Some Thoughts on Materials Used in Key Covering

by Michael Morvan

Sometimes we need to remind ourselves of the obvious, so here goes: one of the most vital things in any keyboard instrument is the keyboard itself. It is the player's primary interactive medium with the instrument. If music is an art, a passion, and career for many, playing on poor keyboards is like breathing bad air. Certainly a poorly covered or worn keyboard is discouraging to the student and distracting to the accomplished.

Central to the keyboard experience is the direct tactile connection between the finger and the key covering. For decades in this country, it was assumed that any keyboard instrument had its natural keys covered in elephant ivory. As ivory became more expensive, other materials were explored or developed as alternatives. The ivory importation ban of 1989 made the use of alternatives more widespread. As of this writing, pending regulations will most likely further restrict, if not prohibit outright, the use of elephant ivory (Asian and African) as an option for covering and recovering organ and piano keyboards. Therefore, it seems an appropriate time to review the materials we use for covering keys — even ivory, just for the record — and other considerations in key-top refurbishment.

The earliest keyboard instruments, such as virginals, organs, and harpsichords, used a wide array of materials to cover their naturals and sharps. Fruitwoods were used initially, but once European country began to colonize the African continent, the "African Treasures" of ebony and ivory became available. Ivory was initially so expensive that it was used only as a thin laminate to cover the sharps, while and the naturals were covered in ebony. Greater demand and more efficient processing eventually led to a reversal of that pattern, with ivory-colored naturals and sharps of ebony or other exotic woods.

Covering options fall into natural and synthetic categories. Natural materials include elephant ivory, ancient wooly mammoth ivory, bone, exotic wood species, nut, shell, horn, or hooves. In addition to their traditional appeal, natural materials tend to feel good. The visible grain grips the fingers, and the porosity usually wicks away moisture.

Synthetic materials include many forms of plastic, such as mineral plastic, acrylics, cellulose acetate or nitrocellulose. Some manufacturers have chosen to give different brand names to the same material, which can confuse the issue. Synthetic materials are less expensive, more readily available, and generally easier to work with and maintain. And, they don't have to be inelegant.

NATURAL MATERIALS

IVORY

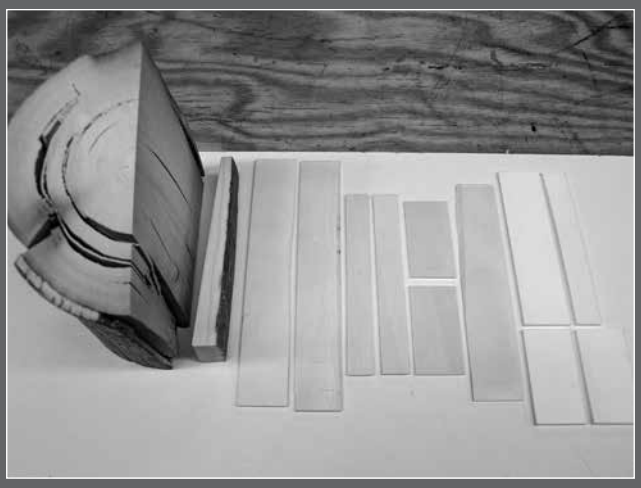
It's hard to work on keyboards and not be fond of ivory. Certainly it has made up the majority of my work with natural materials. Part of that love came with the right training and equipment. A real boon to me earlier in my career was coming in contact with Frank Stopa of Pratt Read & Co. in Deep River, CT. Frank ran the keyboard fabrication department there for many years, and after retiring continued to recover keys for decades. He arranged for me to obtain original factory key-making equipment, and trained me in its use. By then he was in 80s and eager to pass on his knowledge. For me, it was pure luck.

Who doesn't prefer ivory? Certainly listening to musicians, technicians, and instrument builders now for decades, it seems that most people agree on its superiority. It's cool to the touch, wicks off moisture, and grips the fingers beautifully, giving the player a natural confidence. It is traditional and elegant, and adds luster to any instrument; just think of those beautiful thick ivory keys on the finest old organs. Unfortunately, ivory has come to mean something else: images of exploitation of people and elephants. The 1989 ban made ivory into a finite, non-renewable source.

