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The Restoration of Pianos

and other keyboard instruments

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FOREWORD

Restoration is repair work which is historically oriented and is applicable to objects which have ceased to be made or are now made in a different way. It is particularly appropriate to objects which are rare and those whose traditions of making are uncertain. In such cases, the object often preserves in itself evidence of making which is vital to its correct repair, evidence which can easily be lost in the repair process. One of the important arts of restoration is the preservation of such evidence and the ordering of the repair processes with preservation constantly in mind. It is always important to remember that restoration is temporary - one day it will need to be done again through wear, accident or unavoidable failure of an old or a new part.* The next restorer will depend on the evidence the earlier restorer has contrived to leave in place.

Mention piano in 1st paragraph.

By contrast, the modern piano is built in a factory and maintained by a well-organised trade. When the hammer felts are worn, the usual method of repair is to replace the complete set of hammer heads with new ones from the same or a different factory. If the strings are replaced, the old tuning pins are usually discarded and replaced by new ones which have a slightly bigger diameter so that the new pins grip as firmly as the old ones did when the piano was new. Methods like these make commercial sense for instruments whose technology is contemporary and completely understood. They are utterly wrong for the instruments we are concerned with here. The technology of the older instruments is only partly understood and the instruments themselves are an essential clue to gaining further insight into the materials used and the techniques involved.

repetition

The hammer coverings on an old instrument may be worn, damaged or decayed. If they appear to be original, they are vital evidence whatever their present state, and if they have to be removed

* The lifespan of instruments is many times that of we who create, use and repair them.

they must be preserved in a box for the benefit of future restorers. If the coverings are only worn, those in the upper and lower parts of the compass may still be serviceable. Retaining some of the originals in use is a good check that the replacements are similar in the sound they give and is good practice from the point of view of those concerned with historical accuracy. A lazy restorer will often be tempted to avoid any such embarrassing comparisons by making a clean sweep of all the old hammer coverings, but this is a wrong attitude which can spread into all aspects of restoration. A good restorer should be self-critical, and always try to see what the original maker was trying to achieve. The 'clean sweep' kind of restorer not only tends to alter the instrument, but will often prevent any subsequent restorer from putting things right.

This book attempts to describe the various processes in the repair of early pianos and other keyboard instruments and to give useful information about the parts which tend to be missing or to have previously been changed. It is intended to help people who are skilled with woodworking tools, who have a good feeling for antiques and who are willing to take care beyond what is commercially necessary. I realise that it may in some cases have the unfortunate effect of exposing old instruments to repair by unsuitable people whom this book will give more confidence than is desirable, but I trust that its overall effect will be to raise the general standard of restoration and protect our valuable antiques from many of the undesirable procedures to which they are at present subjected. If all professionals were nowadays trustworthy, and if there were enough of them, one could simply say 'leave all this kind of work to the experts'. This book is written because that happy situation does not yet exist.

I have tried to cover the period of piano building up to about 1850, and most of the references will be to British square pianos which make up the majority of survivors. Grands and uprights mostly suffer from the same problems as squares. Much of the text also applies to clavichords and members of the harpsichord family but it is hoped that readers will pause before tackling any but the fairly superficial tasks on any instruments of real rarity and high value, asking themselves what damage they might do and what evidence they might destroy.

I have included a chapter on the climatic requirements of old keyboard instruments, because much of the damage done nowadays is the consequence of modern central heating. It is doubly iniquitous to restore an instrument and then destroy it by subjecting it to a hot dry atmostphere every winter. Some of our most prestigious museums and the majority of our music schools are guilty of this kind of neglect.

Note names and compasses are referred to by the usual system derived from German 17th-century practice. The bottom note of the modern piano is written AAA and subsequent octaves as CC - BB, C - B, c - b, c^1 - b^1, c^2 - b^2, c^3 - b^3, c^4 - b^4 while the modern top note is c^5. Middle c is written c'. Mozart composed within the range FF - f^3, Chopin within CC - f^4.

Restration or conservation.

Use of reproductions for concerts and originals for recordings.

Chapter 1 Reversibility

The first responsibility of a restorer is to perform every task in as reversible a manner as possible. A part which appears to be a replacement may later be found to be original or a new glue joint may fail or some mistake may be made. If these repairs can be undone and begun again no permanent harm will have been done.

