

# Restoration of a Longman & Broderip Square Piano

Diary written by Tom Strange

## Acquisition History and Description:

This instrument came to my attention in late January of 2008, when a participant of the Yahoo Fortepiano Forum alerted the group that it was located in Georgia. Looking at the pictures, and with a given serial number 361, I was convinced it was older than the assumed date of 1795, and for the price and distance of just over 100 miles, I could pick it up without bothering over shipping. On inspection, it was in a fairly moderate state of disrepair, with all the usual problems for an instrument of its approximate age. It is an English single action, 5 octaves of the usual span from FF to f3, without any fretwork in the name board or right rear corner. The name board carries the inscription:

“Longman *AND* Broderip Musical Instrument Makers No. 26 Cheapside and No. 13 Hay-Market, London”.





I always photograph and document everything first, before any work is done, even major disassembly. Although this diary is meant for publication, I typically generate a lengthy journal of what can be seen, just in case questions come up later that seem unimportant at the time. I think the modern restorer, with access to digital cameras and cheap computers should do this as a matter of course, and attach a hard copy in a pocket on the bottom after you're done. Things get separated so easily, and your restoration documentation is important!

Real excitement was generated when, on removing the action and inspecting the case, a signature and date was visible through the "mouse hole", written on the bottom boards under the soundboard. Getting a good picture of this was difficult, but with an inexpensive micro video camera (about 0.5 inches cube!) and some patience assembling the many images with Photoshop, a composite was put together:

John Geib Feacit (*sic: ed.*) London 1785



So we have an L&B made by John Geib in 1785, and a good example of his handwriting. Geib's contribution to the development of square piano actions is in every reference on the subject, and this instrument, from only a year before he patented his improved escapement, represents one of his last pianos of the type, it would seem. The serial number of 361 and this date fit nicely in David Hunt's short list of dated L&B squares. Dimensions and particulars were taken and submitted to Martha Clinkscales for inclusion in the list of historical instruments, with a copy to John Watson at Colonial Williamsburg Foundation.

A number of hammer hinges were broken, some of the over dampers were not visibly present, some brass and overspun strings were broken, several of the ivories had been replaced with material too thin and lacking the double scribed line at the interface to the tail, and the veneer was compromised in the areas of high wear. Three key fronts were missing, as was the strip of mahogany in front of the keys. The lid was cracked in several corners, and the lid support missing. Most significant, the base board had come apart from the case at the right rear and side, and to a far less extent from the left rear corner, largely due to extreme shrinkage of the base boards, which are now  $\frac{3}{8}$  inch less wide overall than when they were originally made. However, the instrument was still under some tension, and several notes were only a whole step down from A 415.





The wrest pins are marked for their note value as usual, and more unusual the top of the bridge is marked for each string pair using the Doe Ray Me form (b = D, c = DE, c# = R, d = RE and etc.) in the key of b major, and the number 32 appears on the key well name board groove, the name board, and various places on the case. On removal of the action, it was obvious that many of the now missing parts had been collected and thrown into the works for safekeeping. An inspection of the area under the sound board indicated that additional parts had wound up in there. Once everything was collected and assembled there was a complete set of over dampers, one key front still missing, and one more hammer than needed for a full complement. At some point a hammer was probably tossed in or left by a former repairman. The mop heads (old man's head) were suffering abrasion and dry rot, and no longer anywhere near the right height to actuate all but a few hammers.

The damper felts are shaped as simple wedges and look very fresh, but are made of felt which was not in any kind of widespread use at the time, and since dampers were generally made as pad-like stacks these are almost certainly replacements. I do wonder though if the restorer was copying an original wedge shape or just improving as he went. There is a brown paint on the damper tops to make them all the same color, since two different pieces of mahogany was obviously used for groups of dampers, and the color difference would be striking. I think the paint is original or at least quite old, as it is on the damper rail and damper spring rail as well. Insect damage was limited to the blue damping flannel in the wrestpin area, pieces of the action flannel under the sharps keys, and the touch cloth made of fine animal hair. No mouse damage was seen at all. There were the usual wax splatters, and something was spilled into the key frame area long ago.

