

3

RESTORATION 1

Ethical process
Sequence of operations
Global level adjust
Select colour range
Single-area level adjust
Colour fills
Pattern fills
Combinations
Filters and Variations
Layer transparency
Common errors and problems
Variations on colour select
How far to go
Unethical process

What I'm aiming for here is to create 'quick and dirty' results which give visible (if not very attractive) restorations, but enables you to see the method behind the process and expand on it yourself. When you are working on your own images you will have time to refine colour ranges, tidy up tiny areas that are unsatisfactory and generally spend as much time as you need to get your image looking exactly as you want it.

Here my priority is to restore readability: the result may not be particularly pretty, but if it is transcribable then it has met its purpose.

Ethical process

Generally, when someone sets out to restore an image to readability, they are aiming to retrieve information rather than attempt to re-create the look of the original document. However, there are some restoration specialists (e.g. Fotoscienifica in Bologna) who claim to restore documents to their original appearance, even though this is not actually possible. The work they do is extremely meticulous, and the results are spectacular (if expensive), but they are aiming for something different than the academic, who mainly wants to retrieve lost information. Their work is analogous to the furniture restorer, who makes a damaged antique piece of furniture look as if it was new, as opposed to someone who simply polishes and tidies up an old item so that it is no longer falling apart. The second type of restoration still has its distressed look, but looks aged rather than decrepit.

The sort of restoration undertaken by DIAMM is the second sort: we aim to return a document to usability, but the results are not always beautiful: principally we need to be able to retrieve the information recorded in the text.

At the outset we asked ourselves: where is the line between restoration and just enhancing the view a bit? At what point do we become editors?

The answer is that the first time you touch an image, no matter what the process, you are editing it. If the image is not an adequate representation of the original you may have had to sharpen or colour adjust, but these are editing actions. This is why we insist that the image should be as accurate as possible without any post-process activity.

Doing an 'ethical' restoration means that

- Only colours which are patently not supposed to be there should be removed;
- Only figures about which there is no question can be treated as colours to be brought forward;
- If there is a figure which you believe to be a certain shape you *must not* restore it so that your belief is confirmed. You can only use colours on shapes that are not in question, and you may find that the shape you believed is there is actually something different.

If you intend to publish a facsimile, but have decided that there is not much point in reproducing the source as it is (since it is unreadable), and you will produce a restored version, then what you publish is no longer a facsimile, it is now a photographic edition, and you *must* make it clear in what way your published images differ from the original source. Ideally publications like this should have the original and restored versions printed side-by-side.

Apart from anything else it is important to the library that their source is not misrepresented by your edition.

With damaged sources, publishing in colour gives the reader far more information than grayscale, but if cost restricts you to grayscale you may have no choice but to alter the gray images in a way that you would not have needed to do in the colour ones.

Before you start to restore it is advisable to decide how far you will go in this process. Are you simply going to try to reveal what the machine tells you is there, or are you going to 'help it along' by deciding before you restore what you expect to find? This is very easily done, and poses an ethical dilemma: your restoration may be correct in your eyes, but someone else reading the original document may disagree with the result you have achieved.

The ethical position taken in DIAMM was that any process should be applied to whole areas of a document, not single colour-artefacts that we believed to be musical notation. Attempting to 'brighten up' something that appears like a faded note form is akin to going over it with a pencil in the original source to make it look more like what we think it is. We could be right about the content, but we could just as easily be imagining that it says what we expect it to say. Where we attempt to retrieve a specific colour range we make sure that we select it from point where there is no question that what we are selecting is indeed music.

Basing research materials on digitally restored images lays your work open to criticism, and you need to decide for yourself at a very early stage how much further you will go on from global adjustments into fine detail, which is where disagreement about content will arise.

The best way to present digitally restored materials is in the electronic medium, generally online, where you are not tied to any single view as you are in print. Different layers can be presented as overlays that can be turned on and off for example. The online environment is already offering quite spectacular possibilities for digital editions, with powerful image-delivery, annotation and display facilities becoming commonplace.

Sequence of operations

The order in which you do things may not seem important, and in many cases it isn't particularly important, particularly when layer adjustments can be swapped around, but there is a simple sequence of actions that will 'clean up' an image surprisingly quickly, and may save you a lot of time painstakingly trying to separate out colours that you want to find.



Having created a series of adjustment layers, you may find that swapping the order around gives you different results.

Global level adjust

All the actions in this session will be done in layers as adjustment layers, and the first of these is a global level adjust. All the following images have been pre-cropped and saved to Photoshop format to save time.

This image is extremely dirty as it was used for binding reinforcement and was covered in glue. It has gone rather like a thick piece of greaseproof paper. It is clear that there is music on the page, but it is difficult to read. The colours are all rather similar. The image used is <Sample1.psd>



First of all I 'Save As...' into Photoshop (.psd) format, giving the file a new name. This leaves the original file untouched.	Save As... Photoshop format with new name
Since you are going to be performing processes that will change the colour, and since the scales are saved in the original file, cropping off any data that is extraneous to that which you need to work with minimizes file size and will speed up any actions you apply. The picture above has already been cropped.	 Crop (C) to optimize file size and memory usage. SAVE
The first restoration process should always be a global level adjust: this action 'spreads out' the colours in the picture so that the pale colours become paler and the dark colours become darker. Use the adjustment layer tool to add a level adjust layer: click on the bisected circle at the bottom of the layer window and	 Global level adjust creating new adjustment layer SAVE

<p>select from the menu 'Levels...'. Moving the white slider to the left makes the whole image paler, which is not terribly useful. However moving the middle (grey) slider to the left makes the mid-tones paler, and the notes can be darkened by moving the black slider to the right. Hit OK to apply.</p>	
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Select colour range

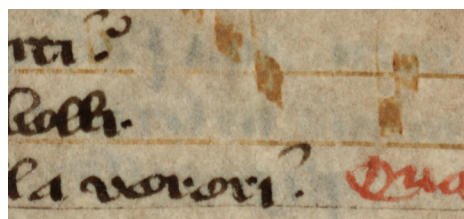
There is a certain trick to colour-selection for restoration that has nothing to do with how clever you are with Photoshop, or with Photoshop's tools and features. For those who have used Photoshop before, the techniques described here are likely to be familiar, and the question may arise: 'but I tried that, why didn't it work for me?'