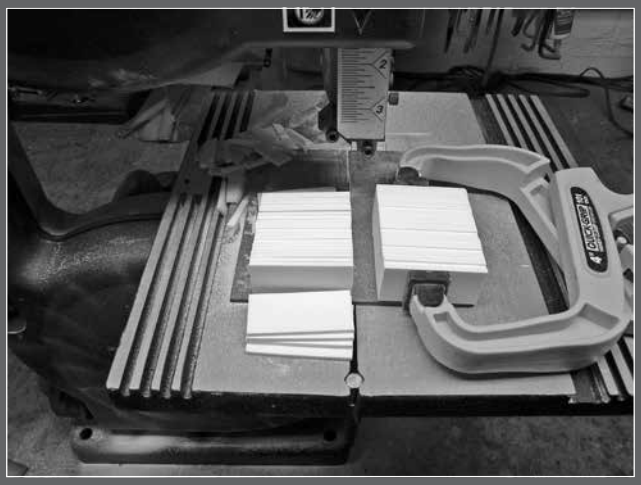
Being a natural material, ivory varies. It can be uniform in texture and color, or it can have variation in grain and color, especially when cut close to the outer bark or the inner nerve. Its great strength comes in being wonderfully workable. Its hard, flat and semi-porous surface can be left in flat in appearance, brought to a high gloss, or anything in between. Ancient wooly mammoth ivory is similar to elephant in all aspects except color. These tusks tend to be a few shades darker with mineral streaks and spots throughout.

Ivory is graded much like lumber. First, a tusk is evaluated for size, weight and quality, taking into account color, condition, age, and any cracks or disease. Once cut and bleached for key-tops, ivory is further graded on a scale of 1 to 4, with 1 being the best. Cutting along the grain, the higher grades came from around the axis or nerve of the tusk, which supplies the flame-point or fingerprint-type patterns. The lesser grades are cut out closer to the bark and display more linear and wild grain. The bleaching process is solely cosmetic, to ensure maximum uniformity of color and minimize the visibility of the grain. An average sized tusk (55-75lbs.) would yield about 5,000 pieces of ivory depending on thickness, enough to cover between 45 and 55 complete piano keyboards.

The thickness of an ivory top is referred to as its "cut", related to how many key tops can be cut from a 1"-wide slab. For example, 8-cut would give eight finished key-tops at a thickness of 0.100", while 12-cut keys end up at a 0.060 finish thickness. In its rough form, the key top is left a little thicker to allow for flattening, smoothing, and buffing. For example, an 8-cut key top starts at 0.113 to finish at 0.100. European instruments (I'm thinking mostly piano keys here) tend to have 8- or sometimes 6-cut keys, while the majority of U.S. piano and organ keys were 12-cut. Not surprisingly, thicker cuts tend to give longer service, since the worn ivory in the middle sections of the keyboard can be planed down and rebuffed for another lifetime of use. Also unsurprisingly, thicker ivory is easier to work with and tends to look better. If the ivory has a



Much like wood, many different kinds of ivory can be taken from the same tusk.



Once the pieces are grouped together for consistency, they are cut to length.

A reed organ keyboard comes in for restoration and recovering. It's already been recovered once using molded plastic key tops.

Plastic tops are removed to reveal that contact cement was used to apply them, and the key-stick surfaces not optimally prepared.

The removed tops, and what they look like underneath

New ivory is selected

surface imperfection that requires a thickness reduction of 0.005, it's just that much more visible on a 12-cut key than an 8-cut.

As the regulatory side of things unfolds in the coming months, it's hard to know how we will be able to work with ivory. My hope is that we will at least be able to harvest ivory from older keys for use in restoration work. It would be a shame if perfectly good ivory were destroyed or not allowed to be used.

BONE

Bone is mostly obtained from large cattle, camel, and water buffalo. Bone shares ivory's tactile advantages (temperature, grip, moisture-wicking), but the similarities mostly end there. Compared with ivory, bone has a rougher surface texture and is usually darker. It requires more frequent cleaning and tends to capture dirt in a permanent way. Only regular rebuffing will prevent premature darkening. In an ideal world, bone keyboards would be removed every five years for re-buffing — a pretty tough sell to an organ customer, I realize, but probably what is necessary, particularly in high-use situations.