Hammer heads in the action are largely original, only four in the treble have been recovered (in now hard leather). The iron and brass strings, including the over spun, all look to be original, judging from the attachment to the wrest pins, uniformity of hitch pin loops, and similar state of oxidation. This is fairly unusual as there is often a hodgepodge of strings to deal with, so each was measured and the diameters and lengths to be sent to Malcolm Rose for possible inclusion in future editions of the handbook of stringing practice.

### **Beginning the Restoration Process:**

The first task once the condition has been photographed and recorded is to plan out the activities. The action needs cleaning, hammer hinges replaced, a few hammer heads recovered from earlier attempts, and the mop head (or old man's head) cranks recovered and their head height set. Several of the ivories are replacements, and some are the wrong thicknesses, now presenting a dingy or discolored appearance. Three of the ivories in the middle are original but have developed dry cracks or been chipped. These will have to be saved, but a cleaning of the cracks and rounding of chip lines will give a more pleasing appearance. The obvious replacements will be upgraded to the correct thickness with

ivories of similar buff color but otherwise clean. Two replacements were fine as-is. The one key front still missing can be re-made.

It is easy to tell an original ivory in early pianos. There is usually a scribe line, in this case two lines, on the key near the point that the key head joins the tail. This is a holdover from harpsichord days where this ornament was common. These lines are made after the keyboard is assembled, and will line-up down the key frame. Replacement ivories rarely would have any lines, and these would invariably be off from their neighbors, as the scribing tool was unique to that builder.



With the action out, the case can be more closely inspected. A set of divided damper stops are still place to raise the bass/tenor and treble dampers independently. A buff stop was once present but is now removed entirely. A set of iron bars appear at the opening to the mouse hole, and these present a puzzle that remains unsolved. They appear to have been put in place to reinforce the lip of the soundboard, but this is not generally a high stress area. They might possible have been added to keep the case and bottom boards together better, but no one among four experts on square pianos has ever seen this done by a builder. However, they do not come up from the bottom or down from the top, and access would have been so restricted as to preclude doing this without removing the

lower layer of the bottom boards or the soundboard. No sign that this ever happened. I am thinking this was some kind of experiment by Geib, but to what end I cannot say.

With everything removed, now is a good time to lay a length of brown paper over the whole inside space of the instrument and secure it, so that with a soft pencil or graphite stick, you can do a rubbing of the hitch pin, nut, bridge, and wrest pin positions. Should you decide to replace the over spun strings this is critical to have for your string technician to make a good set, and it is never easier to do than now.

After conferring with David Hunt, Michael Cole, and David Hackett, it was decided to proceed with restoration work, but not to a point of removing the soundboard, thus leaving the original strings intact. In fairness, Cole is not convinced that once the soundboard has bowed a competent restoration can occur without attacking the problems of case attachment and possible rib separation from inside. David Hackett points out that original strings are never expected on old violins, so why bother on pianos? The points are well taken, and my logic going forward with the more limited plan is that is very conservative, and should it fail the aggressive approach is still possible.

### **Materials:**

A word or two on materials and the approach is now in order. First, the leather bits are not readily identifiable by species now, though documents have revealed some general trends used in these instruments. In “The Pianoforte in the Classical Era”, Michael Cole gives an inventory of general woods used, and the Yahoo fortepiano forum has links to many past exchanges where the materials and leathers are discussed in detail for many types of fortepiano. In English pianos of the period, goat and deer skin using a vegetable tanning process was widely employed, with some parts made by animal tanning. Lanolin oil and brains are used to make softer leathers, while vegetable tanning produces a firm leather. Mineral tanning employing chromium was adopted over 100 years later. Most leather found today uses the chrome process, but specialty leather supply houses can offer any of the other needed types. There is debate and disagreement on how important the tanning process is to the sound, particularly regarding the quality of the hammer heads, but the restorer is going to bring some of their esthetic into this process, so getting close and then a few trials is usually enough to steer you in a good direction. With a supply of soft goat skin tanned with a vegetable process on hand for the possible use of the hammer head replacements, and with only four heads needing full replacement, the debate was settled in favor of goatskin, with the rough surface turned out, one layer per replacement.