The key is not in understanding Photoshop (though that helps) it is in understanding the image.

A very high-resolution image gives you a far better understanding of the document than you can obtain with anything of lesser quality, and even by looking at the original document. Although smaller images can be used for restoration, only the high-resolution makes detailed colour selection possible, and it is in accurate colour selection that almost all digital restoration takes place.

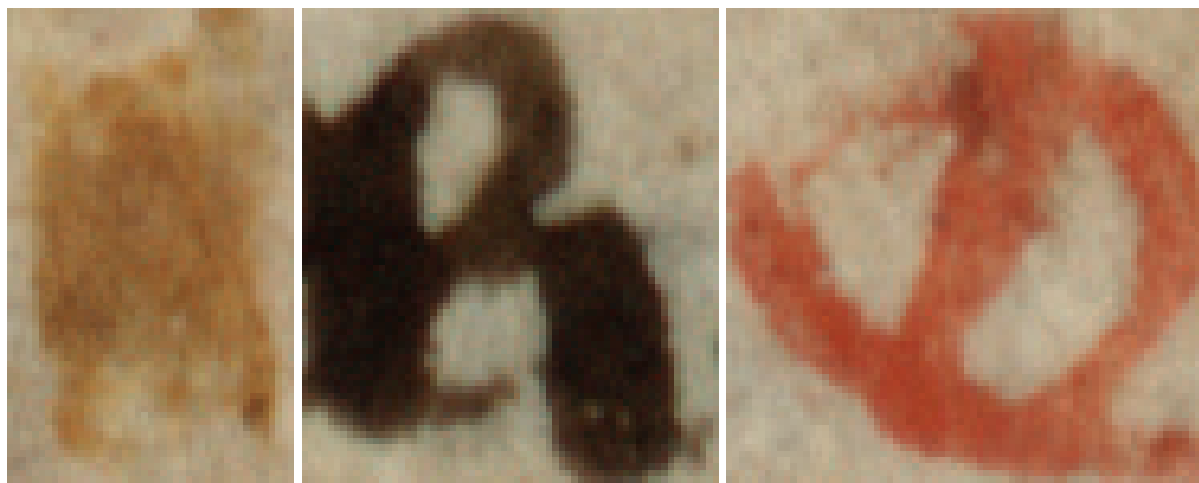
This is a close-up of a section of palimpsest. The image is slightly crooked, but I have *not* straightened it up as that causes a blurring of the fine detail. Superficially we are dealing with four colours:

- the background of the parchment;
- the original writing (pale brown);
- the overwriting (dark brown or black);
- a second colour of overwriting (red);
- You may also decide that there is a fourth colour present: the grey of show-through from the reverse of the leaf.



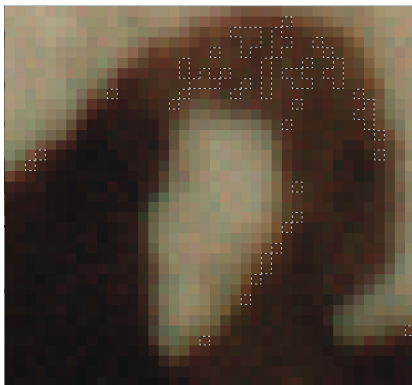
We need to get in a lot closer to see what is really going on: doing so will cause the image to break up into pixels, but that suits our purpose very well, since we can see the difference between the various pixels in the picture.

Because these are digital images, we can zoom up beyond pixel-for-pixel view:





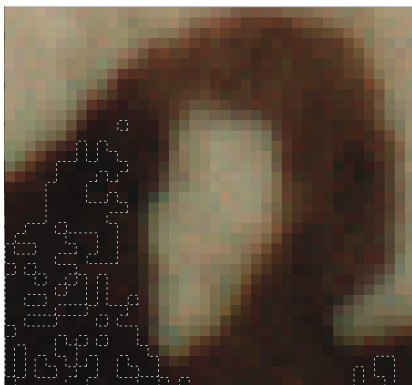
At once you should be able to see that each of these colours is breaking up into many different tones, not least in the background, which is far from being a single flat colour, regardless of any show-through; this is particularly visible with the red and pale brown writing. When you colour select with photoshop you are dealing with electronic information which is far more detailed than your eye can see. Dark brown is not *just* dark brown. In fact even one stroke of the pen has dozens, perhaps hundreds of colours in it. Using the Magic Wand does not show how many colours are available, as its range is not subtle enough, but using Select Color Range is extremely



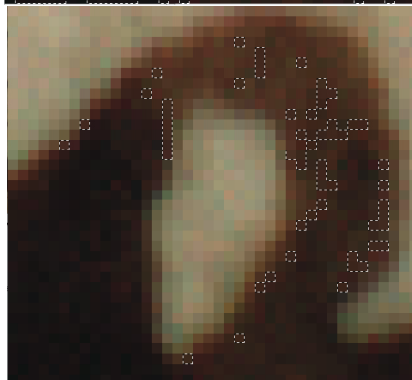
revealing, even with the fuzziness set at 20. This is why, when you select colours, the results are sometimes surprising, and occasionally disappointing. The eye does not see what is actually in the image, hence the need for many colour picks when you are selecting a specific colour, not just one or two.

This is why we never use compressed image-storage formats, as this fine gradation between colours would be lost.

Various colour selections collect only a few pixels, even with a high degree of fuzziness.




Adding a number of selections based on the main part of the letter stroke together, and then replacing those colours with a pattern based on the background shows why, when ink colours are selected and removed, the edges very often remain:




In the next example, a global level-adjust has little useful effect, so I have moved directly on to a colour-range selection to pick up the colour of the music notes and darken them.

