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TSUYOSHI FUJIMOTO

Studies of wear on grinding stones

It is well known how difficult it is to prove the cereal utilization from archaeological material. Finding grains *in situ* is the most reliable evidence but only when conditions are good for preservation the grains do survive. Even so seeds and grains are small in size and, therefore, they move easily through archaeological layers and it is often difficult to decide whether grains come from a sealed layer or are intrusive.

Studying wears on stone tools is another method used to suggest cereal utilization although it also has its limitations. Finding a gloss on flaked stone tools (often rashly called sickle-polish) can only indicate that these tools were used in the tasks related to plant utilization, especially *Gramineae;* it does not prove the utilization of the cereal grains.

Grinding stone tools (pestles, mortars, upper and lower quernstones) are generally thought to show the practice grinding of grain for consumption. However, the real function of these artefacts is not clear; it is certainly not proved but merely assumed. Considering the importance of the function of the grinding stones in archaeological research this author has investigated the traces of wear on these tools using an Olympus BHMJ-42KB metallographic microscope and microphotography. This microscope is composed of lenses, an incident light and movable eye pieces which provide enough distance between the lenses and studied specimens. However, as grinding stones are usually thick, a modification was necessary. The main body of microscope was attached to a binocular microscope stand with a magnification of less than 50; with this modification a distance of more than 30 cm between the lenses and specimen could be obtained. The stand was then fixed to a desk.

Observations of the traces of wear on grinding tools were then carried out, but due to the weight and dimensions of the specimens, their surface weathering, roughness and calcareous concretions it was difficult to compare the results with those carried out on flaked stone implements. In the case of specimens with lengths of less than 20 cm such as pestles and upper quernstones (rubbers), they were put on the sliding stage of the binocular microscope; the whole surface of larger and heavier specimens could not be observed. In spite of all these difficulties, wear marks and striations could be detected and on smooth surfaces a lustrous gloss was seen.

Some 200 specimens from the following sites have been studied:

1. Saddle querns from sites of the Iankov culture of the 2nd and 1st millennium B.C., excavated in the Peschanyi Peninsula, Maritime Region, Russia;
2. Saddle querns from the Neolithic site of Ta-T'ung, Shang-si Province, Northern China;
3. Saddle-querns, mortars, pestles, handstones and natural cobbles from the Neolithic sites in Northern Iraq;
4. Pestles and handstones from Neolithic sites in Iran.

It was found that a fairly large number of specimens have a gloss on their surfaces. Because these surfaces were usually heavily weathered or had calcareous concretions it was difficult to identify them further. Generally speaking, "peaks" in the harder parts of the surfaces had a lustrous gloss on their sides and, at the "summits", abrasions and striations. The lustrous gloss looked the same as that seen on the edges of "sickle-blades". In the "valleys" and on the softer parts of the surfaces, gloss was hardly visible.

Telul-eth-Thalathat

Most of the specimens investigated were the upper and lower components of saddle querns from the Ubaid layers of Telul-eth-Thalathat in the Northern Iraq (Fukai *et al.* 1970). They are made of basalt and calcareous sandstone. Gloss

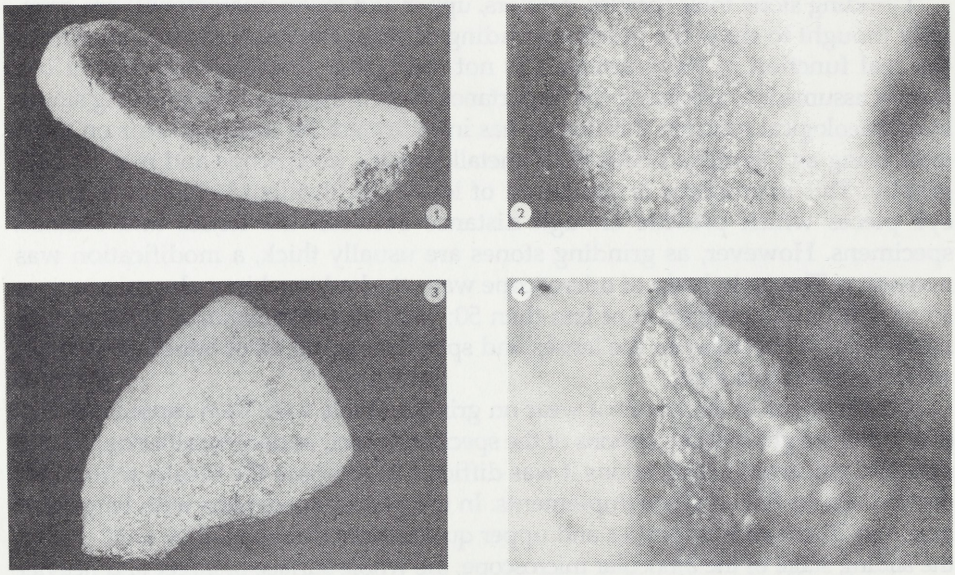

Fig. 1. Telul-eth-Thalathat. The lower stones of the saddle querns and microphotos of these querns.

