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The Pleistocene Hominid Site of Ternifine, Algeria: New Results on the Environment, Age, and Human Industries

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A new multidisciplinary research program, started in 1981, provided new data on the stratigraphy, fauna, and human industries, as well as the first results on paleomagnetism and sedimentology, for the Ternifine site in Algeria, which yielded the earliest hominid remains known in North Africa. The fossils were deposited in a swamp or lake surrounded by a very open, dry environment. The lake was fed by artesian springs that raised the underlying Miocene sands. Although nothing suggests a camp or butchery site, we discovered the first undisputable bone artifact in this site, the earliest known in this part of Africa. According to paleontological data, 700,000 yr B.P. is a likely age for the Ternifine deposits, which is consistent with the paleomagnetic results.

INTRODUCTION

The Tighenif quarry (previously known as Ternifine or Palikao) is located 20 km east of Mascara, Algeria. The sandy levels of a hillock were worked from 1872 onward for the building of the village, and soon began to yield fossil bones and artifacts. Pomel (1878, 1893–1897) published the first studies of the fauna and undertook a small excavation in 1882 with Tommasini, who first documented the presence of prehistoric industries (Tommasini, 1886). The main prior excavations at the site, however, were made by Arambourg and Hoffstetter between 1954 and 1956. The fossil hominids they discovered there remain the earliest ones ever found in North Africa (Arambourg and Hoffstetter, 1963).

The upwelling of artesian water from the bottom of the deposits made continuous pumping necessary during their excavations and hindered the study of the stratigraphy and the collecting of fossils. Partly for this reason the digging stopped in 1956. Recently, however, a considerable lowering of the water table has dried almost all of the fossiliferous levels. This allowed a new study of the site under much better conditions by a team from the French CNRS, the University of Paris VI, and the Algerian ONRS in 1981–1983.

GEOLOGY AND PALEONTOLOGY

Under the soil, the sandy hill was protected from erosion by sandstone layers. The stratigraphic succession (Fig. 1) can be divided from bottom to top into a layer of varicolored clay overlain by a grayish clay with carbonate nodules, up to 1.5 m thick in the southern part of the quarry but locally thinning to 20 cm. Above are very-fine-grained light-yellowish-brown sands with ferruginous lenses. These sandy deposits reach a thickness of 5 m in the eastern section where they have been divided into eight main levels. Lenticular formations and lateral transitions of facies are numerous.

The observed variations of thickness are partly due to the paleotopography of the

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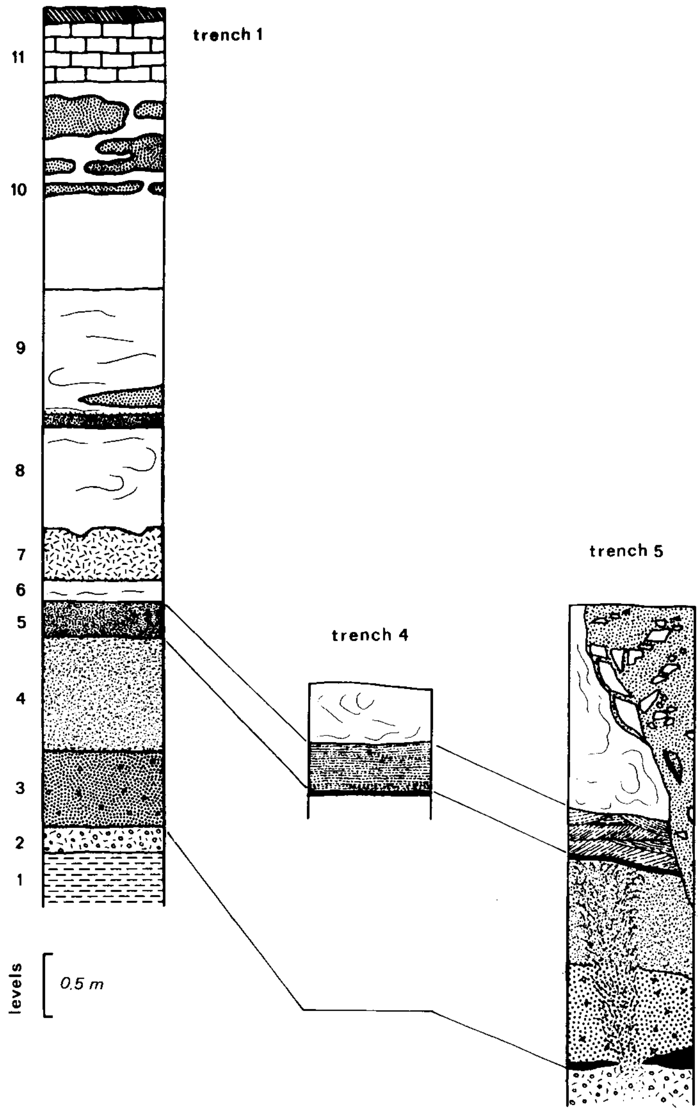