The image used is <Sample2.psd>.



<p>The simplest way to select the note colour is to zoom up to 200% view. The image must be magnified to do this, as you need to be able to select specific pixels.</p>	 Zoom to 200% view (Z)
<p>Go to the 'Select Color Range' tool. Set the fuzziness to 20 in the first instance. Use the pointer to select pixels within the note shapes on the image behind the dialog box.</p> <p>It is unlikely that a single colour selection will collect enough pixels for the notes, so keep clicking around on the same note, checking the dialog box preview each time to make sure you haven't selected the wrong colour pixels. You can undo a single selection by using Ctrl/Cmd-Z, but only one.</p> <p>You may get better results by selecting colours in several places on the image. Don't forget also to select the edge colour, as ink bleed is usually paler than the body colour</p>	<p>Menu: Select > Color Range...</p> <p>Set fuzziness to 20, select note colours on image.</p> <p>Pan around image for range of colours, including edge-colours.</p> <p>Ctrl/Cmd-Z to undo a selection that looks wrong.</p>
<p>You will need to balance the note-colours that you select against the fuzziness to get the right colour range. When you think you have an optimum selection, hit OK.</p>	<p>Try altering fuzziness to get a more accurate selection range.</p> <p>hit OK to select.</p>

There will be a short wait while the software finds the colours and creates a selection. This appears as a dotted active line surrounding the selection. At high magnification you can see whether this has been an effective selection or not, but don't give up on it: zoom out before deciding to discard what you have chosen. Assuming the selection is good, we need to darken it up to make these notes more readable:

<p>Create a new level adjustment layer (as above). To make the dark tones in this selection darker, move the leftmost black slider to the right until the image looks how you want it. Clicking in the 'preview' checkbox in this dialog box will show you the image with and without the adjustment you have just done without actually applying it. Hit OK to apply. SAVE your work.</p>	 Create new level adjustment layer to darken note shapes. SAVE YOUR WORK
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Single-area level adjust

In this image the problems are similar to those in Image 1, but I know that a global level adjust won't work on the whole image because of the heavy staining in patches. This staining was almost certainly caused by the use of oak galls in a physical restoration process several years ago. Galls darken up faded ink, but at the time they were in common use conservators didn't realise what it would do to the surface a few years down the line.


The image is <Sample3.psd>; this image is also referred to in Chapter 4.




As in the first image, the first process to try is a global level adjust, adding an adjustment layer. The results on the unstained parts of the page are good.

 Global level adjust creating new adjustment layer
SAVE YOUR WORK

The division between the stain and the rest of the page is very clear, so the magnetic lasso is the ideal tool for selecting out the bits of the image that are going to require further work. Once an area is selected any new layer created will only affect the selected portions. Create the selection of the top stain using the magnetic lasso, then add to the selection using **shift** to select the lower stain.

 Create a shape selection using the magnetic lasso tool.

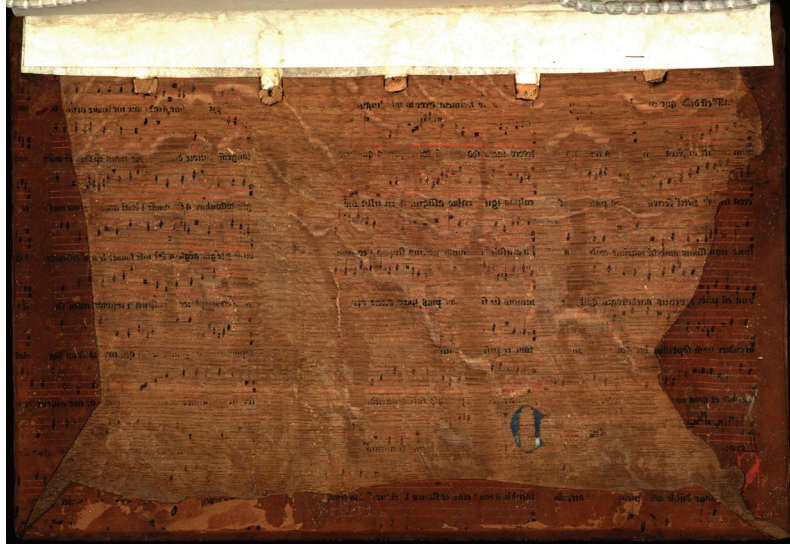
Once again go to the level adjust tool. This time, because we've already performed a level adjust on the image, the histogram shows gaps in the colours, but it has values right across the spectrum now. A second level adjust may sort this out...

 Level adjust on specific colours

If that is not enough, then the next step is to look at the stained areas more closely and try selecting specific colours to brighten or darken (in this case it may be best to select the background dark colour and make it paler: see variations on colour select, below).

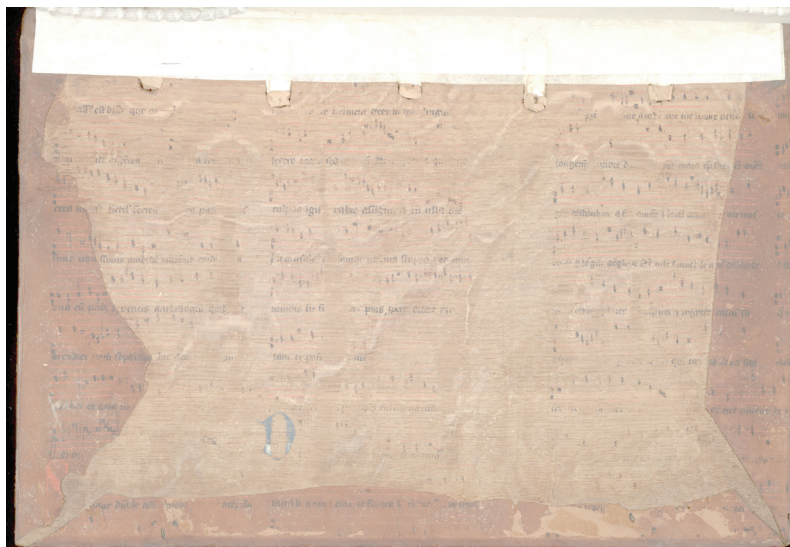
Another example where this type of restoration is very effective is in offsets onto wood. In the example below the offset is all that remains of the original paste-down, which was discarded during rebinding. The whole image is very dark, and there is some difficulty in distinguishing between wood grain and ink offset.