Hot hide glue on the other hand, is easy to apply, has a long working life if used properly, can be easily and completely reversed, is historically accurate, and is structurally sound on complete drying. It will not creep, and remains inert until moistened and warmed. It is also tremendously strong when used correctly, as a film between two pieces of wood or leather. The only drawback is that it must be warmed before each use, and a pot dedicated to this is important. Personal soup pots can be used like a double boiler to warm and keep the glue in a damp environment until use, and a soft brush is a great application tool. Luthier grade hide glue is used for all my repairs.

I attempt to reuse original materials where possible, and have had good success in saving all but the most badly insect damaged flannels and cloths by removing them, cleaning in Woolite or similar, block dry and replace. Occasionally reversing the side facing out can give a nearly complete restoration of color. In this piano, the touch cloth was a coarse woven haircloth, similar to fabric interfacing. Modern haircloth is invariably a finer weave. The purpose of the touch cloth is to damp the sound of the hammers falling back, and a variety of materials were used over the years for this including flannel and soft leather on other instruments. However, I was able to find a haircloth interface with one side fusible that has a fairly coarse weave. The original touch cloth was cleaned in Woolite and dried, then arranged so that a continuous surface was located on the fusible side of the new cloth and ironed in at medium heat. This gives us the original surface with a reinforcing liner below. It is slightly thicker by about 0.5 mm than the original configuration, but that can be compensated for with adjustments to the action.

### **The Restoration:**

While the action frame is out, the keys are removed one by one and cleaned of wax and debris on the ivories, and the wooden shafts lightly cleaned with a damp cloth. Care should be taken around the hand written numbers for each key, and everything photographed. The action flannel and felt was examined and vacuumed of bug remains and etc. It was only necessary to replace a few of the accidentals wool pads due to insect loss. The balance rail cloth was clear of major defects.

Before replacing the keys in the frame, each one is tested for action and balance, and the balance pin hole is either opened slightly or if needed, dampened and allowed to dry to expand the wood for a good fit. None of the keys were so worn as to need to be swelled back, but several pins had built up oxide and dirt and were polished to allow for easy movement of the key. The key should return to its rest position from a full depression on its own with no assist.

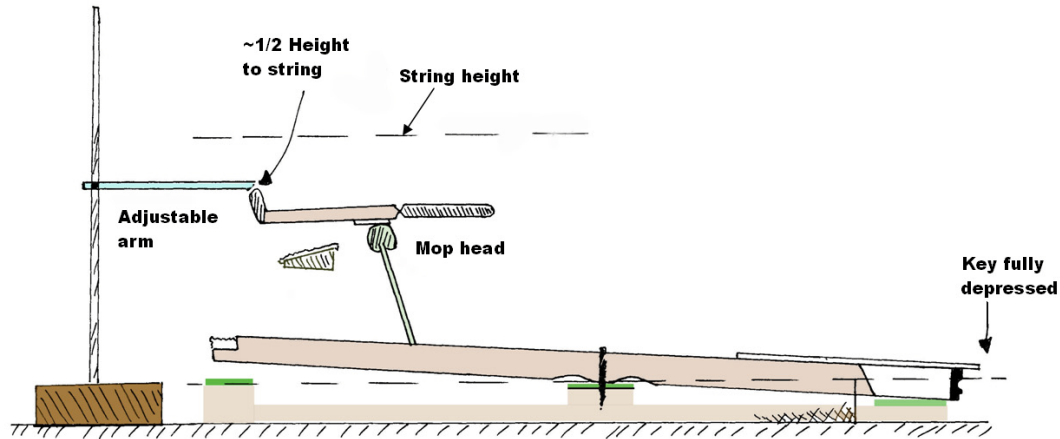
The keys are lined up and each of the mop heads covered in goatskin, smooth side up, as original.





Replacing a hinge involved splitting the wood wedge and hammer butt away from the hammer shaft, and with a sharp knife slicing out the remaining leather hinge. Both wood faces should be clean of leather before the new hinge is inserted and the three pieces glued up. It is critical to line up the beveled end of the hammer with known good neighbors so that the hammer head will hit the intended pair of strings and not those above.