Any old instrument is a link with the musical requirements and workshop practices of its period and is a repository of information which is valuable to anyone who wishes to understand the music of that period and how it was performed. It is usually possible to learn something of the source of the various woods, the tools used in preparing the parts, the order in which they were assembled, the methods of laying out the hitch pins, bridge pins and tuning pins, and the methods of finishing the case surfaces. There is usually evidence of how the maker attached the strings to the tuning pins, how he wound his loops for the hitch pins and how he applied the hammer leather. It may also be possible to deduce some of the original adjustments, e.g. the original depth of touch or the plucking order. A clear impression can usually be gained of the speed and accuracy with which the work was done, and whether the maker tended to work less carefully on parts which did not show.

As far as the sources of timber are concerned, the evidence will only be lost by the removal of some of the timber itself. Past restorers whose practice was to replace jacks or soundboards are troublesome from this point of view. Evidence for the use of tools is largely in the surfaces of the worked parts; some cleaning processes could obviously reduce the evidence. The order of assembly can sometimes be deduced from the cut of the joints, the marking-out and the direction of the glue runs. The joints can often be assembled only in a certain order. If two scribed lines cross, it is usually possible to see which was made first. Glue runs can show that one part was already there when another was glued in, and often reveal which way up the instrument was when gluing took place. Scribed lines can be damaged by moisture and heat, and glue runs will disappear if extensive regluing takes place. It is often difficult to be sure whether a case was originally finished in one way or another and whether a soundboard was originally varnished. Such evidence as still exists is liable to be confused

if any new finishes are applied.

The survival of evidence is closely linked to the degree to which the treatment is reversible. This axiom should increase our interest in reversible processes and lead us to realize that most so-called reversible processes are, in fact, only partially reversible.

The only operations which are fully reversible are those concerned with the dry assembly, without force, of separate parts. Thus a set of jacks may be removed and replaced any number of times without damage taking place. Provided that components are identified as they are removed and are re-assembled accordingly, there is no reason why such a process should involve any loss of evidence.

Next in order of degree of reversibility are the dry processes involving force (stringing, quilling, etc) and processes which involve the releasing of glued joints and the re-gluing of separated solid parts (e.g. the removal of a soundboard). Old quills and strings are usually damaged in removal, and the exact mounting relationship tends to be lost. It is best to perform releasing and re-gluing operations as few times as possible, though, if carefully done they can be regarded for most purposes as reversible. The evidence which is liable to disappear as a result of this kind of process concerns the original gluing of the part and may not be of great importance.

The removal of soft parts, e.g. leather, from hard parts, e.g. wood, is often irreversible. The choice sometimes has to be made either to cut the soft part dry, leaving traces still glued in place, or to soak the glue and damage the soft part. A dry cut will usually preserve more evidence and is therefore preferable, especially if replacements can be glued on a neighbouring spot in order to avoid covering traces of the earlier work. Naturally the preservation of evidence involves the preservation of the removed pieces, and identification of their position is sometimes important.

The repair of a broken structural part in such a way that it can again take a load or force is also often irreversible (e.g. repair of a jack damper slot). Usually the part has to be cut to give a good surface for jointing to a new piece of material. Usually the loss of evidence is insignificant if the piece which is cut off is preserved. Such pieces can also be useful for microscopic botanical identification of the wood.

It can be seen from the above remarks that an alternative to repairing a broken jack by cutting off a piece (irreversible) is to make a new jack and remove and preserve the old jack (fully reversible). This raises a number of questions. Removing an old part and replacing it with a new part is something which most people associate with bad restoration. The old part used to be thrown away because it was easier to make a new one than to repair the old, a perfectly legitimate way of servicing recently-made mechanisms such a modern pianos or motor cars, but one that in past restorations has destroyed a great deal of information. The essential difference here is that the removed old part is not thrown away. But if it is separated from its position, how should we prevent it being lost? The only safe way, at least with a privately-owned instrument, is to put it in a cardboard box, label it, and fix it inside the instrument.