The image used is <Sample4.psd>



Because this is an offset it is a mirror image, so the first action is to flip it to the right way around. This is in the same menu as rotating, but is a different function. Menu: Image > Rotate Canvas > Flip Canvas Horizontal.

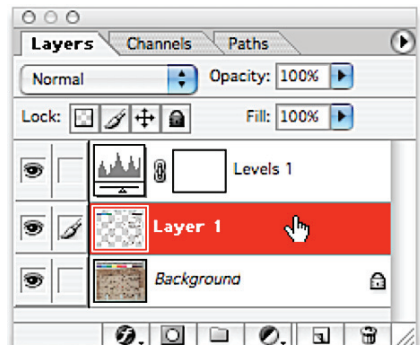
A global level adjust is reasonably helpful, but the point of doing it on this image is to fade back the dark background colour as much as possible. To avoid making the result a garish yellow colour use the white slider a small amount, but make a greater adjustment using the gray slider. Don't worry about making the music notation pale as well as the background for the moment.



Because the music notation was already dark, it's unnecessary to darken it further, however we don't want it as pale as the background is now. Turn off the level adjustment layer you have just made by clicking on the icon of the eye beside that layer. The eye disappears and the level adjust is no longer visible



Turn off the level adjustment layer visibility

<p>Now zoom in to see the music notation clearly. Use the 'Select Color Range' tool to select the black of the ink. Remember to balance between fuzziness and number of individual colours selected. Once you are happy with your selection range, hit OK.</p>	<p>Select > Color Range... to select black ink of notes.</p>
<p>Instead of creating a level adjustment layer, this selection will be used to create a new layer altogether. Copy the contents of your selection, the Paste immediately. Doing this automatically creates a new layer containing the contents of your selection range. It is placed exactly on top of the selection area, so is not obvious yet. On the Layer list you will see a new layer between the background and the level adjustment layer.</p>	<p>menu: Edit > Copy or Ctrl/Cmd-C menu: Edit > Paste or Ctrl/Cmd-V</p>
<p>At the moment, when you return the level adjustment layer to readability by clicking where the Eye icon should be it will affect everything beneath it the same. Move the new layer that you created until it is above the adjustment layer. Click-and-hold anywhere in the layer title box, and drag the layer to the new position (your cursor turns to a hand). Immediately the notes are visible as they are not affected by the level adjustment (which is now below), so they remain dark against the paler background of the main image.</p>	

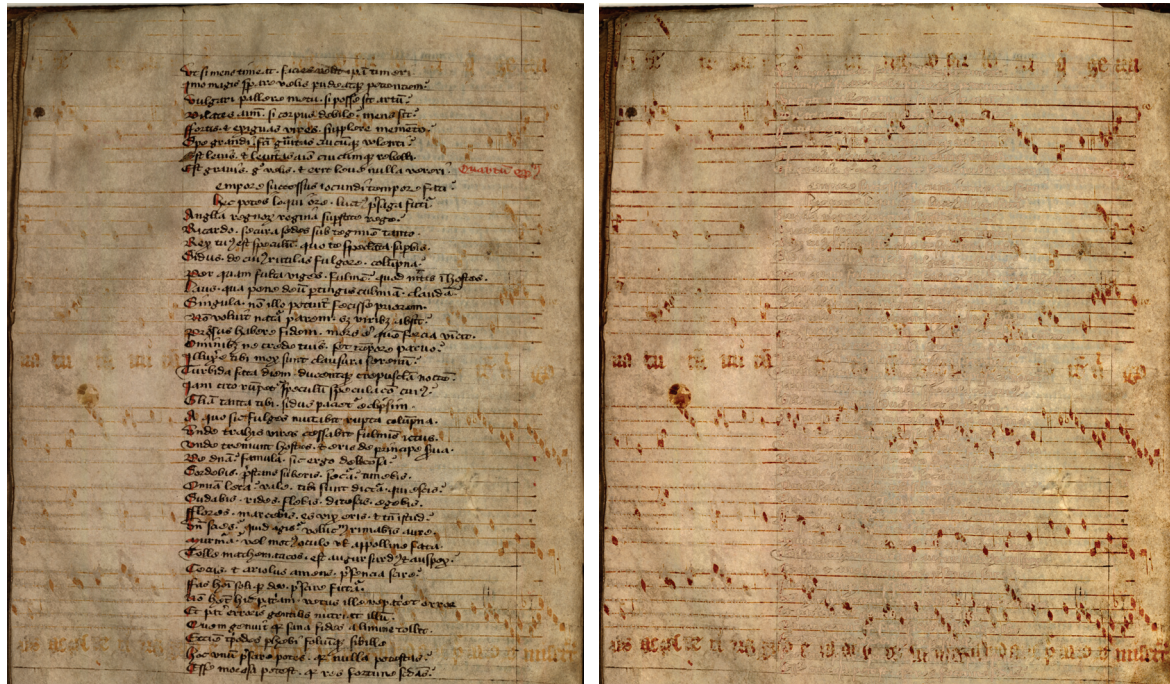
Repeat the process for the red stave lines and blue initials separately, and the result is a much more readable record of the inks left behind on the board.




Colour fills

This technique is mostly done when removing dirt or palimpsest over-writing.

This is what I would call an easy restoration sample because the two texts are visibly different colours. This technique is the same that would be applied on text deletions, but the closer in time between the original writing and the deletion, the more difficult it becomes to separate the colours. The image is <Sample5.psd>.




