Reshaping Euler
A collaboration with Hermann Zapf

It is no secret that over the last few years Hermann Zapf has been reshaping some of his designs, most notably Palatino and Optima. Some three years ago, when Volker and Hans were talking to Hermann, they discovered he would like to improve the Euler fonts as well. These fonts were developed a few decades ago using the technology of those days, in close cooperation between Don Knuth and Hermann Zapf.

The glyphs were drawn on paper about 6cm height and these drawings were digitized using pinpoints on paper with a raster. The resulting points were translated to Metafont and some additional math shapes were added afterwards. Later, when the fonts became popular with TEXies, virtual fonts were created using Euler and AMS Math fonts.

The resulting bitmap fonts were fine for the bitmap-oriented TEX backends of those days. Later, when bitmaps became outdated, the bitmaps became outlines, and the artifacts introduced in the digitization became somewhat more prominent especially when the fonts were scaled).

The reasons why Hermann wanted to reshape Euler were manifold. First, he wanted to improve some details related to drawing with a broad pen. Then, the slope as well as the descenders of some glyphs needed to be adapted. The strokes had to be made more consistent too. Finally, the characters that were not Euler (but had been added afterwards) had to be redrawn: first the core characters, later (in principle) all characters that TEXies use. This last effort is still on the agenda and part of making Euler Unicode compliant.

When we met Hermann on a subsequent occasion, the topic of reshaping Euler came up again, and we decided to go ahead with an active project. Taco was willing to join in and we decided to improve the fonts by just editing the Type 1 fonts.

Because the project would take more than a year (at that time Hermann was still working at Linotype on his other projects), we decided to make this redesign into a present for Don Knuth's 70th birthday. At that point the old Euler was 25 years old.

The following graphics display some of the changes. Some are more prominent than others. Even small corrections help improve the overall look and feel because they influence our perception of black on white. (It may help to have a magnifier at hand.)

In figure 1 we take a first look at some of the reshaping. The gray area is the bounding box, the white shape is the new font, the outline is the old one.
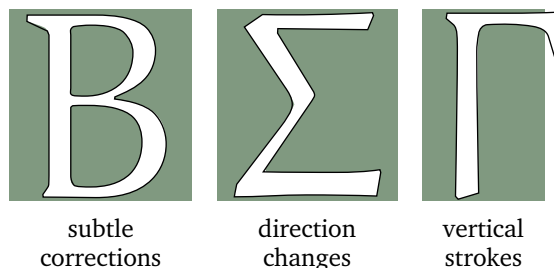

| subtle corrections | direction changes | vertical strokes |

Figure 1. New Euler Roman Medium (a)

In figure 2 we see more drastic changes: shortened strokes. The bounding box is kept unchanged since we made it an initial goal for the new shapes to work well with the existing metric files; that way, New Euler would be a drop-in replacement for the existing fonts and could be used with no fear of changing line breaks.
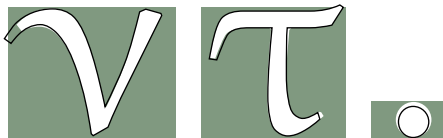

Figure 2. New Euler Roman Medium (b)

As with Palatino Nova and Optima Nova, Hermann did not hesitate to go even further than this. Figure 3 demonstrates this clearly. A nice side effect of harmonizing the font is that we can now use Euler for running text, although the text font is not yet released (due to too many holes in the usual text encoding vectors).

Figure 3.   New Euler Roman Medium (c)

Some of the changes result directly from looking at the fonts in a larger size (see figure 4). The redesign started by printing the outlines of the fonts at sizes up to 12cm but finally Hermann decided to focus on the 6cm variant. The corrected outlines were mailed, faxed and/or presented in person. Many such corrections concerned the way corners are cut off. In that respect some of the original characters didn't qualify as Euler at all, for instance $<$ symbols, but by cutting some corners and adapting the strokes they became eulerized.
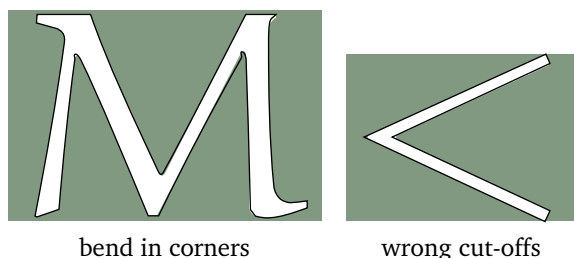

bend in corners   wrong cut-offs

Figure 4.   New Euler Roman Medium (d)

When the discussions about reshaping started, the changes mostly concerned small corrections and descenders, but once we had the proper work-cycle in place Hermann went a bit further. Of course the descenders have been lowered too, as is demonstrated in Figure 5.