Chapter 2 Soundboard and Strings

If an instrument has a good natural accumulation of dirt it is a welcome sign that it is some time since anyone worked systematically on it, and it is more likely to be relatively undisturbed. Restorers tend, therefore, to be suspicious of instruments which are too clean before restoration, and also of restored instruments which look too new.

All instruments show signs of their history in their appearance, and it is no part of the restorers duty to pretend that such history has had no effect. Ordinary use, even in a careful home, is bound to leave scratches and dents over a long period and such marks do not offend anyone who likes antique furniture. If the damage sustained implies abuse or neglect then some treatment is justifiable. A piano which has severely faded on one side by exposure to the sun may be recoloured and repolished to match the unaffected side and severe dents can be filled so that the appearance is of only careful wear and tear.

Many of the typical problems of restoring pianos can be illustrated by describing the work which was necessary on a Broadwood square piano of 1817, no 20050 which I bought in Edinburgh. This had had little wear and the only recent work had been restrained and superficial. It had probably spent most of its time in a reasonably pure atmosphere and the iron strings, which had every appearance of originality except for a few obvious replacements, had little rust.

Before starting work on an instrument I always record the main details of its state of originality and preservation in a notebook. These consist of the position of non-original strings, the state of the soundboard, action etc, the parts which are missing (like music desk, dust cover, pedal or castors) and the twist of the casework. Squares always twist so that their ends are out of parallel and grands so that the cheek and spine are out of parallel, though this problem almost disappears with instruments which are braced with iron. Some grands also develop a twist in the tail. The way to measure a twist is to place a straight edge on one side, lift it at one end with a wedge until it is parallel with the other end, judged by sighting across the instrument, and then measure the effective width of the wedge. This is shown in fig. 1, and the twist can be recorded either in mm or by converting it to an angle. The twist of this piano was 12mm, with the pitch about a fourth below a′ = 440 herz. A twist of this magnitude is somewhat unsightly and calls for a wedge under the left-hand back

castor, but does not affect the playing. It increased when the pitch was raised to a' = 415 and was 17.5 mm at the end of the restoration process. Expressed as an angle, the latter value becomes only 1.6°, which looks much less alarming on paper. As work proceeds, everything should be recorded in the notebook, with diagrams where necessary, so that a restoration report or record can be written when it is complete. For important instruments a series of photographs should be taken, in order to record details which may interest later observers, even if they are unnoticed or misunderstood at the time of restoration.

The low pitch of the 1817 Broadwood before restoration made it easy to detach the strings from the bridge without touching the tuning pins. The soundboard was very dirty, so my first task was to remove all obviously non-original strings which would later need to be replaced, to detach the strings of the lowest 6 notes from their bridge pins and hook them over the bridge pins of the notes higher up. This gave access to the front of the soundboard and the bass end of the bridge, which was cleaned up to the line where it was covered by the strings. The original varnish was somewhat damaged in the front corner which is not protected by strings, but was well preserved where the strings had covered it. Most of the dirt disappeared with gentle rubbing with a plastic eraser and the remainder was removed with a tissue damped with water containing a drop of washing-up liquid. Nothing should be allowed to remain wet for more than half a minute, but sometimes a persistent patch of greasy dirt may need to be 'shampooed' by dipping an old artists brush in the liquid and twisting it on the spot, afterwards drying the patch with a cotton bud or a piece of cotton wool held in eyebrow tweezers.

When the soundboard under the displaced lowest strings had been cleaned, these strings were put back and the strings of the next 6 notes were detatched in the same way and hooked over the strings higher up. This revealed a strip of soundboard and a patch of bridge which was cleaned in the same way as previously. This process was repeated until the whole soundboard was clean. English square pianos always have a ribbon or strip of cloth laced through the strings between the bridge and the right-hand ends of the strings to stop unwanted resonances, and the ribbon on this

piano was not seriously disturbed by moving the strings in this way. This ribbon was in good condition and not unduly dirty so was left undisturbed, but if you have one that is too dirty it can be unlaced, washed, and relaced in its original position.