The first action is always to see if a simple level adjust will clarify what is on the page.

 Add level adjustment layer

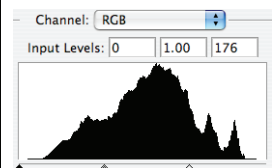
The over-writing is quite varied in colour, particularly the edges of the words where the ink has bled, and selecting it will require quite careful balance between fuzziness and number of colours selected. It may be necessary to create two or more select colour ranges and treat them separately. Enlarging the view higher than 200% will assist in the process of selecting very specific colours.

Select > Color Range... to select black ink of text. Menu:

Once you have a selection first of all try applying a level-adjust layer just to that selection. This is done just the same way as applying a global level adjust, but as you have pixels selected it will only act on the selection.


 Add level adjustment layer

When the white slider is moved to the left, to make the notes paler, they tend to go bright yellow. This is because the colour selected (in this case) is too dark. The level adjust alteration will not give you the desired result. You can abandon this adjustment and go back to your selection simply by clicking on cancel (keystroke **Esc**). The dialog box disappears, and you see your selection again.



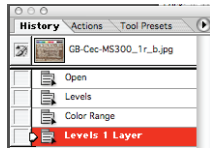

Level Adjust histogram

Instead try selecting 'Solid Color...' from the adjustment layer menu. You can choose a colour in the colour dialog box by clicking in the main part of the box, the colour gradient panel to the right, or by entering specific numbers in the RGB or CMYK value boxes. However the most effective way of finding the right colour is to click on the background colour in the image. The colour selection box will change with each click, and you can see whether you have the 'right' colour to create a masking colour fill because the effect is previewed in the display.

 Add solid colour layer; click on the image to find an appropriate colour

One important aspect of what you will see by clicking on the background is that it is made up from a huge number of

SAVE

component colours. We are used to assuming that the background is a single colour, but even with the eye you can see that across the leaf the overall colour ranges very widely. You may need to click-select on the background many times before you find a colour that works – the best places to try are in the middle of the leaf, between the lines of text that you want to disappear. When you find a colour you like, click OK.	
If you are happy with the result that is good. However, if you think that it has left a ghost of the original text behind, you may need to expand and feather the original selection. Use the History to go back to your 'Select Color Range' selection – you can click back and forth to find the place you want.	 History
Now go to menu: Select > Modify > Expand... and type '2' into the pixels box and click OK. Your selection will expand noticeably.	Select > Modify > Expand... 2
To feather the expansion you just created, go to menu: Select > Feather... and type '2' also into the pixel box and click OK.	Select > Feather... 2
Now go through the same steps as above to create a colour fill layer.	 Create colour fill layer



If you accidentally lose your selection remember that you can get it back by stepping backward in your History.



Pattern fills

The image is <Sample6.psd>. Colour fills are a quick and easy way to deal with something that you want to hide or merge into the background. It works best with small shapes, like the tight secretary hand on the previous sample.

However there are some images where the thing you want to hide is very large – perhaps a large stain or, as in the case of the next sample, overwriting that is very large and obtrusive. The best way of hiding large areas is to select the colour and then do a level adjust to fade the colour back. However, particularly with dark colours, this is often not satisfactory, as the colour gets brighter rather than lighter, and with colours that cover a

wide spectrum a single level adjust on the whole thing will not work. In an example like the one below, a pattern fill is almost certainly going to be more effective, although the background colour is perhaps too variable for an ideal solution.

In this case a single colour fill could work, but the result of having such a large area of solid plain colour may be almost as distracting as the original text was.

It would probably be more effective (if slower) to create a pattern fill based on the background of the document: so instead of finding a single colour among all those that go to make up the background, you are able to take a much broader selection and create a more generalized fill pattern.

To create a pattern fill you need to duplicate the background layer, as this is where the pattern will be created. Having done that, go to menu: **Filter > Pattern Maker...** This shows you a preview of your background image. Find a clear area of parchment without any writing or obvious marks on it. Preferably from the centre of the document, or close to the text that you want to obscure (in this case the large title hand, as this area will be best for hiding the over-writing. Point and drag diagonally to create an approximately square selection. It does not have to be very large. Click on **Generate**. Then at the bottom left of the tools on the right hand side of this window, click on the (tiny) disc icon to save the selection as a pattern. Click **OK**.

Filter > Pattern Maker...;

Select area;

Click on **Generate**

Click disc icon to save as a pattern

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You can create a pattern before or after you have created your colour range selection. You will not lose the selection by duplicating the background layer and using the 'Pattern Maker' tool.

When that window disappears you will find that your new layer (a repeating pattern) is obscuring everything else. Just turn it off, or discard it. Now you create a colour pick selection as you would normally (as above). Once you have your selection (you may have to create several different selections as the large text covers a broad spectrum of colours), go to the adjustment layer tool and select **Pattern...** from the top group of options. On the patterns palette that pops up the pattern you just created will automatically be selected.

Select > Color Range... to create a colour selection;



Select **Pattern...**

from adjustment layer menu

Combinations.

On an image like <Sample7.psd> you may have to create a number of selections and pattern-fill each one individually in order to get the desired result. This image is graded 'Medium' not because it is particularly difficult, but because it requires patience and meticulous colour selection.

This image has some interesting problems, mainly due to the accretion of different colours of dirt across the surface, coupled with some fading, and the fact that the music is both darker (in the middle) *and* lighter (at bottom right) than the background colour of the parchment.

A global level-adjust is not very helpful here as it creaes a pink cast and does not really clean up the dirt: this is because the range of colours in the dirt and in the notation is so broad, so any blanket adjustment will improve some parts of the document but disimprove others.