Figure 5.   New Euler Roman Medium (e)

As usual, TeX math fonts have interesting ways of combining characters in fonts and so we have old style

digits in the Fraktur font. The elegance of New Euler is well demonstrated by these numerals (see figure 6).
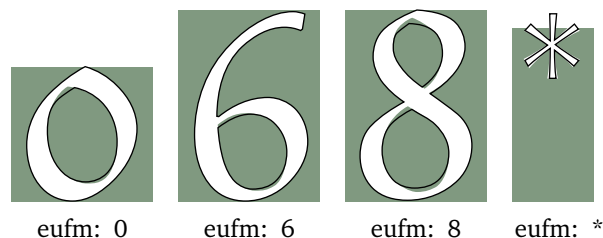

eufm: 0   eufm: 6   eufm: 8   eufm: *

Figure 6.   New Euler Fraktur Medium

Most characters have been changed, some much more than others. In the symbol font, the aleph now better matches the rest (it was rather fat) and the script L is less upright (see figure 7).
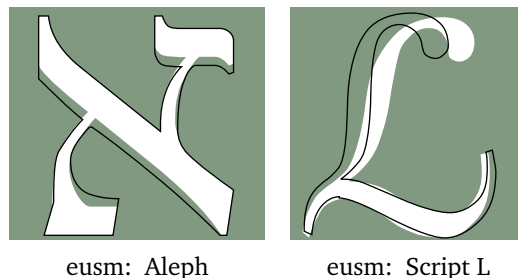

eusm: Aleph   eusm: Script L

Figure 7.   New Euler Symbol Medium

As intended, New Euler is metric compatible with Old Euler, and of course the smaller sizes and the bold variants have been adapted too. By the end of 2007 all the medium variants at 10pt were done, and Taco had to go into overdrive. We were quite lucky that he has mastered FontForge so well (figure ??), and so we could start 2008 with a complete set of fonts.

The fonts were presented to Don Knuth on January 10, 2008 on an eight-page leporello hand-made by Willy Egger, with each page showing one of the aspects of the reshaping, all of which kept us pretty busy during the holidays (figure 8).

Does the project end here? No, this is just the first stage. Hermann is willing to participate in extending the Euler fonts with the Unicode math characters that make sense.

An important aspect of the project is to get the old fonts replaced by the new ones. We're very happy that Barbara Beeton has managed to convince the AMS folks to accept the new font as a formal substitute for the existing ones. And of course, the TeX distribution wizard Karl Berry will take care of getting the fonts in the right places and rooting out traces of old ones.

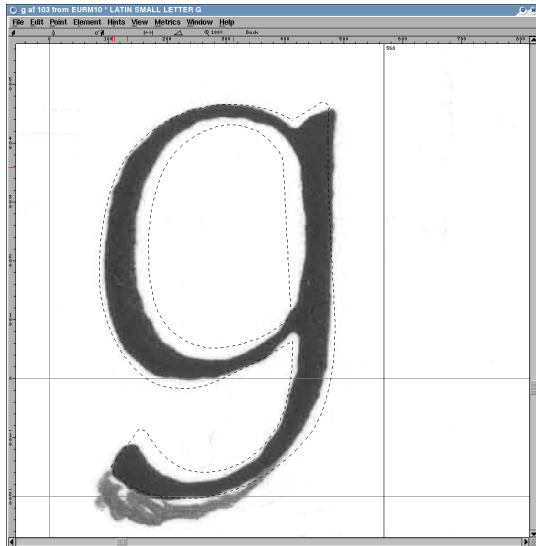**Figure 8.** Presenting New Euler

Figure 9. Editing Euler in FontForge

For quite some time Don Knuth has been asking users to get rid of the old Computer Modern delta, so in closing let's quote him from his web site on behalf of Hermann:

> If you see that your system produces the symbol δ instead of δ for the Greek lowercase delta, you should tell your system administrator immediately to upgrade your obsolete version of the Euler fonts.

And don't tell us that you don't see the difference. And, as you may expect, this quote was typeset in Euler Text.

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