The iron strings of this piano were almost clean and were left as they were, but if your strings are somewhat rusty they can be cleaned with fine emery paper. The best time to do this is as each string is being lifted from its position and hooked further up the bridge as the soundboard is cleaned. The string can also be unhooked from the nut and released from the damper so that it can be cleaned up to its left-hand end, but one hand should always keep it taut so that it does not unwind on the tuning pin. If the dampers are the kind with a wooden top on a threaded wire, as on this piano, they can be unscrewed most easily by making the device shown in fig. 2 from a spring clothes-peg and a piece of fencing wire. This can be twisted in the fingers to spin the damper and unscrew it quickly. If the dampers are threaded in their correct order through holes in a piece of card they can be set aside without getting mixed.

This piano had two soundboard cracks between the left-hand edge and the bridge, both of which had started from the screws which held the thin strip which ran along the soundboard edge above the keys. The strings above the crack and a little to each side were lifted again and hooked aside on the bridge so that the crack was accessible. As shown in fig. 3, the two sides of the crack were then levelled and supported firmly by wedging a harrow temporary strip under the crack and supporting it from the base-board. This was not difficult because this part of the soundboard is accessible when the action has been removed. The edges of the crack were straight and fairly smooth, but were trimmed by sliding a thin file along each side and angling the file so that the crack became slightly wedge-shaped in section, with a slightly wider gap at the top than at the bottom. A strip of soundboard wood was then cut slightly higher than the thickness of the piano soundboard and slightly too wide all along its length to fit in the gap. It was then slightly squeezed in a metal-working vice and carefully trimmed to fit all along, resulting in a strip about 2mm wide at the left-hand end and tapering to nothing at the right. In section it was also wedge-shaped to fit the taper which had been worked on the sides of the crack. As it was trimmed it was repeatedly

using a pointed piece of softwood or a tiny brush.

tried in the crack to get a good fit. The two sides of the crack were then coated with thin water-soluble fish glue, which can be used cold, and the strip pushed into the thin end of the crack near the bridge and then pressed downwards all along and rubbed home firmly using a wooden stick with a rounded end like the bottom of a spoon.. This left the top of the strip slightly above the level of the soundboard and the excess was carefully pared away with a narrow chisel after the glue had dried. The strip was then stained and varnished to match the rest of the soundboard. The effect of the moisture in the glue tends to release the stresses introduced into the strip when it was squeezed and so tightens the strip in the crack. With a wide strip, this effect can be increased by applying a little hot water with an artists brush as soon as the strip has been pushed home, immediately following this with a dry cloth to remove any excess water.

Another way of ensuring that a soundboard crack is tightly filled is to expose the soundboard to gentle infra-red rays for about 2 hours before filling the crack. The soundboard should be masked with pieces of hardboard so that only a band about 3cms wide each side of the crack is irradiated and the soundboard should feel warm but not hot to the touch. The crack should be measured at the beginning and the heat withdrawn when the crack has widened by about 15%. This will not work, however, if there are soundbars running under the soundboard across the crack.

During all these processes the tuning pins were not moved. This is because there is likely to be a few millimetres of fatigued wire where past tuning has alternately bent the wire round the tuning pin and straightened it out as the tuning pin was twisted to and fro. This will lie where the wire meets the tuning pin. When all the cleaning processes are completed the pitch will need to be raised to a′= 415 herz or thereabouts and this will involve winding the fatigued part round the pin and turning the pin an extra ¼ or ½ turn. If the fatigued part survives this extra bending the wire will probably last indefinitely, with subsequent tuning bending and fatiguing a piece of wire 3 or 4 mm away. If, however, any strings are slackened in future so that the preciously fatigued portion is again straightened, it is likely to break. The best technique for preserving old wire is therefore to leave the pitch low, as found, until all the cleaning processes and soundboard repairs are completed and then finally to bring the pitch up to its

working level and leave it there. This usually results in a few immediate breakages, after which the strings last indefinitely. Good iron wire with a similar sound to old wire is now available (see the list of suppliers) but it adds to the interest and value of a restoration if as many old strings are preserved as is possible. Old broken covered strings are often found in place on square pianos and these can often be repaired and retained in use by a technique described in chapter . Although the bass strings of modern pianos often deteriorate after about 40 years, those open-wound strings from around 1800 usually sound as good as new copies.