In this case the first process is going to involve a colour-range selection, and the most obvious one to go for is the red ink. If you zoom in to 100% (click on the 'Actual Pixels' button on the tool menu-bar) on the cluster of red notes near the top of the page this will give you some idea of what you are going to have to do to make this document readable:



The red notes are straightforward. However the brown notes and the stave lines going horizontally across the page are more interesting. Parchment is a fascinating medium because the ink tends to sit on the surface rather than soaking in. Obviously it does soak into the skin to some extent or we would not be able to retrieve palimpsests, but the majority of it remains stuck to the surface because it is slightly greasy. This behaviour is of course what made it easy for writing to be scraped off and the surface re-used.



In this small sample you can see that the notes range in colour from dark brown, where the ink has survived best, through dark to pale yellowish where it has worn off, down through pinkish to very pale pink where the ink has been rubbed off altogether. The very pale

effect is where the ink has protected the parchment from dirt, but has finally chipped away.

This image is also a good example of poor focus. At 100% magnification you can see that the edges of the colours are slightly soft. A feature of parchment photography is that it is possible to get an extremely sharply focussed picture (assuming the parchment is flat) because the edges of the ink do not bleed as they do on paper. A perfectly focussed image of writing on paper may look soft because of the ink bleed, even though it is possible to see the paper fibres clearly.

Although this image isn't sharp, the colours are sufficiently defined that you should be able to create a useful colour selection.

Using the 'Select Color Range' tool, select all the reds on the page. Remember to zoom in on the picture before choosing 'Select Color Range'. The red is quite easily selected (the smaller the white dots on the preview, the better your selection range), but make sure that you have sampled ink from right across the document: the ink at the bottom of the page is much pinker than that at the top, which is darker and more intense. Use the selection preview options to make sure you have chosen all the colours that appear in the notes.

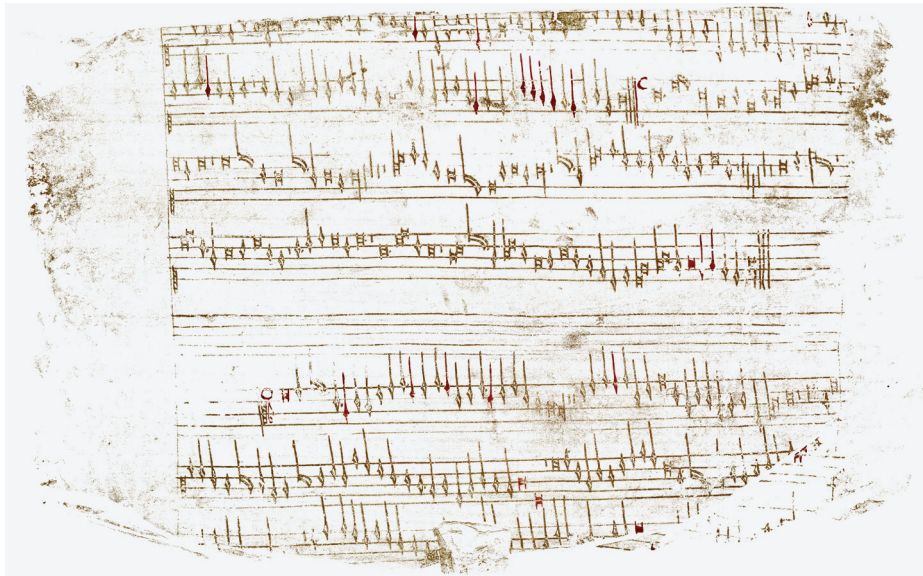



Zoom in to high magnification;


Select > Color Range...: reds across whole page

<p>Since this colour is not faded, there is no need to darken it up. What we want to do is save it so that any other colour adjustments do not affect it. Once you are happy with your selection create a new layer with the red ink only using copy and paste. The new layer appears in the layers menu. You can turn off the background to see the results of your cut-and-paste.</p>	<p>Copy and paste reds, creating a new layer SAVE</p>
<p>The note colours, because of their range, may require several different selections. Because of the overall colour of the document (pinkish rather than grey or yellow) the yellow tones in the notes are probably going to be the most productive colour to select. In the Color Range dialog remember that a tiny portion of white in the preview is probably a good selection, whereas a great deal of white may result in too much material selected.</p> <p>Because the tones across the document are quite similar, keep the fuzziness low (around 10-12), and go for many colour picks.</p>	<p>Select > Color Range...: brown notes (concentrating on yellows);</p> <p>Keep fuzziness low and create a large number of colour picks</p>
<p>As a 'safety' measure I'm going to create a new layer with this selection in it by cutting and pasting. You can name your layers by double-clicking on the layer title name. Now I want to return to the previous selection and try expanding or smoothing it to see if it gives me a clearer selection of the notes.</p>	<p>Copy and paste this selection to create a new layer; SAVE</p>


If the background is made invisible so that only these two pasted layers show, you can see what has been saved. It's quite possible that this type of view would be acceptable as a restoration for some users, since it achieves the goal of readability.



<p>To get back to a colour select that you have used on a colour range previously, without stepping back in the history (in which case you would lose all the interim actions), click on the background layer and then Ctrl/Cmd-click on the layer where you created a selection. The previous selection will reappear.</p>	<p>Return to previous selection: select background, Ctrl/Cmd-click on selection layer</p>
<p>Expanding the selection by 1 pixel picks up a lot of extra detail in the notes that were not caught on the original selection. However when I zoom out to check the whole image it seems also to have picked up a good deal of the edge dirt, which is not desirable. I</p>	<p> Zoom out to check effects of expanding selection range;</p>

can keep it, and go back afterwards to blank out the dirt perhaps with a pattern fill, but it may be better to go back to my original selection and try a different expansion, or just work with the original selection.	Use history to step back if this is not satisfactory
Using History to step back to the original selection, try Smoothing instead. Although this doesn't pick up some missing note colours, it is a better adjustment as it does not find the dirt at the edges.	Try smoothing instead;
A level adjustment layer on this selection doesn't make the notes very much darker and there are specific patches where the pinky note residue has not been found by the previous colour selection, and I will have to select those notes in a later selection. For now though, this is an improvement.	 Apply a level adjustment layer to darken the notes
I'm going to go back to this note colour selection as it seems a useful one: re-select it using the Ctrl/Cmd-click facility. What I'm interested in now is what was NOT selected by this previous selection – in other words the dirty background.	Re-select note colour selection

Because the background is made up from many colours including black and all the way through to pale pinkish-brown, selecting it would probably take many different colour-select actions. By inverting the selection I made to find the brown notes, I will select everything that is not music, i.e. the whole background.