European instrument makers seem to have access to a superior quality of bone. Here in the United States, "A" quality bone costs even more than ivory. In the end, I've found the biggest problem with bone is people's misperception of it. It is thought to be identical to ivory, when it can never be. So, if you are considering bone-covered keyboards, you should first come to terms with how bone will perform over time. If you decide if it's right for the project, it's probably best to talk to the customer about the realities. A final thing to remember: even when bone looks bad, it still tends to feels good. If customers can put up with bone's appearance, they will always have the nice feel.

WOOD:

Exotic wood species have been used both for naturals and sharps, and most often just the sharps of piano keyboards. While any species can be used, some see greater use: ebony of course, but also teak, maple, beech, granadilla, padouk, pear, plum, rosewood, boxwood and walnut. Though a wood species may be as hard as ivory or bone, it's usually never as dense, which is why it tends to wear, or dish, more rapidly, especially between hard and soft layers.

For several decades, reverse-color keys were trendy for organ keyboards, but more recently the piano standard of white naturals and dark sharps seems to have returned. I suspect this is both about tradition and practicality. Certainly the gaps between keys of light color make a keyboard immediately more legible, even in low light. (I note

that the 1970s trend of dark wood naturals against dark wood sharps didn't seem to last very long!)

Ebony and rosewood are excellent for both naturals and sharps. However, their supplies are dwindling and in certain instances are becoming restricted not unlike like ivory.

In summary, where natural materials are concerned we have been spoiled by having access to the best. Both worker and customer will increasingly have to settle either for lesser grades or different and more renewable species: maple or beech for naturals, lower grades of rosewood and ebony for sharps. Perhaps we should look to the piano trade, where synthetics have been the standard since the 1950s and premium materials have always been a more expensive option.

SYNTHETIC MATERIALS

Before discussing individual types, it's important to know that synthetics come in two formats: sheet or pre-molded. The advantages of pre-formed or molded tops are:

- they are inexpensive and readily available
- they require less equipment and skill for trimming and shaping
- they are useful for a technician to train on before advancing to better quality work
- they give the illusion of being easier to apply than more complex materials
- they can offer a quick, inexpensive facelift to a worn-out keyboard
- they are the most commonly applied kind of key-top
- they are uniform in size, length, width, thickness, contour and profile
- they are available with or without an attached front

The disadvantages of pre-formed or molded tops are:

- they are not as high a quality material as cast sheet acrylics
- the uniformity of widths won't match up with the keys themselves
- they give the illusion of being easier to apply than more complex materials
- they do not come in various thicknesses
- they can have surface imperfections molded into them
- they are not traditional

The new ivory key top is glued in place.

At this stage, all the new ivory key tops are in place and acclimating.

The new ivory key top in its rough-trimmed state, using a flush trim router bit.

- they are often falsely marketed as a universal one-size-fits-all key-top solution

The advantages of sheet form key-top material:

- they tend to be of higher quality and produce better results
- they can be machined to different thicknesses, shapes and sizes
- they are used by the finest manufacturers

The disadvantages of sheet form key-top material:

- they are more expensive and less readily available
- they require more equipment and skill for trimming and shaping
- they do not have an attached front; top and front must be applied separately

The molded variety are pre-made individual key tops, with the shape and thickness ready-made. This pre-shaping is both curse and blessing. Ideally, all keys would be exactly uniform in width. Unfortunately older keys vary as much as .125″ in width within a given manual. When the old key is wider than the new molded top, the key is usually trimmed down to match. But when the key is *narrower* than the molded top (more often the case), the molded top must be trimmed down to the width of the key-stick. This leaves both keys and tops inconsistent, which doesn't just look bad but can be surprisingly hard on the eyes.

Sheet material is like natural material, in that it must be machined to the desired thickness, processed into usable sizes for both top and front. Just as with ivory, bone or wood, the piece is fitted oversize and then shaped and finished. It permits a finer result along the lines of how key coverings have always been fitted to keys in the best tradition. (One of the best things an old keyboard can teach us is how well it was made in the first place.)

