**Scales and Artefacts**

In this post I'll explain how I've tried to make size scales look better when photographing things. These scales can often look good enough without changing anything, and this saves a lot of time. Sometimes though, they can look distorted for a number of reasons: the surface material mightn't photograph very well, or it might reflect too much light. In some cases, the markings might have faded over time, or the original markings themselves may not be easy to see when the image has been resized at a later date. On a very technical level, it's possible the camera lens also adds distortion across the image as a whole. With a scale bar covering a large proportion of the image width/height, the exact divisions across a scale might not be represented digitally as equally as in the original scene, and these distance irregularities will also affect the representation of the artefact being photographed (to varying extents). The exact characteristics will depend on the lens and overall camera setup, and I've not experienced an issue so far (although I've not been able to make a side-by-side comparison using expertly calibrated photogrammetry equipment either). Without veering into the depths of photogrammetry, it is possible to recover an acceptable scale from a photographed one with some basic photo editing. I've made a few assumptions:

1) The finished scale bar needs to be reasonably accurate. Nobody is going to use a photographed scale as an absolute final measurement source, but there's no point adding a scale if it's not useful;

2) they should look clear.

The picture below shows a printed scale bar that has been scanned. The depicted scale was accurate in its original context, with each red square equating to 1cm^2. It was scanned at 400dpi:
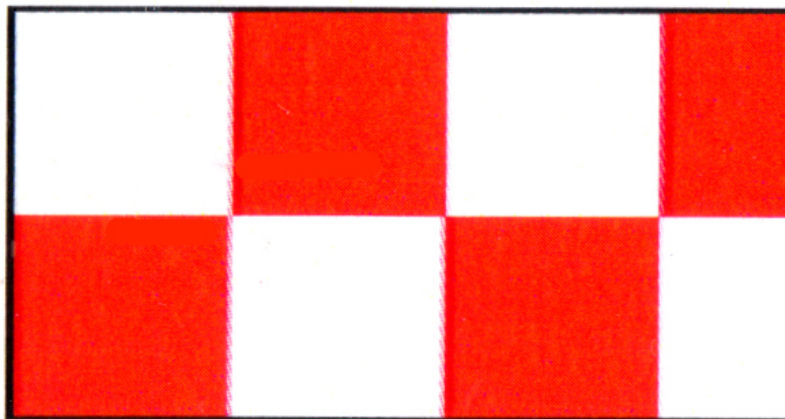
Above: *the original scale bar.*

Typically, any dimensional changes made to the scale bar should also be applied to the artefact, in order to maintain the overall scale relationship. The procedure I describe below makes no changes to the total scale as such, it merely corrects errors in the digital

representation of it. The scale bar shown previously is adequate for usage in the field. It's accurate, is printed on stout card, and also shares my tastes in food, political opinions and seating preferences. For digital representation though, I'd prefer something neater.

Ideally, there'd be a computer program/formula that draws alternately coloured squares, runs on every version of every operating system, and is free. In the absence of this (or knowledge thereof), I've taken to drawing squares in a picture editing program called the GIMP.

The procedure

I start by copying the scale I want to replace into a new image, and saving it. On top of a square in this scale, I draw a new colour-filled square which is about the same size as the one beneath it. I copied this square and pasted it into a new image, which should be the same physical dimensions as the scale I want to replace. I then align the square to the lower left of the image, like this:
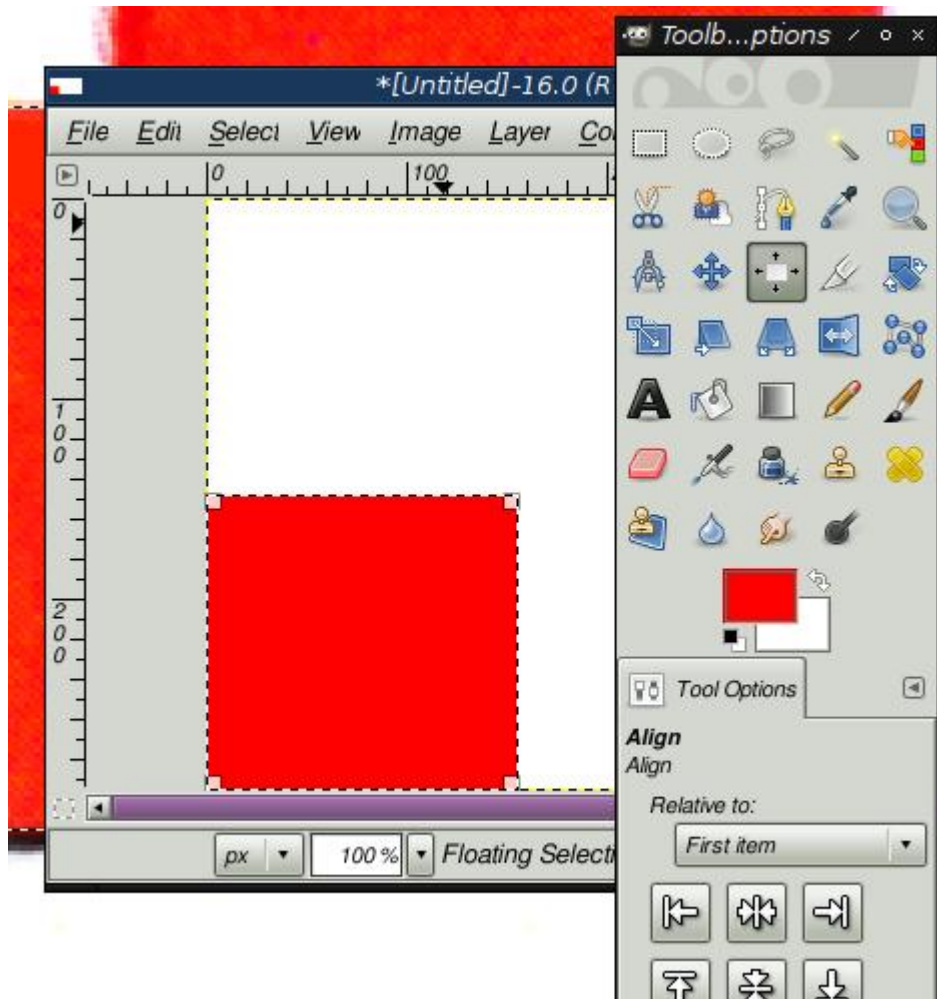
Above: *Square aligned to lower left.*