To make this inverted selection use keystroke Cmd-shift-I or menu: Select > Inverse . This will also select the red notes, which were not included in the brown-note selection, but that doesn't matter, as we have saved the original colours of these notes in the first layer created, and putting this layer above all the other adjustment layers will ensure the red notes appear in their unadjusted form.	Invert the note-colour selection using Cmd-shift-I or menu: Select > Inverse
Applying a level adjustment layer seems to make the document go much pinker (probably a deficiency in the colour settings of the original capture), so rather than adjusting the colours individually in the level-adjust drop-down menu, which is difficult and requires quite a lot of tweaking, in this case I'm going to use the 'curves' adjustment layer (on the same menu as levels), which allows a much subtler colour adjustment. This will be described more in Chapter 4. Curves is a different way of looking at colour levels from the histogram on the level adjust. Here the colours are 'described' as a diagonal line, and there is no indication where the colour is concentrated as in the histogram. The top right corresponds to the white slider, the bottom left to the black slider. There is no corresponding point for the grey slider, but you can create adjustment anchor points by clicking on the line; all these points can be moved. I will create an adjustment point in the middle of the line and drag it just a small amount towards the top left corner, which makes the mid-tones in the picture paler. Working with curves or level adjust creates a more pleasing result visually, as colour or pattern fills don't work well across a surface that is so varied in base colour.	 Apply a curves adjustment layer to fade out the background colours Click to create adjustment point on the line, and drag towards upper left corner slightly
All that remains is to colour-select the notes that were not picked up in the first note colour select and darken them. Creating a level	Select > Color Range... for pale

adjust layer will do this, but in this case a more effective solution is to cut and paste the note colours selected in this process (creating a new layer), and changing the layer action from 'Normal' to 'Multiply'. Layer actions will be discussed further in Chapter 4.

notes; create new layer using cut-and-paste; Move layer above curves adjustment layer; change action to 'multiply'

The result is a great improvement, and makes the text perfectly readable. I could further refine my restoration by colour-selecting more of the dark background dirt and fading it out, but actually what has been done already is really sufficient to create a readable result.



If you like what an action has done on part of your image, but not on the rest, you can select and delete the parts of the layer you don't like *as long as you have the layer in question selected*, but only on certain types of adjustment layer (those created by prior colour selection or other selection range)

Filters and Variations

There is a tendency in image restoration to get bogged down in details. If you feel you are in danger of losing sight of your goal, or becoming frustrated by the results you are getting, try something completely off the wall and see what you get. The results can be very surprising, and often very effective.

Filters cannot be added to the image in layers like adjustment layers, so in order to apply a filter that you can turn on and off you first need to duplicate the background layer. The filter is applied to the duplicated layer. Filters are found in the 'Filter' menu.



Unfortunately once a filter is applied to a layer it cannot be edited or the settings changed. The only way to do this would be to create another duplicate of the background layer and re-apply the filter with different settings.

An unsharp mask heightens edge contrast, which can brighten up faded letters on a dirty page. The degree of mask should be checked both with the image at high and low magnification, as what looks good in one view may look terrible in another. A very small

unsharp mask will just add punch to a picture when printed, as it compensates for ink bleed. However over-sharpening makes a picture become grainy as shown in Chapter 1.

Also, using a low-resolution copy of your image to save processing time, try the following filters on duplicates of the background layer, for unusual effects that often heighten readability in unexpected ways:

Filter > Stylize > emboss creates a 3-D effect based on colour intensity

Filter > Stylize > find edges

Filter > Other > minimum ('fattens' all the dark-coloured pixels on the image)

Filter > Render > Lighting Effects (to create a raking light effect)

Filter > Other > High pass

Layer transparency

A layer does not need to affect those layers beneath it at 'full power'. A layer can be made more or less opaque using the transparency option at the top right of the layer window. The number in the box can be changed from 100% by typing a new number into the box, or by using the slider which is accessed from the drop-down menu icon just beside the percentage box.

Turning the picture into a negative of itself with an adjustment layer ('invert') is often extremely revealing, as dark data becomes light and vice versa. The change in what this does to your eye and what it sees often makes previously unreadable material readable, and can be used in conjunction with other layers or adjustments to get an optimum result. Mostly though, this is used to rest the eye and brain and look for information that might be enhanced in less dramatic ways for other users to see.



Another way of dealing with material with very little contrast is to create a duplicate of the background layer, change the overlay effect to 'Difference' and then shift the top image by one pixel left or right and one pixel up or down using the Move Tool (keystroke **V**) and the cursor keys. The filter effect will give a black image when exactly overlaid on the original, but when shifted creates a highlight where there is a difference between the colours in the two layers, effectively finding the edges of all the dark/light components of the image. Again, this is probably not a result for the finished restoration, but could give you valuable information.

If an adjustment layer looks too dramatic to be of any use, try changing the opacity to fade it back before discarding it altogether.

Overlay modes are dealt with in more detail in Chapter 4

Common errors and problems

The commonest error in attempting to create colour selections is to start the selection process without having the background layer selected. You may want the selection result to appear higher up the list of layers, but you can always move and adjust it after you have created it.

Poor colour selections which take up too many or too few pixels are usually the result of a) incorrect balance between the number of colours selected and the fuzziness (or Tolerance if using the Magic Wand Tool).

The more you work with Photoshop images, the more your actions fill up the memory buffer. If you go too far without saving you will receive an error message when you do try to save, telling you that there is not enough memory to complete the operation. All the actions between your last save and this point will be lost. **SAVE SAVE SAVE.**

Losing the mouse

Not as strange as it sounds! With the tools set to precise cursors the mouse pointer can disappear all too easily on a surface that is complex or predominantly pale colours. A quick way to make it more visible is to hold down the **Ctrl/Cmd** key and the cursor will change to a pointer enabling you to locate it.