CELLULOID

Invented in the 1860s as an economical ivory alternative, celluloid started to be used a replacement key-top material in the early 1900s. It soon became standard for the fronts of keys. Being a soft plastic, celluloid can disclose imperfections of the surface to which it has been adhered. For example, any cutter marks from removing the old top, any damage to the key-stick top from the removal of the original key-top, the boundaries of the mortise cover, and the mortise itself — all these things can be oddly amplified when covered in celluloid.

Celluloid can be stable and predictable for drawknobs or plaques, or when thinly cast for fronts or fascia. It's less stable when used as a thicker key-top material, with added stress concentrations such as notching material away as clearance for sharps. Finally, one must be very careful working with this material, as it can easily catch fire when machined using methods typical for other materials.

MINERAL PLASTIC

Mineral plastic has two of the three coveted properties of ivory and bone: cool to the touch and a bit of tactile grip. Unfortunately, there isn't any porosity to wick away moisture. But its good qualities make it worthy of consideration. Though roughly twice as expensive as a high-quality acrylic, mineral plastic is still less than a third the price of ivory or bone. Mineral plastic also has the advantage of coming in sheet form.

Mineral plastics have been more widely used in Europe. When buffed, the material takes on a softer sheen than acrylic plastic, even though it is a perfectly flat and high gloss material. Varying compounds permits different levels of gloss without having to resort to abrasives to temper the shine.

ACRYLIC

Acrylic is the most common contemporary key-top material, available in both sheet and molded form. Most organ and piano key manufacturers employ it, with good reason: it's hard and durable, holds a buff well, and comes in many shades of white. The least expensive of the synthetic materials, acrylic will likely grow in popularity.

ELFORYN

Elforyn (www.elforn.de) is a relatively new material developed as a kind of artificial ivory. It is mineral based with an added component to eliminate yellowing over time. I have used it, and find it to be similar to mineral plastic. It's available as blocks, individual slabs, or sheets.

In my experience with synthetic materials the most reliable options have been the acrylic-based ones, both pure acrylics and the mineral plastics. They have come a long way and are reliable and renewable.

THOUGHTS ON RECOVERING

MATERIAL THICKNESS

Understanding key-top thickness is critical to maintaining the relationship between naturals and sharps. When key-tops are replaced a thicker top must be used. Once you've planed down the key-stick to get a fresh surface, the loss

of material on the key-stick needs to be compensated for in the new key-top. For example, if the new key-tops are thinner than original, the distance between the top of the natural and top of the sharp increases, leaving the sharps high and the naturals low. This is an important dimension to keep tabs on in keyboard restoration.

GLUE

Today's range and quality of glues have certainly improved our work in many ways. Where keyboards are concerned, however, we only need to be familiar with a few of them, as we are only ever bonding wood to wood, felt or cloth to wood, plastic to wood, or the semi-porous ivory or bone to wood. In the early days, only a few adhesives were available: hide glue, casein glue, bone glue, and fish glue. The range of modern synthetic adhesives is truly impressive, but they don't have much application to good key work. Wood to wood application has greatly improved with fast-tacking, quick-drying, waterproof PVAs with or without creep, but most people forget that hot hide glue can be modified to have the same properties with the added bonus of being reversible and repairable, which PVAs are not.

Among modern glues, I have not found any specifically designed to the properties of ivory and bone. We have most benefited from the glues that can bond non-porous surfaces, mainly plastics to wood. Glues such as PVC-E have given a non-toxic option to smaller shops trying to get a good plastic to wood bond. We do not recommend using contact cement, at least the types available to us. In this regard I know no manufacturer that has ever used it for key-tops.

PROCESS

Regardless of the material chosen, the best thing we can do for our customers is to back up any key-top material choice with the best workmanship and good maintenance. Poor craftsmanship during the application process will not compliment any key-top material. Maintenance is important as well, particularly with ivory and bone. An expensive keyset, particularly bone, can deteriorate quickly without proper care. Remember: it's the player's primary point of physical contact. We should make it feel as good as possible.

Michael Morvan is an associate member of the Boston Chapter of the Piano Technicians' Guild. In his work, he applies his machinist's training and background to the restoration and recovering of musical instrument keyboards. He lives and works in Uxbridge, MA.

The sharps are also refinished.

The fully restored keyboards with new ivory key tops.

The fully restored keyboards with new ivory key tops.