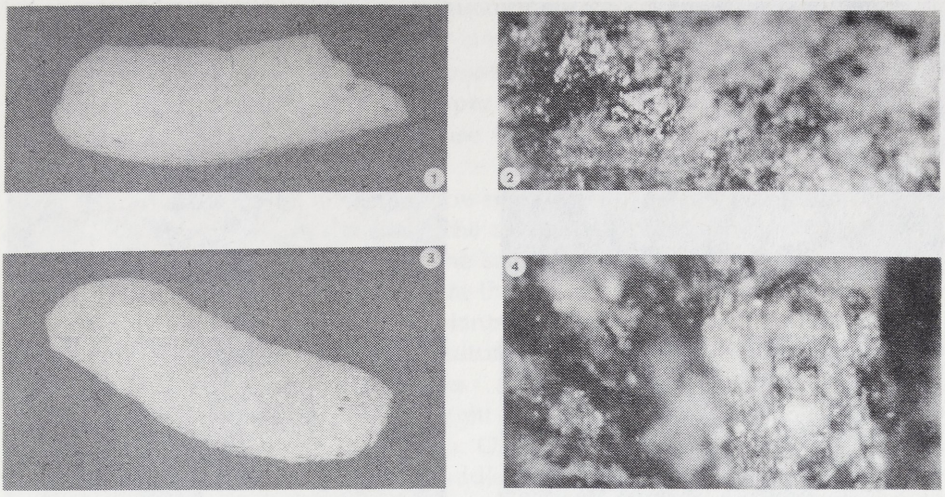

Fig. 2. Telul-eth-Thalathat. The lower stones of the saddle querns and microphotos of these querns.

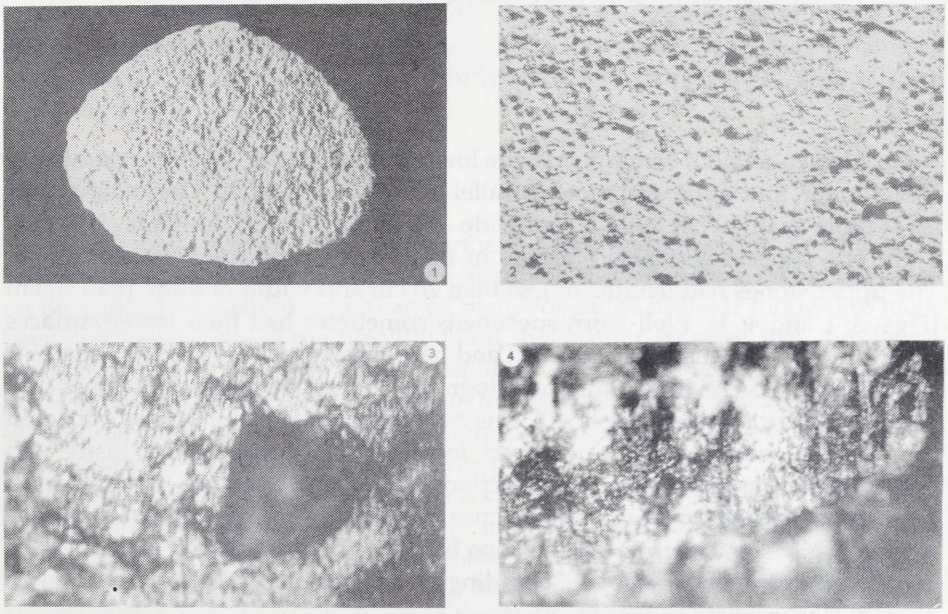

Fig. 3. Telul-eth-Thalathat. An upper stone of the saddle quern, a detailed view of the surface and microphotos of this quern.

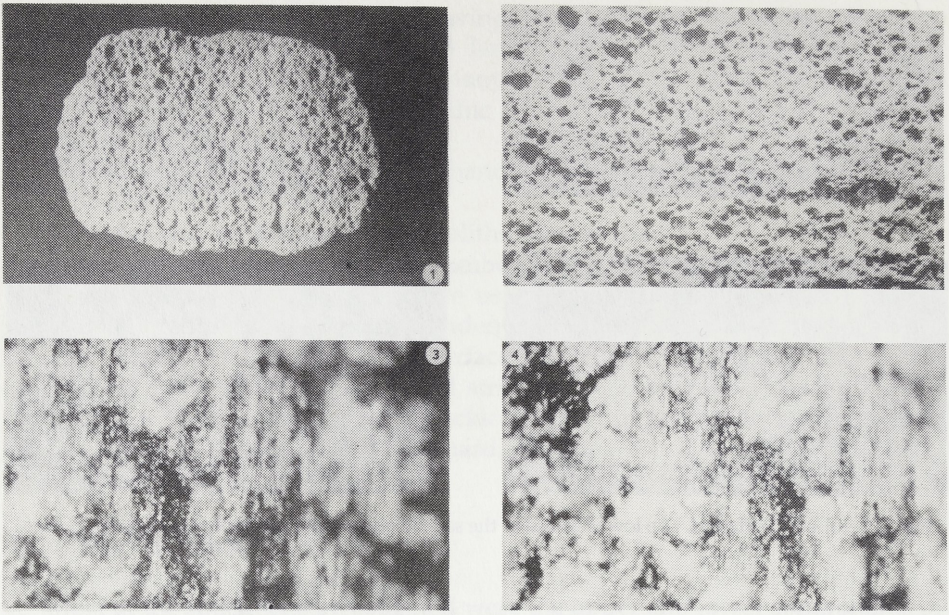

Fig. 4. Telul-eth-Thalathat. An upper stone of the saddle quern, a detailed view of the surface and microphotos of this quern;
The width of microphotos of Figs. 1: 2,4; 2: 2,4; 3: 3,4 and 4: 3,4 are about 500 microns.