Variations on colour select

In the example of a very dirty document above I dealt with the background by selecting the note colours, and then inverting that selection to create a selection based on the full background area.

However, if the notes themselves had been more difficult to pick out, it is sometimes easier to create a colour selection based on the colours that you do not want (e.g. the background colours) and then either fade these colours back, or invert the selection and darken what remains. Fading the background is one of the more effective techniques for water stained documents.



Simply making the text you want to read darker creates an improvement immediately, but you can create a more dramatic, and often more readable result by making the same colour select, but replacing the colours you have selected with another, completely different, colour. This is because darkening text nevertheless keeps it in the same colour spectrum as everything else on the page. Replacing the text colour with red, blue, mauve or green lifts it away from its background quite differently, and is often far more striking and thus readable. In the example below (which was originally palimpsest) the two images have had exactly the

same colour range selected, but in the second I have used a replacement colour rather than a level-adjust darkening, as in the first picture.

How far to go

Any painter will tell you that a large portion of the skill they exercise is in knowing when to stop. If you are working with a large batch of images you may be forced to stop. Once you can read it, that's far enough. However, some actions will improve one part of the document, but disimprove other parts, and you may want to create a sequence of restorations, not just one, and use them all side by side.

Digital restoration is analogous to furniture restoration: you can over-restore quite easily. It is not necessary to remove all traces of dirt, nor is it necessary to make faded ink black: only do as much as you need to do to read the text.

Remember that digital restoration is an editorial practice, and must be described as such in any presentation of restored images, not matter how 'accurate' the results are believed to be.

Unethical Process

This may seem a strange heading, but there are processes possible in Photoshop which create superb results on the most severely damaged documents but, in my opinion, are unethical as restoration procedures. It might be more appropriate to describe this as 'Editorial Process; rather than 'Unethical Process', but it is important when using this tool to keep in mind all the time that you are falsifying data.

One of the most difficult types of damage to restore is burn-through of ink, most often found in paper sources from the late 15th and early 16th centuries. In the example below some parts of the text are very clearly show-through and can be eliminated with a clear conscience. However, other damage, where the front and reverse writing coincide, requires a decision about what note-shape has been lost so that a copy can be superimposed.

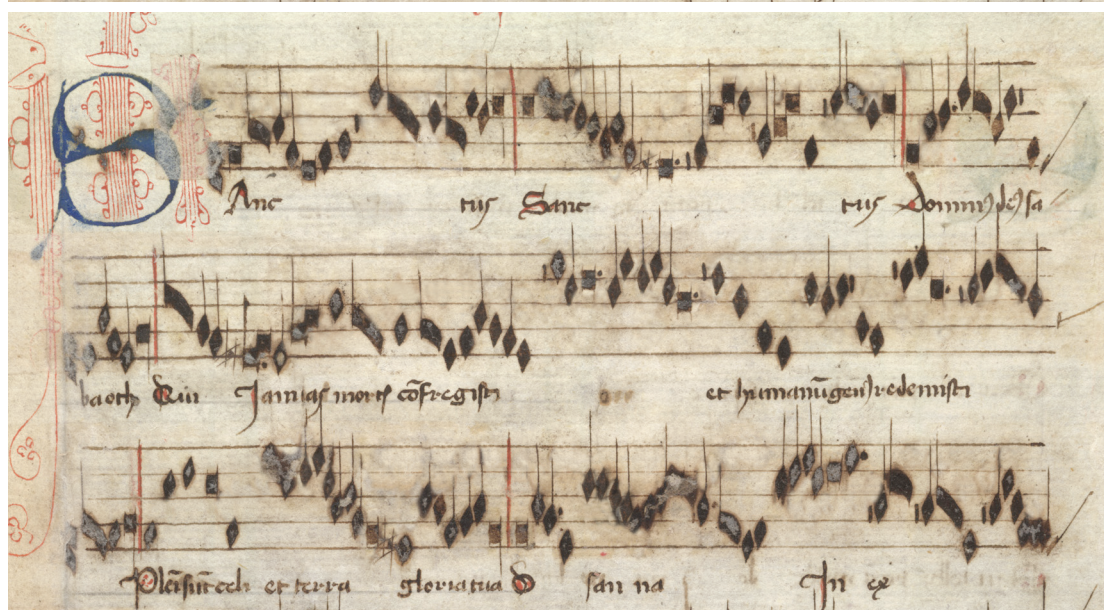


The tool used in this process is the Clone Stamp Tool on the Tools palette (keystroke S). This tool allows you to instantly cut and paste sections of a document onto itself without going through the process of selecting, feathering, cutting and pasting.

You click on a point from where you want to clone, which is your anchor point, by **Opt-click/Alt-click**. Then release the key and wherever you click and drag on the page, the material from the anchor point will be copied.

On the Tools Options Bar you will see a drop-down menu where you can specify what size of brush to use and whether it has hard or soft edges, an airbrush option, and whether the cloning should read from all layers or not. If you create your cloned material in a new layer it can be switched on and off.

In the example below it was generally clear where text was show-through, either from the colour or because of the duct of the hand (slant), and it was simple to delete this where it did not coincide with the surface text. In some places I knew what should be there, but had to clone it from less damaged notes, and there are definitely some possibilities for being wrong in these areas. Where I was really not sure what I was seeing, I simply did nothing, leaving the final decision to the editor of the music, who can work much more easily on these few awkward corners if all the obvious problems have been eliminated in advance.



Once you have a cleaned-up version of one side of the leaf, it would be possible to flip it and superimpose on the reverse as an aid to eliminating the burn-through on the other side. However that would require that both images are the same size and at exactly the same rotation. Even if this were not the case, the tools available in photoshop would enable you to correct one image to match the other.