ANTHROPOLOGIE * XXIX/3 * 1991

PIERRE-FRANÇOIS PUECH, STELLA PUECH

THE MODIFIED TEETH OF SINANTHROPUS OFFICINALIS: EVIDENCE OF ANIMAL PROCESS

ABSTRACT: The activity of scavenging animals is an important factor affecting the distribution, preservation and morphology of bone. SEM was used to distinguish surface wear patterns of Peking man collected by Zdansky at Zhoukoudian by comparison with other Sinanthropus teeth from Southern China. With tooth marks of the porcupine, a species that accumulates bones in caves, the hominid teeth point to one agent of accumulation of the Sinanthropus fossil assemblage.

KEY WORDS: Sinanthropus – Gouge mark – Animal process.

In the Middle Pleistocene early man from China took shelter in a cave at Zhoukoudian near Beijing for more than 200,000 years. The species is classified as *Sinanthropus, Homo erectus pekinensis*, or Peking man. Because in China the fossil remains are sold as dragon's bones and teeth for their medicinal properties, the cave was at the beginning of the 20th century a favorite haunt of collectors. From 1921 to 1937, the date of the Japanese invasion, a number of palaeontologists and anthropologists made the active excavation of the site that yielded *Sinanthropus* specimens.

In 1941, the fossils of the Peking man were sent south with the Peking - Hankow railway, and it is fairly certain that they arrived at the Yangtse river. What happened then is a mystery. The Zhoukoudian hominids have remained lost. With the exception of three teeth collected by Otto Zdansky and sent to Uppsala (Sweden), the only preserved fossils of *Sinanthropus* collected before World War II are isolated teeth discovered by von Koenigswald among dragon's teeth. This material originated from unknown sites in Southern China, Kwangsi and Kwangtung provinces. Generally, the roots of the teeth had been gnawed by porcupines (von Koenigswald 1951). Here we report the details on the inflicted tooth marks.

MATERIALS AND METHODS

Von Koenigswald (1951) has distinguished the *Sinanthropus* under consideration from the classical species from Zhoukoudian as *Sinanthropus officinalis* because of a simpler cusp pattern. Proof that the teeth collected among dragon's teeth belong to a *Sinanthropus* is mainly based on the very similar morphology to that of Peking man. The dimensions of the premolars, however, fall above the range observed in *Sinanthropus*.

Among the fossils sent from Zhoukoudian to Uppsala for preparation were three hominid teeth discovered by O. Zdansky. In the summer of 1921, on the suggestion of J. G. Andersson, Otto Zdansky was working in Zhoukoudian at a small pillar of laterite containing a great number of small mammal bones, mostly rodents, when a quarry man came and wondered why he was spending his efforts in this place when there were much bigger bones in an old quarry nearby. He led him to the place, where Zdansky was to find the first teeth of what became known as Peking man. The clay was mostly soft and easily worked. One day he found an upper right third molar which he immediately recognized as being of hominid nature. In the late summer of 1923, he went once more to Zhoukoudian and found a lower left first premolar crown germ. He

returned to Europe in the autumn. In the later half of 1926, the Swedish crown prince visited China and the Geological Survey held a special meeting in his honour. That gave the occasion to Zdansky to present his discoveries (Zdansky 1927). In January 1927, Zdansky was appointed lecturer at the Egyptian University of Cairo, succeeding in the following year to the chair. He left Cairo in 1951 to live in Uppsala where he went through material from Zhoukoudian which had been considered less interesting. On this occasion he found a lower right second premolar of *Sinanthropus* (Zdansky 1952).

The surfaces were inspected on epoxy and nitrocellulosic replicas using scanning electron microscopy (SEM) with techniques proposed by Pameijer (1978). The choice of negative impression was made to provide fewer artifacts than a two step replication.

OBSERVATIONS

The very root tips of the upper right M3 (Uppsala 2) and of the lower right P2 (Uppsala 3) are missing and chips are present on the flanks, but we have found no evidence of marks of animal tooth action (*Figures 1 and 2*). When examined microscopically, the crown surfaces showed the following types of marks: flakes, pits, micropits, scratches, gouges and wear polish (*Figures 3 and 4*). These alterations are commonly observed on enamel surfaces and have various origins (Puech 1979).