FIG. 1. Main stratigraphic levels in trenches 1, 4, and 5. Trench 1 is situated at the SE extremity of the site; trench 5 is almost central; trench 4 is intermediate. The differences in altitude between the three sections have been considerably reduced: the top of the level 5 is 1.60 m higher in trench 4 than in trench 5, and 4.15 m higher than in trench 5. (1) Varicolored clay; (2) Nodular grayish clay (more sandy in trench 1); (3) Slightly clayey grayish sand (ferruginous and ocher in trench 5) with some carbonated nodules at the base; (4) Yellowish-white slightly ferruginous sand with rare greenish clay balls, emersion marks at the top in trench 1. Grayish sand with rare greenish clay balls, emersion marks at the top in trench 1. Grayish sand with rare carbonate nodules in trenches 4 and 5; (5) Reddish clayey sand, homogeneous in trench 1, horizontally microstratified in trench 4, with marked cross beddings in trench 5. Reddish clay at the base in trench 5; (6 and 8) White sand with oxydation marks; (7) Grayish brown clayey sand with organic matter and thin ferruginous beds, gulllying at the top; (9) Slightly argillaceous sand, ferruginous base with a sandstone lens; (10) White sand with numerous sandstone layers; (11) Superficial calcareous crust and soil. Numerous chimney-like upwellings in trench 5 (see comments in text).

site; the slope gradient of the dished clayey bottom can reach 8° on the northern margin. In the central, lower part of the site (Fig. 1, trench 5), we observed thin cross beddings mainly in level 5. These layers, a few centimeters thick, show strong variations in color but no granulometric differentiation. The same levels are recognizable in more peripheral trenches, where they show no cross bedding, but only thin horizontal beds of reddish and yellowish sands. Furthermore, in the center on the site several heterochronous chimney-like artesian upwellings strongly disturbed the horizontal and cross-bedded layers. Some of them are undoubtedly older than the deposition of the main fossiliferous white sands. More recent ones often include still recognizable fragments from the lower layers. These observations suggest that the upraised Miocene marine sands, which yielded most of the sediment in which the fossils became embedded, were redeposited in disturbed water in the bottom of the lake, but under quiet conditions in the peripheral areas.

Most of the sand particles do not exceed 1 mm in diameter. Frequently histograms and cumulative curves reveal a single mode of deposition, the elements being very well sorted (Asq : 0.025 ; Hq = 0.625), the mode and median being close to 0.16–0.20 mm. Blunt lustrous quartz grains (of marine origin) predominate over blunt (or even rounded) unpolished ones (having undergone an eolian alteration). We also observed some unworn grains, perhaps of volcanic origin, showing crystalline growth on their surfaces. These observations were confirmed with the scanning electron microscope, which reveals, however, a film of silica gel coating the blunt grains, suggesting lacustrine stage.

Heavy (tourmaline, zircon, and rutile) and argillaceous (illite, kaolinite) minerals are inherited from the Miocene sands, upraised by the artesian springs. Smectites of montmorillonite type, present in the clay as well as in the sands, must have been formed in a confined environment.

The bulk of the fauna comes from the nodular grayish clay and from the lower part of the sandy levels; the lower varicolored clay has hardly been excavated and appears sterile. The very compact nodular grayish clay is rather difficult to excavate but yielded some of the best specimens.