I then paste the square into the image again, and align it to the lower left, again. Then I move it, pixel-by-pixel, to the right until it is exactly next to the original square in the lower left.

Then I move it upwards, so it's diagonally above the first square. I use the zoom tool to make sure the square is in exactly the right place. It looks like this:
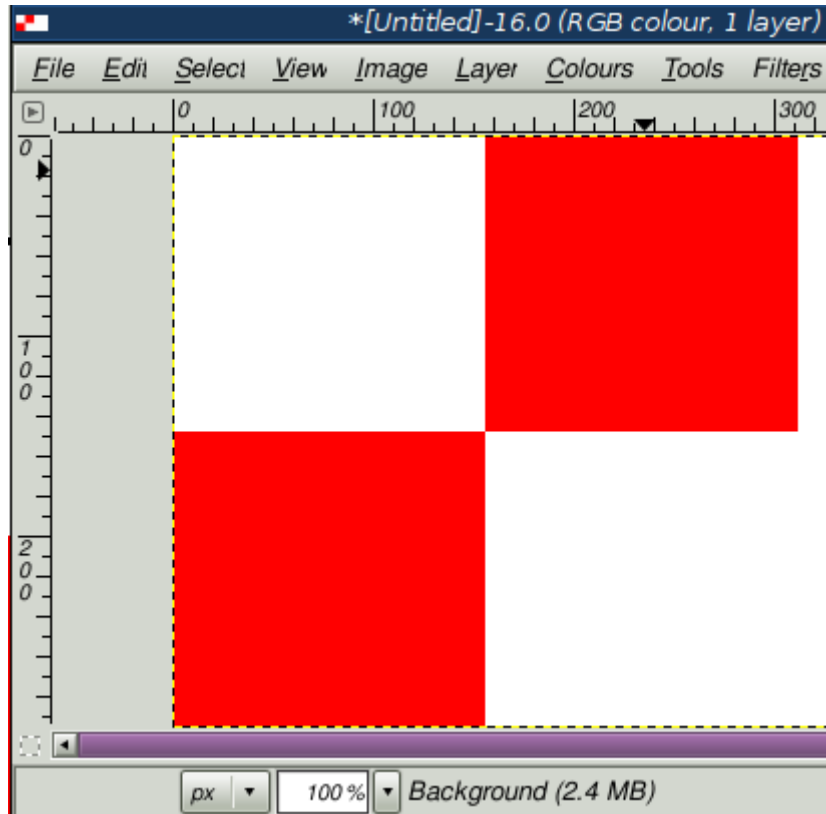
Above: *The first pair of squares*.

This pair of squares can now be copied to make the next pair, and so on. I copied these until I had the right length for the scale I needed to replace (20cm).

This next step is quite important because as the new scale length increases, so does any discrepancy between the length of the new scale and the length of the one it replaces. It's important now to find out just how much of a discrepancy there is, and to correct it. I pasted my finished scale into an image above the original scanned scale, and the difference can be seen:

Above: *The compounding error in accuracy*.