FIGURE 1. *Uppsala 2: upper right M3 of Sinanthropus from Zhoukoudian.*

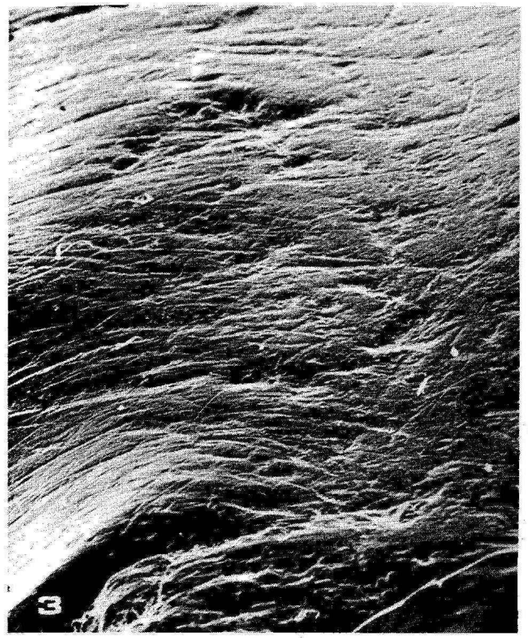
FIGURE 2. *Uppsala 3: lower right P2 of Sinanthropus from Zhoukoudian.*

Wear traces did not give evidence of chemical weathering or postmortem abrasion. The ridges of the marks are microscopically sharp and the wear traces are identical to those seen on teeth with little or no postmortem abrasion. The character and distribution of the microscratches and pits show a natural aspect expected to result from food mastication (with the exception of few gouges; *Figure 5*).

Gouges occur in multiple paired sets on several tooth roots of *Sinanthropus officinalis* (*Figure 6*). These gouges vary in width from a few millimetres to one centimetre. They are U-shaped in cross-section with a rounded or flattened bottom marked by multiple parallel and longitudinal striations. The width does not generally vary in a mark except at the ends. The same may be said for the depth. The course of the marks is slightly curved. The compliant course and constant depth are typical of incisal gnawing by rodents (*Figures 6 and 7*). These marks are macroscopically distinguishable from cutmarks, which are generally V-shaped, with a rigid course. Application of the biomechanics of secondary fracture patterns of brittle materials was not successful.

DISCUSSION AND CONCLUSION

To determine if the gouges on the crown surface of Uppsala 2 are of postmortem origin we have microscopically searched an overprinting and made comparisons with experimental marks produced in a known sequence. It was discovered that incorrect



FIGURES 3 and 4. *Characteristic tooth microwear features of oral food processing are present in Sinanthropus from Zhoukoudian in the form of scratches and pits.*

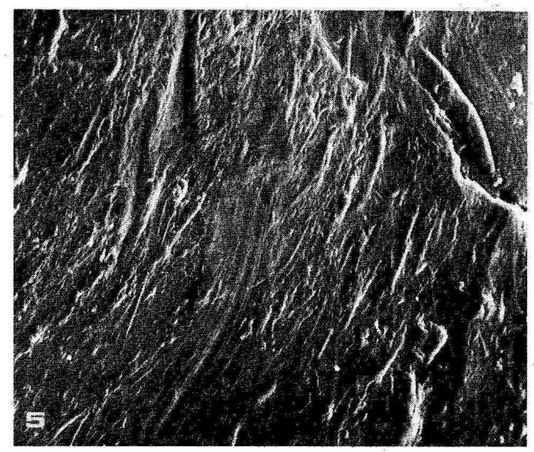
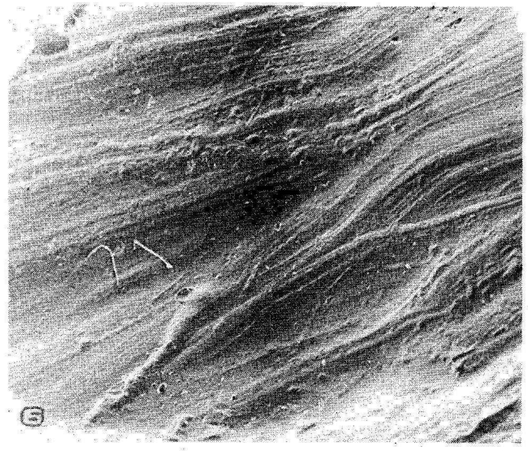
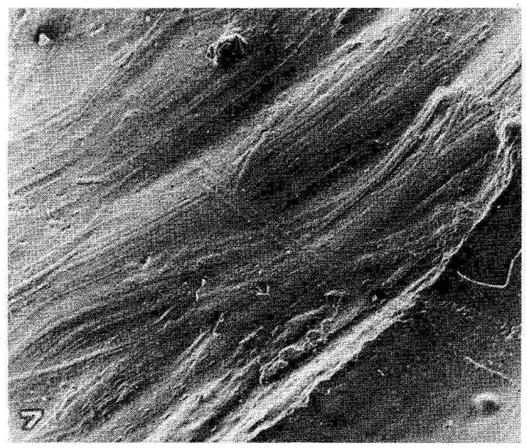