Now we need to set the distance from the mop head to the hammer butt. Rather than concern ourselves with this exact distance, we will actually regulate how far each hammer travels on full depression of each key. Doing this is fairly simple. Measure from the base board to the strings in several places and take an average height. Next measure the height to the top of the hammer heads at rest. A jig is then made that will sit on a table, with a small sturdy base and a vertical dowel, and a boom that can be locked onto the dowel and extends at a 90 degree angle about 6 inches.



Set the height of the boom such that it is about the height of the hammer head midway between the rest position and hitting the string. This jig is then placed in front of each hammer as the keys are returned. The keys are then returned to the frame one at a time, and depressing the key fully, check the head height. If too low, the mop head can be raised by turning the mop head shaft one complete turn. Fine adjustments can be made by bending the mop head shaft away from the hammer butt to lower slightly or, or toward the hammer butt to raise it. The position of the wire and mop head with respect to the hammer shank is called the “crank”, and adjustments to this are subtle and critical so bending the wire is best left for rare circumstances.

In general, with an English Single action, there is a good deal of key travel before the hammer begins to move, as much as half the total dip. Increasing the crank (mop head hits the hammer butt closer to the hinge) increases response but in order to keep the hammer from jamming against the string the lost motion is increased. If the crank is reduced, the lost motion can be reduced as well but at a loss of hammer responsiveness. In general, the mop head should hit the hammer butt at the last third of the butt’s length as measured from the hinge joint. Each key is tested for general responsiveness and adjusted as needed one at a time.

Before replacing the action, several items required attention. The bottom boards have begun to detach from the case as noted, and need to be re-glued which presents our first real dilemma. The bottom boards have not simply detached, but have obviously shrunk, with a maximum of 3/8 inch gap to the rear spine now evident. For that reason the two faces no longer line up as they did originally and there is unevenness of the two faces. Glue works best as a very thin film between the wood faces, and has little strength of its own internally.

A few feeble wood screws will not help make the situation better. The best approach is to take it all apart and resurface everything for a new fit up, but as we are going with a far more conservative approach, I opted to clean the joints by soaking for several hours in warm wet towels fed in dry to begin with, followed by threading in thin wet linen

edgewise into the joint until the result comes back clean, dry overnight, then lightly sanding to get the two faces nearly parallel.

A cork pad was taped on the top of the case wall all around, and boards laid across for the bar clamps to bite. A low voltage flashlight bulb soldered onto wires is threaded into the mouse hole all the way to the back, the clamps tightened until the two faces come together, and a note made of any gap in the faces where they do not completely meet. With a little more light sanding, the two faces are now lined up completely. After warming the case to about 32C in these areas, glue was injected through a syringe and spread with a thin pallet knife. The clamps were applied and the two surfaces drawn together and allowed to sit for 48 hours. After this the case was unclamped and following a week of drying, tension was brought back up on the strings.

With the strings back under partial tension, we address the action bed. Originally flat, the movement of the base boards as they shrank has resulted in a 1/8<sup>th</sup> inch bulge in the middle of the key frame bed. Since the action must sit with the hammer rail very close to the strings, it happens that this much bulge actually causes the hammer rail to touch the strings, and those strings buzz against it when struck. The key bed was hand planed back to flat with a 3 inch plane, and the problem was solved. It is always a pity to have to shave away wood and patina, but either the bed or the action frame had to change.

The veneer is made of mostly stringing on the lid and case, and in many cases consists of rosewood with the long axis against the grain, so that a pretty banding with varying grain texture is obtained. However, this wood is very fragile, and over time as the glue beneath loosens, the ribbon is free to break away with almost no force. So a fair amount of similar stringing was lost on the lid sections on the sides where the lid has flexed over the years while being lifted, and the veneer popped away.

The stand received more abuse from people passing by and hitting it, and 7 of 14 wood plaques around the top of the tapered leg section were missing. These were rosewood with boxwood stringing and easily remade. Indian and Central American rosewood can be obtained and the stringing cut to width and replaced.