In the image above, the upper red squares (well.. *quadrilaterals*) make up the new scale. The lower ones are the original, as scanned. The new scale works out about 3mm longer, which now needs to be reduced to match the length of the original. There are different ways to do this but in my experience using the Resize tool introduces reduction artefacts into the final image, and there doesn't seem to be a way of avoiding this in the version of the GIMP I'm using here. The solution is two-fold: First, I need to find out *how many pixels* longer the new scale is, and then reduce the size by that amount. I can find out approximately what the

difference is by zooming in and making a selection between the end of the smaller scale and the end of the newer one:
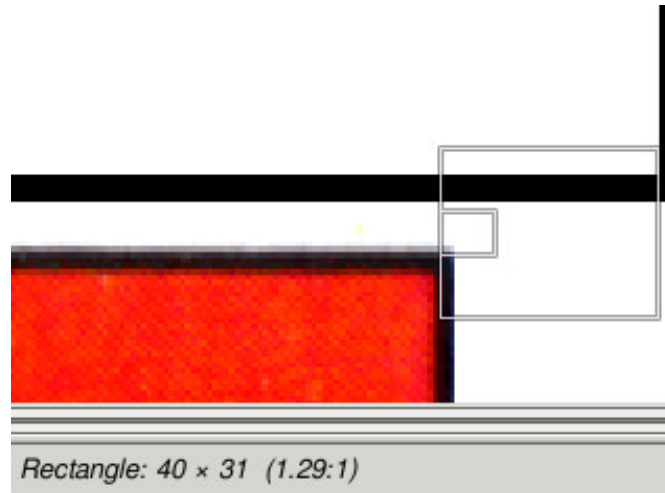
Above: *The selection length is 40 pixels.*

The difference doesn't need to be precise, because the total difference only equates to about 3mm. The important thing is that the horizontal figure is equally divisible between the number of squares in the new scale. This is so that all squares can be resized equally, and there will be no aliasing. Instead of using the Resize tool, I went back to my image containing the new scale and used the Scale tool (Image → Scale Image). This tool gives the option of resizing without any interpolation of any kind, although it's important to select no interpolation as it isn't the default setting. Normally this would make for a very pixelated resize, but this is now exactly what I want. In this case, I take the width of the new scale and reduce the size by 40 pixels. The original width is 3720px, minus 40 equals 3680. I reduce the image both horizontally and vertically as I want to maintain the shape of the squares, although this might not always be the case. The dialogue box for this is below:
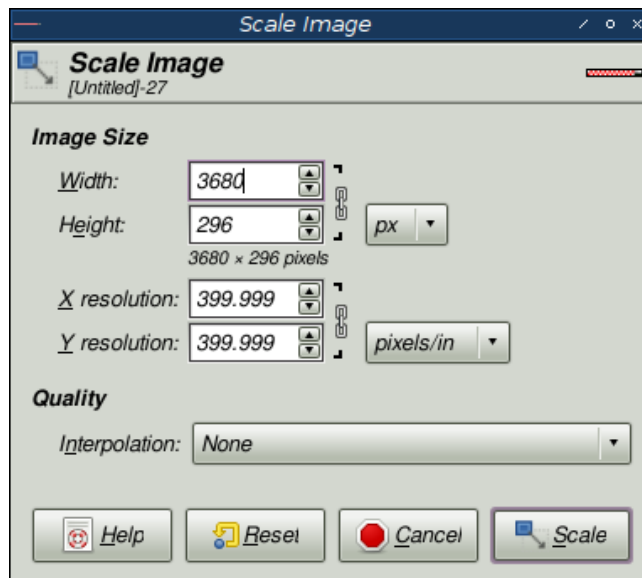

Above: *Scale Image dialogue box.*

The newly resized scale can be aligned above the original one again, showing an improved level of accuracy. The red shapes on top are from the new scale, the red shapes beneath them are from the old scanned one:

Above: *Comparison showing the new, re-scaled scale (top red shapes) and the original (lower red shapes).*

Below is a closer comparison of the two scales. The upper set of diagonal squares is the new scale, the lower set is the original scan:
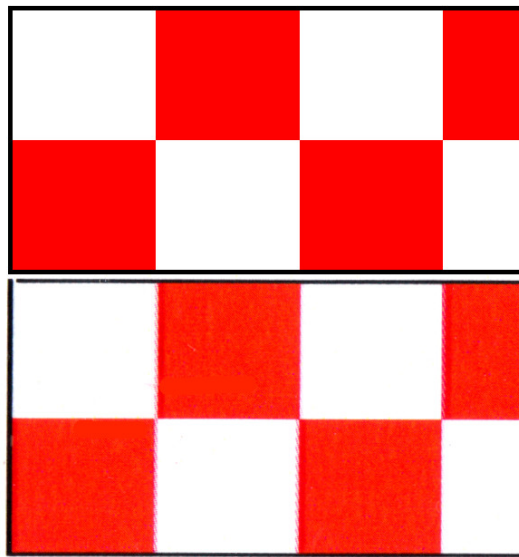
Above: *Comparison showing the new scale (top double layer) and original (bottom double layer).*

The new scale isn't perfect, but it's good enough. There is still a very minor difference in length toward the right edge but it's barely noticeable at the centimetre level, and shouldn't affect any sensible interpretation of the objects with which it is included. The procedure is suitable for recreating scales present in artefact photography with no realistic degradation in accuracy.

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