FIGURE 5. *Sinanthropus: Unusual broad and shallow indentations named gouges.*





FIGURES 6 and 7. *Sinanthropus officinalis. The curved course of paired sets of gouges is typical of incisal gnawing by rodents.*

FIGURES 8 and 9. *Different appearances of the same intersecting scratches illustrates the difficulty to determine whether a mark is overlaid by another one.*

interpretation could result from various degrees of pressure. When the first mark was drawn with more pressure than the second, the first appeared to be the last. Illusion could also result from the shadow produced by the electron beam on the breakage made by the second incision just after the crossing. *Figures 8 and 9* illustrate the same crossing zone with different shadow. Arrows point to the first mark. These micrographs portray the variation of appearance of the same intersecting marks. In *figure 8* the first line appears to cut the second line, but in *figure 9* it is the second line that seems to cut the first line. This establishes that micrographs may give the illusion of understanding the sequence of striation in showing if a mark is overlaid by another one (Puech et al. 1988). With no reliable indicator we are unable to determine if the gouges in Uppsala 2 occurred before the fossilisation process or during preparation of the specimen in the laboratory.

In *Sinanthropus* a possible agent to dispersion and fragmentation of skeletal elements may be animal activities (Pei 1932; Puech-Robert 1981; Binford and Ho 1985). Observations have been made on the tooth surfaces of *Sinanthropus* to find evidence of animal process. Metric and microscopic data have been used to find diagnostic criteria. The marks of animal teeth usually include puncture, pitting, scoring and scooping (Potts and Shipman 1981). Rodents produce tooth marks by gnawing bones and teeth but they can also inflict tooth marks in the use of a viselike grip. Most modern dens observed by Binford are occupied by porcupines that accumulate bones (Binford and Stone 1987). These bones give a well-documented pattern typical of rodents. In the present case the pattern observed in *Sinanthropus officinalis* is indicative of incisal gnawing by rodents.

The possibility of differentiation of excavation, cleaning and collection damage, or gnawing in Uppsala 2 can be considered in the location of the mark. Rodents prefer to gnaw tooth root that is softer than the crown covered by a very hard shell of enamel. But if enamel of rodent teeth can easily scrape dentine, they can occasionally mark enamel in "manipulative" grips. The distinction in the two *Sinanthropus* are based on the locations and frequencies of marks. We inspected collections of human teeth which, in some cases, revealed similar enamel gouging. Few gouges on enamel, with a similar set of features as observed in Uppsala 2, were not exceptional. The origin is uncertain in Uppsala 2 but in the two cases under study, Zhoukoudian and Southern China, the recognition of gouge marks favour the conclusion of disturbed fossils. Due to the small size and weight of teeth that strongly enhance the possibility of transport by rodents, we conclude that teeth are probably an accurate indicator of multiple agents of accumulation of the fossil assemblage.

REFERENCES

BINFORD C. R., HO C. K., 1985: Taphonomy at a distance: Zhoukoudian, "the cave home of Beijing Man"? *Current Anthropology* 26: 413-422.

BINFORD C. R., STONE N. M., 1987: On Zhoukoudian. *Current Anthropology* 28: 102-105.

KOENIGSWALD G. H. R. von, 1951: Gigantopithecus. *Anthropological Papers of the American Museum of Natural History* 43: 295-325.

PAMEIJER C. H., 1978: Replica techniques for scanning electron microscopy, a review. *Scanning Electron Microscopy* 11: 831-836.

PEI W. CH., 1932: Preliminary note on some incised, cut, and broken bones found in association with *Sinanthropus* remains and lithic artifacts from Choukoutien. *Bulletin of the Geological Society of China* 12: 105-108.

POTTS R., SHIPMAN P., 1981: Cutmarks made by stone tools on bones from Olduvai Gorge, Tanzania. *Nature* 291: 577-580.

PUECH P. F., 1979: The diet of early man: evidence from abrasion of teeth and tools. *Current Anthropology* 20: 590-592.

PUECH P. F., PUECH B., CIANFARANI F., 1988: Technical note on questioned imprint. *XIVth Congress of the International Academy of Legal Medicine and Social Medicine*

PUECH-ROBERT E., 1981: La découverte de l'Homme de Pékin. *Préhistoire et Archéologie* 29: 6-9.

ZDANSKY O., 1927: Preliminary notice on two teeth of a hominid from a cave in Chilli (China). *Bulletin of the Geological Society of China* 5: 281-284

ZDANSKY O., 1952: A new tooth of *Sinanthropus pekinensis* Black. *Acta Zoologica* 33: 189-191.

Pierre-François Puech, PhD.
Stella Puech
Musée de l'Homme de Paris
BP191
30012 Nîmes, France