. Isotopique du CNR, Pise). Les analyses d'argon ont été effectuées avec une nouvelle ligne d'extraction, qui a permis d'obtenir un niveau de « blank » très bas et des conditions d'opération très reproduisibles. Les âges obtenues vont de 528.000 à 366.000 ans B.P. avec une erreur typique (1 σ) de approximativement $\pm$ 6.500 ans due au très haut pourcentage d'argon radiogenique. Un niveau avec industrie du Paléolithique inférieur de petite taille avec de très rares amigdaloïdes mais avec beaucoup d'os amenagées et outils d'os (figg. 4-5-6) est interposé entre 366.000 et 458.000 a. Inférieurement une cinérite avec flore de facies méditerranéen chaud vient des Volcans Ernici (fig. 1); elle est âgée de près de 487.000 a. Un épais banc de « pozzolana » avec du « tufo litoide » à sa base (le tout avec caractère de nuée-avalanche sèche) du Volcan Latial, ici avec 20 m d'épaisseur, est limité par les dates de 487.000 et moins de 528.000 a. La série se poursuit en bas avec des couches de tufites d'eau douce et continentales, avec un niveau (fig. 2, n. 17) à plantes silicifiées (forêt à Abies). Toute cette série est étayé sur des travertins anciens avec une couche de limno-calcaire argileux qui contient une industrie de choppers sur calcaire. Ce dernier est appuyé sur une couche de sable jaune avec faune du Villafranchien moyen à *Anancus arvernensis, Archidiscodon meridionalis, Dicerorhinus etruscus, Equus stenonis, Leptobos, Croizetoceros ramosus, Cervus philisi, Eucladoceros, Gazella borbonica, Canis* cfr. *etruscus, C.* cfr. *alopecoides, Paradolichopitecus arvernensis.* A ces sables suivent des argiles d'eau douce avec *Pisidium,* appuyé sur une surface d'érosion ancienne du substrat de grès Miocène.