Bone Folders for Book and Paper Conservation: An In-Depth Examination

SUMMARY: The bone folder is a common tool used by book and paper conservators. Many folders are typically made from cow bone, but some are fashioned from deer or elk bones. Synthetic materials, such as Teflon and most recently Delrin are also used to make folders. The initial interest in studying these materials started with a discussion of the tradition of applying oil to a bone folder to provide better slip. This poster examines some of the properties of these materials to provide us with a better understanding of these tools. We were fortunate to collaborate with numerous research scientists using the facilities available at Penn State University.

BACKGROUND: Initial interest in this study started during a discussion with Olivia Kuzio, a Bednar Undergraduate Conservation Intern in our Preservation, Conservation and Digitization department. Olivia is a rising-senior majoring in Chemistry at Penn State University, and had already developed a great interest in Conservation Science as a career.

During a discussion about bone folders, we talked about the tradition of oiling a bone folder, as described in Ann Wilcox’s book, A DEGREE OF MASTERY: A JOURNEY THROUGH BOOK ARTS APPRENTICESHIP. Wilcox wrote that she had been instructed to soak a new bone folder in oil, which was thought to provide better slip. A discussion of this passage on the BookArts Listserve made it clear that many readers felt that the oil could be transferred to paper.

With Olivia’s background in chemistry, she speculated that we could test for any oily deposit using forensic science techniques including Iodine Fuming or the Ninhydrin Solution treatment.

HARDNESS TESTING: Common bone folder materials were submitted for hardness testing. While many plastics are measured using the Shore A and D Durometer scales, the Vickers Hardness scale is used in our Material Science Labs. In the Vickers test, a diamond stylus is pressed into the material with a specified force. The resulting impression is measured and compared to a known scale. The resulting hardness of the other bone folders is shown on our scale.

PREPARATION of BONE FOLDERS: We learned that the front leg bones of cows are typically used as well as bones from deer and elk. These bones are typically cleaned by boiling in water for a period of time, and then sawn to a rough size. These are cleaned further by careful boiling – over-boiling can cause the bone to degrade. Some people add ammonia to the water, but also recommend that bones should not be bleached. The final shape of a bone folder is achieved by sawing and further shaping is done by sanding with various abrasives.

Polishing of bone and synthetic folders: To finish a bone folder, one should consider more polishing after purchase. Very fine, micro-abrasives, such as: 15-micron (approx. 1000 grit); 5-micron (approx. 2500 grit); and 0.5-micron (approx. 9000 grit) abrasives can provide a very smooth finish. These abrasives are available from specialty suppliers. One must be aware of safety issues with such fine particles that will become airborne. All work should be done in water or in a fume hood.

OILING A BONE FOLDER: For our study, we looked at three specific oils: Vegetable oil (100% soybean oil); 100% Olive Oil; and Boiled Linseed Oil. The sample bone folders were rubbed with the oil and then wrapped in an oil-soaked rag for a period of 48 hours. The excess oil was then washed away with soap and water. The three oiled bone folders were then aged for two months in a ~90°F environment. This resulted in a significant color change in the sample treated with boiled linseed oil, and only a slight darkening in color of the samples treated with olive and soybean oil. An additional cow bone folder was prepared using soybean oil days prior to testing and was not placed in a heated environment. After aging, the bone folder samples, as well as the synthetic samples were then examined.

FORENSIC SCIENCE and Iodine Fuming for latent oil residue detection: Iodine fuming is a common forensic science technique that is used to reveal fingerprints on porous and semi-porous surfaces like paper, cardboard and wood. During testing, the material under examination is enclosed in a chamber with several crystals of iodine. Applying gentle heat causes the crystals to sublime, and the violet-colored iodine vapor adheres to any fingerprint residues and turns orange. The orange stains are not long-lasting, so they must be photographed immediately.

CONCLUSIONS: While we did not expect that oil would be transferred from an oiled bone folder, we do see body oil being transferred, though in extremely small amounts. Therefore, one should assume that any bone folder, even Teflon, should be washed from time-to-time to eliminate all oils.

At the same time, we learned: Burnishing of paper is the consequence of the hardness of the bone folder because it generates heat, thus ironing the paper fibers. Therefore, Teflon, due to its relative softness, is indeed a better choice to avoid polishing or burnishing the surface of paper.

One new question arises: Are particles of Teflon transferred to paper? If so, they should be of little or no concern since Teflon is inert.

One additional finding is that the iodine fuming also reveals many other oil spots that may have been deposited by the papermaking machinery.