The revised large mammals faunal list (Table 1) includes taxa represented in Arambourg and Hoffstetter's collection. The most common taxon, the alcelaphine *Parmularius*, is represented by several hundred specimens, but the caprine by a single one. Rodents represented in the fauna include *Ellobius africanus*, *Paraethomys tighennifae*, *Arvicanthis arambourgi*, *Praomys* (*Berberomys*) *eghrisae*, *Meriones* n.sp. (very large), *Gerbillus* n.sp. (similar to, but larger than, *G. campestris*), and Gerbillidae gen. et sp. nov. (morpho-

TABLE 1. REVISED LIST OF THE LARGE MAMMALS[a]

Loxodonta atlantica	X
Ceratotherium simum	X
Equus mauritanicus	X
Hippopotamus sirensis	XX
Metridiochoerus compactus	X
Camelus thomasi	OX
Giraffa cf. *pomeli*	O
Tragelaphus algericus	O
Bos (?) cf. *bubaloides*	O
Oryx cf. *gazella*	OX
Hippotragus cf. *gigas*	OX
Kobus (?) sp.	O
Connochaetes taurinus prognu	XX
Parmularius ambiguus	XX
Gazella dracula	XX
Gazella sp. A (cf. *atlantica*)	O
Gazella sp. B	O
Caprini indet	O
Crocuta crocuta	O
cf. *Felis* sp.	O
Vulpes sp.	O
Theropithecus cf. *oswaldi*	OX
Homo erectus	O
Erinaceidae indet	O
Lepus sp.	O

[a] O = rare; OX = uncommon; X = common; XX = abundant.

logically intermediate between *Meriones* and *Tatera*). To this faunal list must be added avian and chelonian remains, as well as amphibians, including *Discoglossus*. This list differs from that provided by Arambourg (1979) because of work on the ruminants conducted by Geraads (1981), and on the rodents by Jaeger (1975) and R. Ameur and T. Hayin (unpublished data). Other differences stem from nomenclatural changes, and from the discovery of four taxa previously unknown in this site: cf. *Felis, Vulpes* sp., Ericaneidae indet., and *Lepus*, all from the grayish clay. We are not able to confirm the occurrence of *Homotherium* (*"Machairodus"*), *Panthera leo*, and *Mellivora*.

Open-country forms (alcelaphines and gazelles) strongly predominate among bovids and provide up to 93% of the bovid remains. Such an arid environment is confirmed by the abundance of gerbillids (84% of the collected Rodents), which today inhabit desertic or semi-desertic areas. *Ellobius* is now restricted to Asian steppes. However, the occurrence of *Hippopotamus* and *Discoglossus* implies the presence of a pool of water while the complete absence of crocodiles and fish suggest frequent drainage. The observed variations in the proportions of the various groups of rodents (Fig. 2), however, suggest environmental changes, with drier conditions (gerbillids more common) before and after layer 4, in which murids are more abundant. The *Ellobius* live now in a rather cool environment and the thermophile Ctenodactylidae disappeared from North Africa between the level of Sidi Abdallah (late lower Pleistocene) and that of Ternifine.

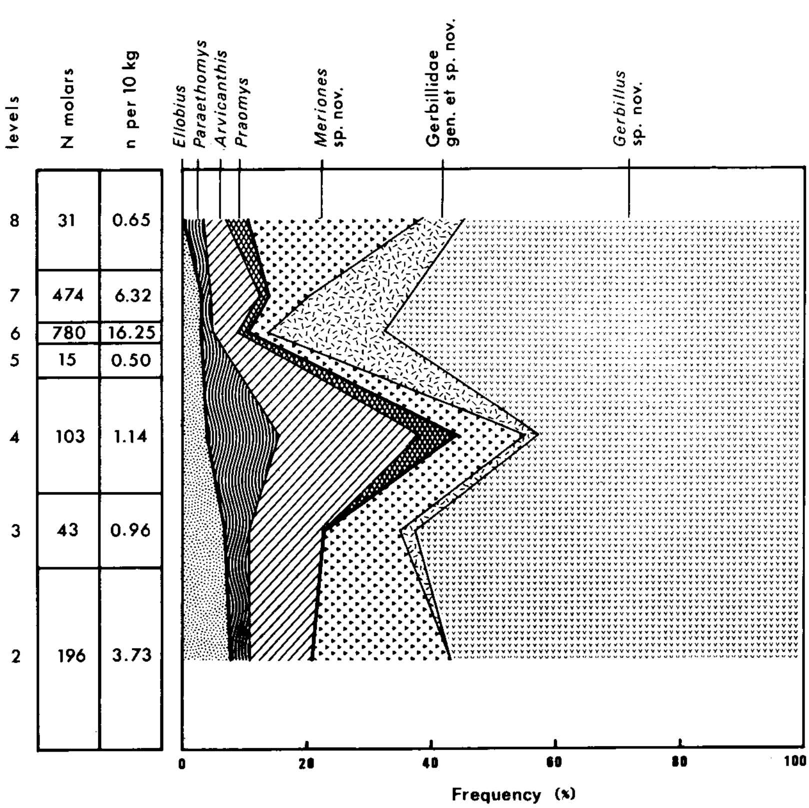

FIG. 2. Cumulated frequencies of the rodent genera collected in trench 1 (levels 3 to 8) and 3 (level 2). The left comumn takes into account the thickness of each level.

