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Organic Additives of the Clay Layers: Hair Identification

The clay layers of the Buddha statues contain animal hair. The hair was added as stabilisation of the clay. While the fine top clay layers only contain a low amount of fine hair, the undercoat contains more and thicker hair, often even in tufts or twisted strands (fig. 1). Samples of the hair were taken to Munich for analysis (fig. 2).

Several hair samples from the clay layers of the two Buddha statues (GBL 011; GBL 30/09/05,1; GBL 086; GBL 024; 25/09/06,2; KBL 004; KBL 084, KBL 208) were examined at the department for microtraces and biology at the Bayerisches Landeskriminalamt (Bavarian State Criminal Police Office) for identification.

Mammalian hairs are composed of three layers (from inside to outside): the medulla (core), the cortex, and the cuticle (scale layer). Species-specific characteristics of the entire hair and its layers, like (relative) size, shape, and structure, can be used to identify the former bearer of the hair.

For the present report, varying numbers of hairs from each sample were examined using low-power microscopy and then mounted on slides for high-power light microscopy. The sample hairs were compared to reference material collected from different common mammal species (goat, sheep, cow, and donkey[57]) in the valley of Bāmiyān by E. Melzl. Important diagnostic characteristics were e.g. structure and relative size of the medulla, cross-sectional shape and width of the hair, colour and pigmentation, and the hair profile.

The samples contained a variety of hair material, from small fragments of hairs (< 5 mm) to guard hairs approx. 150 mm long. Roots and tips are missing in most cases, a common feature of shorn hair or wool. The cross-sectional widths (at the widest part) often reach 100 µm (corresponding to a coarse human hair), the maximum width measured was 150 µm. Some samples contained balls of fine underhair (width approx. 10 to 30 µm). This underhair and other individual hairs lacking important diagnostic features could not be used for the discrimination of species, especially sheep and goat.

The hair colour varied between a yellowish white and brown to almost black. The cross-sections of the hairs and fragments were circular to oval, oblong, concavo-convex and dumb-bell shaped.

The majority of the examined hairs from the samples of both Buddha statues were identified as goat hair. They are consistent with the goat reference material in the most

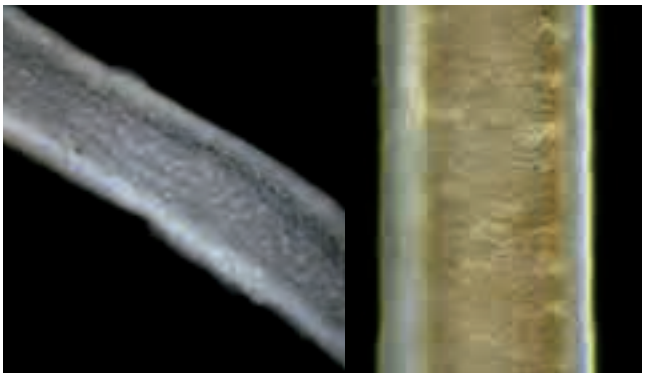
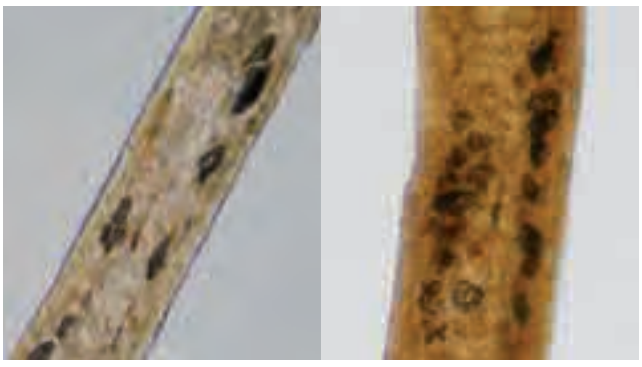


Fig. 3. Medulla structure of a sheep (left) and a goat hair (right; dark-field microscopy). Note the scalloped structure of the medulla lattice in the goat hair

Fig. 4. A hair from sample GBL 011 (Western Buddha, left) and from sample KBL 084 (Eastern Buddha, right, both brightfield microscopy). Note the goat-like medulla structure in both examples. The medulla on the left panel is still filled with air and therefore appears darker.

Fig. 5. Hair fragment from sample ID 55 (finish coat, left) and a sheep hair (right, both brightfield microscopy). Note the patchy, separated medulla



important diagnostic characters, especially in the structure of the medulla (figs. 3, 4).

Apart from fine underhair fragments, the two samples from the fine clay layers of the Western Buddha statue (ID 18 and ID 55) contained short hair fragments with dumb-bell shaped cross-sections and distinctive medulla structures and cuticle scale patterns, matching those of individual reference sheep hair (fig. 5). Especially the medulla structure could not be found in the goat reference material.

The sample from the finish coat of the Eastern Buddha statue (KBL 208) consisted only of two hair fragments that could not be assigned to a certain species, due to the lack of features.

To summarize, the examined samples of the undercoat from both statues consisted of goat hairs, mostly almost entire hairs or long fragments. In contrast, the samples from the top or finish coat contained only short fragments of hair, some of which were identified as sheep hair. Hairs of cow or donkey were not found in any of the examined samples.

Generally, domesticated animals including livestock are subject to selective breeding, which also affects the features of the hair, especially in mammals bred for wool like sheep or goat. This might over time result in major alterations or complete loss of important diagnostic features that are characteristic for the (wild) ancestor of a breed. Thus, hair of such animals can be hard to identify, especially without reference material from breeds common to the relevant area. In the present case, however, the guard hairs from the samples exhibit characteristic features and the reference material from the Bāmiyān valley provided the basis for a fairly reliable discrimination between sheep and goat hair.