Now we come to another conservation dilemma. The finish in places is poor and shows obvious signs of an earlier refinishing on the top of the lid, but is good to fair on the bottom, and fair on the case. The finish on the trestle stand is largely gone in places and also shows signs of something gooped on. Simply replacing the loose veneer can be done, but it leaves the instrument in a battered state. I take the position that if this were a painting we would clean it (remove the old darkened varnish) without a thought, if the base painting was intact. If we can preserve the original state of the wood but replace the disturbed or poor choice varnish with a similar upgraded coating then why should that be a problem? It is true that furniture with the original finish intact is worth more. But if the piece has seen hard use, it is frequently refinished, possibly multiple times over its life. I think we have to approach these old instruments the same way. Stripping that removes original color is a poor choice, but just dissolving away an inappropriate varnish layer and replacing it with a good replacement layer seems appropriate. The original finish was

probably sandarac and nut oil in spirits. The modern Danish oil (polymerized linseed oil) and Tung oil finishes are very similar in appearance, with a bit more robust wear properties. I favor Tung oil for jobs where a more gloss finish is appropriate, and Danish for a satin look. With a protective coating back in place, glued joints remain strong longer, and pieces of veneer that may be loosening but not actually loose yet will be held better in place.

Limited work was done to the lid top, trestle stand, and selected corners of the case where damage was highest and we left undisturbed the original finish on the rest of the instrument. Working in small areas at a time, the damaged finish is removed to a point of just taking it off with 0000 steel wool and methyl ethyl ketone/acetone to remove the softened material. I then clean with a terry towel and denatured alcohol to clear the surface, allowing 24 hours to dry before recoating. Two coats with adequate drying in between followed by buffing lightly with 0000 wool and two more coats returns the surface to something like the original condition. This takes about four or five days per side to allow full curing between coats.

I think that patina has a definite place, and the children's initials, scratches, ink and water staining, and other blemishes that are now well into the wood are left intact. All we have done is remove the remnants of battered varnish and replace with a solid clear coat of similar type. I consider this good conservation, and will accept the dissenting opinion of those more scrupulous about an undisturbed condition being best.





We next addressed the dampers. These are made of mahogany, apparently scraps lying about the shop and rough cut for the purpose, with a coat of brown paint on the top applied. The wool damper pads should be made of buff leather or similar, but the change would be cosmetic only, so for now I'll leave them in place.

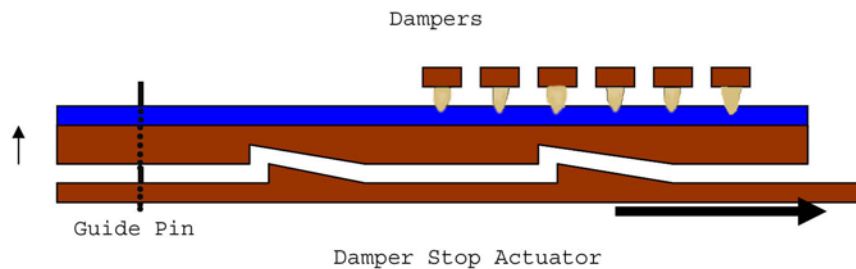
A rail over the back of the dampers is drilled and whalebone springs inserted through the back, with pointed and flattened tips contacting the damper. Not actually a bone at all, this is the baleen from right whales, and is properly keratin, similar to hair and horn material. Large plates were cut into thin strings, and pulled through a die to produce rounded rods of the bone, which were then tapered towards the end that contacts the damper. This makes an excellent non linear spring whose tension increases dramatically as the damper is lifted close to maximum height. The dampers are too lightweight in themselves to effectively dampen the string, and a spring was employed rather than attempt heavier dampers to give proper pressure of the damper on the string.



However, with time the whalebone loses waters of hydration and the springs delaminate and become stiffer than they were originally designed to be, eventually not acting as good springs anymore. Insect attack has also occurred, since this material is digestible. Whale baleen can still be obtained, but is costly and not from the same whale as originally used. Carbon fiber rod has been suggested as a suitable replacement material, but carbon fiber in the diameter of the original spring (about 2 mm) would need to be thinned far more than the original bone, as it is considerably inherently stiffer. Brass wire can work well at diameters of 0.60 mm or so. I experimented with several configurations of carbon fiber and all appear to be too stiff in use. I will use the brass wire, and the job is reversible for a later restorer to attempt more authentic springs.