This slight cooling may also explain the absence of crocodiles at Ternifine. Palynological studies now in progress may provide more precise results.

The formation of the site can thus be described as follows. In a clayey basin, an artesian spring fed a small lake. This lake existed in a closed system (as shown by the presence of montmorillonite) and was sometimes swampy or even dry (as shown by the carbonate nodules), Later, fine-grained marine sands from the underlying Miocene beds were carried up by the artesian springs, inducing synsedimentary subsidence with microfaulting of the clayey bottom, still in a confined environment (as shown by the silica gel on quartz). Local cross bedding is due to the activity of the artesian springs in the bottom of the pool. The fauna and the occurrence of eolian sands show that the surrounding area was a very open and rather dry steppe or savannah. Observed variations in the micromammalian fauna certainly result from minor climatic changes, but the taxonomic list of rodents is the same in all levels. The aspect and color of the fossils in former collections show that almost all the taxa (except perhaps very rare species) are present in the sands as well as in the grayish clay, which suggests that the whole sequence does not cover a long period of time.

The excavations in 1982 and 1983 were centered on a 30-m^2 area north of the main dig of Arambourg and Hoffstetter. Most of the collected fossils come from the light-yellowish-brown sands, slightly above a rubified zone. Bones have clearly been sorted before fossilization. The 1982–1983 excavations showed that hippo incisors and canines are very common compared with long bones, and still more common relative to those of manus and pes. Although no articulated bones were found, many hippo bones, from only a few individuals (e.g., two tibias from the same animal), were still closely associated. However, as this peculiar area is but little disturbed, artesian phenomena cannot account for disarticulation, which must have occurred before burial. Little-weathered or broken, these bone have clearly neither been water-transported over a long distance nor exposed long to severe climatic conditions before burial. One can imagine a quick covering by sand of bones of the animals who died in the lake or on the nearby shore. As for the rodents, the absence of skulls and discrepancies in the proportions of postcranial elements show that they are probably the result of a modified coprocoenosis secondarily altered, possibly by water transport.

HUMAN ACTIVITY

The lithic industry is the chief evidence of human activity, but we did not observe any living floors and the site appears to be poor in stone artifacts. On the basis of the 1954–56 campaigns, the artifact density was very low: 2200 artifacts for an estimated volume of about 5000 m^3. This result has been confirmed by our own excavations, in which artifact density never exceeded 0.8 items/m^3 and was much lower in some trenches. The lithic assemblages include pebble tools, bifaces, and cleavers made from sandstone, quartzite, and, to a lesser degree, limestone (Balout *et al.*, 1967). They were obtained from pebbles and large flakes. Despite the rare use of the soft hammer and of the Kombewa technique, this set related to the late lower Acheulean is archaic, with the large proportion of pebble tools, bifaces evolving from pebble tools, and protocleavers. There is no evidence of Levallois technique. The site yielded large flakes (mean length 88 mm), of which 70% are retouched, as well as nuclei of the same materials. Most of these artifacts show traces of often deep alteration. There are also small flint flakes (mean 32 mm), a third of which are retouched. In a recent study, these two sets have been considered as two different cultural assemblages (Djemmali, 1985). However, Djemmali's graphs show that the most conspicuous difference between them is the nature of the raw material, which may well explain, by itself, the difference in typology. Also, the strong alteration of sandstone and dissolution of its cement clearly prevented the preservation of small sandstone artifacts. Furthermore, there is absolutely no evidence of stratigraphic segregation between the two series, and we can see no reason for considering the Ternifine lithic industry as heterogeneous.