The remaining cleaning processes involve the wrestplank and hitchrail. Cleaning between the tuning pins was done by a 'shampooing' process using an artist's paint brush and a weak solution of washing-up liquid in water. This was done carefully so that the original note letters of indian ink were not rubbed away. This piano fortunately did not have much rust on the tuning pins, so that this treatment left the whole wrestplank looking clean and tidy.

The hitchpins were sited in hitchrails covered with red box-cloth which needed only a little brushing with a stiff artist's brush to remove the dust.

Before replacing the missing strings the action repair was begun, because it is best to have the action working, though not necessarily in perfect adjustment, before beginning to raise the pitch. Then action adjustment and tuning can proceed together.

not necessary once action has been withdrawn

Chapter 3 Cleaning and repairing the action

The action of the 1817 Broadwood was in excellent condition, with no damage and very little wear. All the leather hinges to the hammers and under-levers were intact and nothing needed to be replaced. The action was screwed to the baseboard by screws which were exposed by removing keys 7, 8, 36, 37, 59 - 68.

When the keys of an English double action (i.e. one with under-levers which lift the hammer butts as shown in figure) are lifted at the front to remove them from their balance pins, the hammer rises and tends to jam against the strings. To prevent this happening the jack should be pulled forward using an L-shaped piece of wire so that the hammer 'escapes' and drops away from the string. This should be done every time a key is removed. The purpose of removing all the keys in the part of the action which lies under the soundboard, even though they do not all cover retaining screws, is that this part of the action has a separate frame behind the treble end of the balance rail. The complete balance rail and front rail together with the main part of the action is first removed and then the remaining part of the action for the top notes can be withdrawn. Later pianos have two independent parts to the action, each complete with balance and front rails.

The keyframes of English square pianos usually have their retaining screws in the front rail and in the balance rail. The back rail is held down by a series of wooden blocks or by nails in the back wall of the keywell, under which the back rail is wedged when it is pushed fully back. The lifting of adjacent pairs of natural keys, either notes b and c or notes e and f reveals these screws, though some of them may be under the action cloth. Eighteenth- and nineteenth-century screws have narrower slots than modern ones, so a restorer meeds to have a specially filed set of screwdrivers of various sizes with narrow blades. If an old screw does not turn easily it is probably bonded to the wood by a layer of rust. This layer can easily be broken if the screw is heated by applying a hot soldering iron. Good thermal contact is obtained if the iron has a little solder on it, and this will not usually cause trouble by sticking to the screw. It is important to apply this heat <u>before</u> you have broken the head or the shank of the screw.

When square pianos have twisted, like this one, there is sometimes a difficulty in removing the action because the keywell has distorted. In extreme cases it is advisable to plane a little wood off the keywell sides so that the action again fits easily.

do not use modern piano felt which is rather harder than woollen cloth.

Distortion sometimes tightens the nameboard and the vertical part of the lid in front of the keys. Taking shavings of wood off these parts is, of course, completely irreversible, but there is no alternative short of removing and flattening the baseboard. A moderate twist does not affect the working of a square piano and must be tolerated.

When an action is removed for the first time in a century there is a good chance of finding old pins, buttons etc which have been lost in it, and it is therefore worth sifting carefully through the accumulation of dust. This particular instrument had been repaired in 1938, so nothing of importance was found. The keys were all removed and the action cloth brushed to remove the dust which had accumulated between the layers. Unless it has been badly attacked by moths, the original woollen cloth is usually perfectly serviceable and capable of giving a quiet resilient touch. If the back touch has been compacted by the weight of the keys, resulting in excessive 'lost motion' before the hammer begins to rise, the addition of an extra thin piece of dress material is all that is usually required to bring the jacks up to the intermediate lever so that the lost motion is correct. A few stitches with a thin cotton thread at either end and in the middle will secure it to the old cloth. The balance rail was covered, in this period of English piano, with a single layer of cloth cut <u>in situ</u> into a castellated form. It is possible to tell whether this cloth is original by matching the shapes with the visible marks of the cutting knife on the wood below. It is usually possible to recognise original cloth on the front and back rails by there being no empty carpet-tack holes in the rails. The practice of tacking down action cloth rather than gluing it is a good one because glue penetrates and hardens the cloth. If original cloth needs to be replaced, a thick woollen dress material should be chosen to match the original and the best way from the historical point of view is to lift the original tacks carefully (if they are not too rusted) and attach the new cloth with the same tacks in the same holes, pressing them home with a metal G cramp rather than a hammer. A slip of thin paper should be included under the cloth and held by one of the tacks, giving the year and the restorers name and location.