The dampers are operated by round dowels (made by drawing wood through a die and hand correcting the diameter as needed), actuated by the ends of the keys so as to lift the damper when the key is depressed. Additionally, a flannel or leather covered stick can be actuated with hand stops on the left to raise either the treble or bass dampers as a set, independently. This hand stop action is pictured and diagramed below, where the blue

flannel covered bar is raised by moving the lower bar to the left, and the dampers above are brought up.



The dowels needed cleaning and the height of the pads on the back of the keys adjusted so that the dowel travel is uniform. For whatever reason the dowels are not all the same height and I suspect modification over the years.

The damper rail was found shimmed into place in a fairly haphazard way with an odd assortment of thin and thicker wood scraps, reflecting numerous removals and repositioning. A new spacer was cut to correct height, so that the damper levers still fall nicely on the strings but just miss the top of the damper lift lever. The important parameters here are the height of the damper over the lift and position of the felt on the string pair. With the strings so small, the amount of damper material in contact with a string is minute. Placement is critical to insure positive damping, but not damp a neighbor string.

The brasses were cleaned and lightly polished, and names noted for reference. The hinges for the lid flap are marked “Matchett & Moores, Patent”. Other brass hinges were unmarked. The lock is marked JDB London, with a partial stamp that with a little work

reads “SQUIRE TWO LEVER” and is almost certainly by the Squire lock company, operating from the same address since 1780, and so a piece of this piano manufacturing lives on! No markings on the trestle stand feet, but they were once sitting on castors that have since been removed, leaving the instrument a bit low to the ground.

Along with the two hand stops still present, there is clear evidence that a buff stop or una chorda stop was once present and has been removed. This should be restored and there are sufficient traces to show where it went. What we cannot know is whether this was the traditional buff stop, a thin strip of leather that is pressed to the strings to damp their vibration and create a lute-like sound, or Geib’s idea for a una chorda, where the leather was in the form of a dental mould or comb-like shape, and damped out only one string when activated. This was reflected in his patent 1571, and claimed as a tuning aid, but was never very popular and was not widely adopted. He has the hammer head leather turned rough side out, also claimed in the patent, but of course this is the single action, and the patent describes the all-important double action, so it is probable that the third stop was a simple buff stop. Nothing on the strings seems to indicate one way or the other, nor is wood fading or rub marks indicating anything. We will rebuild a simple buff stop.

This consists of two strips of wood, one with the leather strip on top and about 3/8 inch thick, held by screws through vertical slots so that it can only travel vertically, and another below held by screws in diagonal slots or horizontal slots so that as it moves sideways, it either travels by the diagonal slot upward and pushes the upper strip into the string, or acting similar to the damper lift, translates a horizontal motion into vertical travel. We will take our cues from the damper lift and make our strips with saw tooth incline planes. This solves the need for the lower strip to travel upward as it shifts horizontally, which complicates the attachment to the hand stop lever. A simple spring is needed to keep the upper rail against the lower, and this can be fabricated.





The original lever sat at or very near the wood base for the hand stops, as the marks over the years are in evidence of its travel. I made this one out of hot rolled steel bar, 1/8 inch thick, cut to a length indicated by marks in the wood that show the place where the original stopped. The original lever handles are simple iron balls that are brass plated, with a 1/4 inch rod inserted into one end and the assembly riveted to the lever arm. A brass finial of about the correct diameter was flattened on the top to simulate the riveting of an original to the lever. It was threaded, and 1/4 brass rod screw stock soldered in, and then the new lever drilled and the ball threaded on. This presents a look very much like the originals.



A replacement dust board was made in a pattern similar to others found on such instruments as provided by David Hunt, and fitting to the brackets still on the case. This is not an important element to the sound but it completes our look for the piece and it does lower the action noise somewhat. So now with everything regulated, up to tension and tuned, and sitting on a now sturdy stand, we can make some music. The finished instrument is found below, and I hope to post a video on YouTube shortly so that everyone can hear it in action.





Tom Strange 2008