The most conspicuous activity on bone is tool manufacture. the best example is a zebra distal metacarpal exhibiting spiral fracture and several rather abrupt retouches on the proximal end (Fig. 3). Apart from man, only (1) carnivores or (2) trampling could produce such flaking. Both can be dismissed because (1) there is no evidence of any kind of gnawing, either polishing, pitting, or scoring (as illustrated by Binford, 1981, Fig. 3.02 and seq.); the distal trochlea and the front side of the shaft are intact and smooth. (2) Flaking or retouching by trampling implies some hard

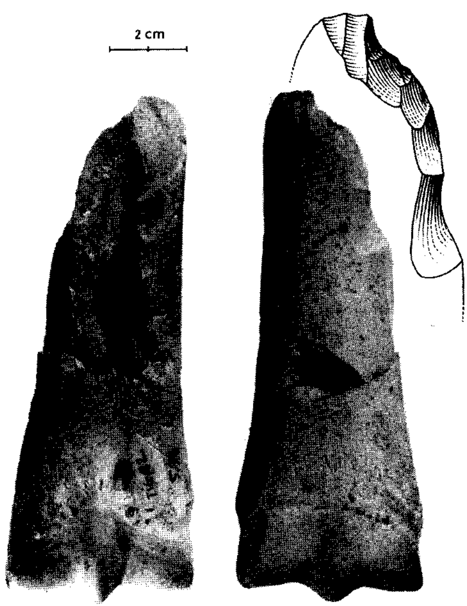

FIG. 3. Worked left metacarpal of *Equus mauritanicus* (TIG 82-5-34), posterior and anterior faces, detail of retouching (photo by C. Abrial, drawing by D. Visset).

object playing the role of an anvil (either bones, stones, or perhaps a very hard ground), but the presumed tool was found in a loose sand with no other bone, stone, or artifact nearby. It is most unlikely that under these conditions even purposeful trampling would produce centimetric retouching. This metacarpal appears to us to provide convincing (if not conclusive) evidence for bone tool use during the lower Paleolithic.

On the other hand, many long bones remain unbroken. Despite previous claims, one cannot assert that the search for marrow was systematically practiced by *Homo erectus* in most of the bones in this site. Human contributions to the accumulation of the fossil assemblage might have been very limited, although possible butchering is attested by scars on some bones.

AGE OF THE SITE

The small thickness of the section and its sandy sediments do not permit a magnetostratigraphic study. However, in order to obtain the geomagnetic polarity of these deposits, several oriented cubic samples have been collected from eight levels. Magnetic measurements have been made with a digito-spinner magnetometer in the *Centre des faibles radioactivités*, CNRS, Gif-sur-Yvette. Only samples from the varicolored clay, near the bottom of the section, were suitable for paleomagnetic study. Others have intensities close to the noise level of the magnetometer. The NRM intensity of the clays is around 10^{-3} A/m. Four samples from this level were demagnetized, either thermally or by alternating field. Their remanent magnetization was cleaned completely at 350° or 400 mT, but no significant variation occurred in their directions (mean values of D = 353° and I = 38°). It seems probable that this regularity during the successive steps of demagnetization is indicative of the primary direction of these samples, i.e., a normal polarity. Thus the lower Ternifine deposits probably belong to a normal period, either the Brunhes epoch or the Jaramillo event.

The very open environment of Ternifine is already present at Ain Boucherit, (lowermost Pleistocene) and Ain Hanech (middle lower Pleistocene) (Arambourg, 1979; Geraads, 1981). The fauna of this later site, although ecologically close to that of Ternifine, is clearly distinct taxonomically, and both are separated by a rather sharp faunal break. Among later sites, those from the Thomas quarries on the Morrocan coast (dated to ca. 400,000 yr B.P.; Hublin, 1985) offer the most significant similarities (Geraads, 1980). Both contain *Connochaetes taurinus, Vulpes* (probably the same species as in Ternifine, apparently closer to the palearctic one than to the other African Pleistocene species), *Theropithecus, Ellobius, Gerbillus, Paraethomys, Ceratotherium, Hippopotamus, Crocuta, Ursus* (?), and *Homo erectus*. The replacements of *Gazella dracula* by *G. atlantica,* and of *Parmularius* by *Rabaticeras* are the chief differences, but do not necessarily reflect chronological differences. Faunistically, Ternifine appears clearly younger than Ain Hanech (itself younger than Ain Boucherit), but closer to the Thomas quarries. Together, the paleontological and paleomagnetic data suggest that Ternifine might date to near the lower middle Pleistocene boundary (ca. 700,000 yr B.P.).

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