could be seen on both components, the lower stones having striations parallel to their longer, and upper striations parallel to their shorter axis. The lower stones were more than 40 cm long, 20 cm wide and about 15 cm thick (Figs. 1: 1, 3; 2: 1, 3). The concave grinding surfaces of the lower stones were usually rough. The upper stones had lengths of less than 20 cm and width of more than 20 cm (Figs. 3: 1 and 4: 1). Well-worn specimens sometimes had their lower surfaces made smooth and lustrous (Fig. 4: 2) and here a definite gloss could be seen. At the "peaks" visible in the microphotography more dimly lustrous gloss and striations were detected (Fig. 1: 2). This may show that once the gloss appeared the abrasion between the upper and lower stones decreased its lustre and caused striations parallel to the directions of movement of the upperstone. If these processes are repeated many times a dimly lustrous gloss and striations remain. This is not seen on flaked stone blades. Grinding stone tools, it may be concluded, have a characteristic abrading gloss (Figs. 3: 3, 4; 4: 3, 4) and only a sporadic lustrous gloss.

On the sides of the saddle querns a sporadic gloss was also seen. It is not so lustrous as on the grinding surfaces and not abraded. It seems that it may have

been caused by contact with plant remains during grinding. On the bottom of the lower components gloss is usually not seen. This may be explained by the fact that when the saddle quern was used this part was embedded in clay. On the other hand, both surfaces of the upper stones had sporadic gloss; this shows that when the upperstones were in use their both surfaces had contact with plant materials.

In all studied cases the upper and lower stones had gloss. On the other hand, on the lithic so-called door sockets, the natural cobbles and more than two-thirds of pestles and mortars from the same layer of the site, gloss was not visible. These observations suggest that the grinding stone tools without gloss had probably not been used to grind plants containing silica and that the saddle querns from the layers of the Ubaid culture of this site were the main grinding stone tool used to process plant remains.

At a lower layer of this site, thought to belong to the Hassuna Neolithic period, similar features could be seen. Only a small number of the grinding stone tools were found here, mostly saddle querns, pestles and mortars. On the saddle querns the gloss could be seen and was similar to that occurring in the succeeding Ubaid layers. Saddle querns were already, probably, the main grinding stone tool used for the processing of plants.

Tall-i-Mushuki

The specimens from the Neolithic site of Tall-i-Mushuki in the southern Iran (Fukai *et al.* 1973) are few and no saddle querns were among them. Gloss was sometimes seen on pestles and rubbers from this assemblage. As specimens were few this author was not able to study satisfactorily the grinding tools from this site.

Ta-T'ung

At the Early Neolithic site in Northern China many saddle querns were found (Fujimoto 1983; Henan Working Team No. 1 of IA 1984; CPAM 1981) and on their grinding surfaces gloss can be seen. Fox-tailed millet is thought to have been cultivated here in the Neolithic and this author believes that they were used for grinding its seeds; on the Neolithic sites of Southern China grinding stone tools for processing cereals are not found at all. It is interesting that during the Middle and Late Neolithic of Northern China stone grinding tools completely disappeared and that at the same time pottery vessels, which may have been used for steaming or boiling, suddenly increased in frequency. Some 4,000 years later, during the Han Dynasty, tools for grinding reappeared; they were rotary querns and they may have come from the Western Asia together with the cultivation of wheat. Saddle querns which had been used in the Early Neolithic of Northern China continued to be used further northeast as well as the Northern Inner Mongolia and in the Amur Basin; they may have been used there to grind the grains of fox-tailed millet.

General comments

It is interesting that in recent times the population of Northern China has been cultivating wheat and barley and grinding them into flour to make "mantou" and "baoz" (which are made of dough by steaming) and noodles. At the same time the population of Southern China has been cultivating rice and consuming its steamed or boiled. It seems then that two ways of processing cereals have been developing in China since the Early Neolithic times. In the north a change from using flour to whole grains occurred in the Early Neolithic and then, a change from whole grain use to flour took place during the Han Dynasty.

The ideas expressed in this paper are of only a tentative character. To make a further progress different experiments are needed, for example, we should experiment with the processing of grains by pounding with pestles in mortars and grinding with saddle querns. Results of these experiments should be compared with the archaeological artefacts in order to identify true "corn-gloss".

This author believes that much progress could be made in studying the corn-gloss on stone artefacts originating also from Northern Africa. However, it should be remembered that different human groups have had different approaches to the use of cereals and the traditions typical for the East or West Asia may not be found in Africa.

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