The keys of old keyboard instruments are always in need of some tightening at the balance and guide points, near the middle of the compass if not also at the ends, and the most commonly found

methods are the replacement of the pins by larger ones or the cutting of knife slots beside the pins and the inserting of small wooden wedges. The first way involves discarding the original pins and should never be contemplated by any restorer. The second method is less objectionable since it does not obscure any of the original features, but it is unsightly and somewhat crude. My own method, that of applying a coating of glue to the working surfaces of the key has several advantages. It is scarcely visible, it does not alter any of the original features, it can be removed or added to as many times as necessary, and the greatest advantage of all is that it protects the treated surface from all further wear.

Any glue that dries with a fairly hard surface is suitable, and I prefer to use a cold-setting fish glue like Seccotine. This bonds well to the wood, can be built up by applying successive layers, is easy to apply with a rod or a blade and can be filed when dry to a smooth surface. The round hole at the bottom of the balance mortices should be treated first if it is loose on the balance pin. The key should lift easily off the balance pin, but should not be loose enough to fall under its own weight or move forwards and backwards if pushed when it is seated. If it is very loose the position relative to other keys should be examined so that glue can be applied more to the front or back if that is necessary to bring it back into line. If the wear is symmetrical, take a metal rod with a diameter about half that of the balance pin, apply glue to it and wipe it all round the hole. After it has dried, it should be tried on the balance pin (or a rod of equal diameter). If it is still loose, a second thin coating of glue should be applied and the fit again tried when the glue is dry. When the hole is too small to fit the balance pin it must be enlarged using a fine round tapered needle file. This should be worked in until the key slides easily down the balance pin but does not drop under its own weight. If a piece of masking tape is then placed round the file marking the limit of its insertion into the balance hole (the file being inserted from the underside of the key), the next hole can be filed to the same size without the need for trying it out several times.

Keys which are a good fit at the bottom of the balance mortice can be tested to see whether they have too much clearance at the top. There should be a just perceptible movement when the key is pressed from side to side, so that there is no measurable friction

at the top of the balance pin when the key is pressed. A thin layer of glue at one side may be sufficient, but bearing in mind that the glue protects the key from further wear, it is better to coat both sides of there is sufficient clearance. The glue coatings should be filed with a fine flat needle file until the fit is perfect.

Before tightening the front guide mortices, the keyboard should be examined to see if any twisting of the keys has taken place, causing the ivory to be inclined instead of level. If a straight edge is mounted in front of the keyboard, the front edge of the keys can be sighted across the edge and any inclined keys recognised. Usually the balance pin can be bent to left or right in order to level the key front, by removing the key and placing a piece of metal tubing over the pin as shown in fig 4. In extreme cases a key which has warped and has a bend or twist needs to be corrected by the careful application of steam. The safest way of doing this is shown in fig 5. The balance mortice is protected by being wrapped in a layer of cloth, adhesive tape etc and the key mounted in a vice or cramp, leaving room for the application of steam. A wedge is used to bend or twist the key and two marks made on the wedge showing the position in which the ~~key~~ wedge just lodges as it begins to bend the key and the position in which the key is straight. The wedge is then pushed in further so that the key is bent or twisted about half as much again past the point at which it is straight and steam from a kettle held in the hand is directed at the key. A simple shield to contain the steam is sometimes desirable, so that the steam surrounds the key. The steam should be applied for 20 - 30 seconds and then the key allowed to cool and the wedge withdrawn to see where it now just lodges. This point will probably be somewhere between the two marks. The process is repeated until the wedge just lodges at the mark showing that the key is straight.

Any keys which have a perfect fit on the balance pin and are level at the front can be treated at the front guide point in exactly the same way as at the top of the balance mortice, but having regard to the gaps on either side. Glue can be applied with a view to equalising these gaps or the guide pin can be bent a little to left or right for the same purpose, using the tubing in the same way as it was on the balance pins.