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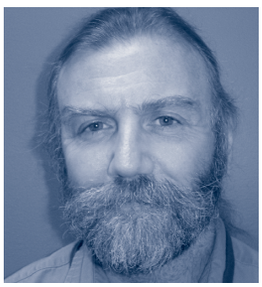
The Microsoft ClearType Font Collection

www.microsoft.com/typography/ctfonts

Microsoft ClearType and Advanced Reading Technologies Group

INTRODUCTION

Type for the new age of Digital Reading



BILL HILL
Bill Hill is Director of Microsoft Advanced Reading Technologies, in Redmond, Washington.

We tend to take reading for granted, since we learn how to do it at about five years of age, and we continue to use the same basic technique for our whole lives – no one ever asked us to upgrade to Reading Version 2.0...

Yet it's a core human competency. Most of us use it every day of our lives. It's hard to imagine a world without it.

It's a magical technology; the closest humans have come so far to inventing telepathy. Consider how it works. I have a thought. I make some dirty marks on a piece of shredded tree, send them to you, and you get my thought – even if I'm five thousand miles away. And my thoughts stay available to you for more than a thousand years.

Most people outside the world of design and layout of text don't realize just how complex is the work involved in creating the text that we read every day. But ask anyone in the field of text composition and font design what they do, and they will happily go on for hours, or days. Many books have been written over the years on the deep intricacies of type.

Writing systems first appeared 5500 years ago in the Fertile Crescent of Mesopotamia – modern-day Iraq. But 550 years ago, a new technology invented in Mainz by the German goldsmith and metallurgist Johannes Gutenberg began a revolution that changed the world. All of our modern economic prosperity, science, and technologies are built on the foundation of widespread literacy and education which Gutenberg's technology enabled.

Now a new and even bigger revolution is occurring. Reading – which in the West has been almost exclusively paper-based – is being done more and more on the computer screen. We're still in the early days of this revolution, but it's now unstoppable. We have spent 550 years learning how best to put dirty marks on shredded trees. Now we're learning how to take reading into the new digital age.

The Microsoft® Corporation has continually set new standards for readability of text on the screen, ever since the core fonts in Windows® 3.1 established a new quality bar back in the early 1990s. I had the good fortune in 1994 to be asked to come and run the group called Microsoft Typography which had done that stunning work. Since then, we have focused on improving text on the screen and ushering in the new age of Digital Reading.

When the World Wide Web began to really take off in 1995, we began a project with renowned type designer Matthew Carter to create new fonts for the screen which were expressly designed for reading large amounts of text. Matthew designed two faces, which were then hinted for the screen by Tom Rickner and others at the Monotype Corporation, and our in-house typographers, Michael Duggan and Geraldine Wade. The sans serif face Matthew created was Verdana, which shipped first with Microsoft Internet Explorer, then Microsoft Windows, and is now a standard for readability on the Web.

In 1998, Microsoft began a research project on electronic books. It will be some years yet before there's any real business there. But the interesting point about electronic books is that to make them feasible at all you have to display text on screen that people can read comfortably for hours at a time. It sets a whole new bar for quality.

As research over many years has proved, you can't just make type bigger to solve the problems. We read using an area of the human retina called the fovea, which is only about 0.2mm across, and has an arc of vision of only 1.5 degrees. So readability needs type for body text that's no smaller than 9 points, and no larger than 13 points. The challenges for displaying type at this size on screens with resolutions of around 100 pixels per inch are enormous.

In the drive to solve the resolution problem for e-books, Bert Keely and I invented ClearType®—a very neat trick to increase the resolution of screen hardware using software alone. Microsoft currently has some 24 patents on ClearType granted by the US Patent Office, and ClearType now ships with every copy of Microsoft Windows XP, and Microsoft Office 2003.

In the course of the work on electronic books, we created a new group at Microsoft called Advanced Reading Technologies. Most of the key people involved in the original core fonts project are part of this team. Our mission is simple: *Research and develop innovative technologies which improve reading on the screen for Microsoft customers worldwide.*

Reading on the screen has become important enough to the company that Bill Gates has made improving it one of his personal "Top 5" priorities, because we all know that the paper

documents we've used for centuries are transitioning to the new digital medium. Electronic mail and the web are leading the way; business documents are following close behind. Textbooks, magazines, newspapers—everything that's printed on paper today—will eventually follow. Books won't disappear. But why should our children have to lug 35-pound backpacks to school when they could carry every book they need from kindergarten to college in a single device weighing less than two pounds?

The great thing about focusing on the electronic book problem is that books are the extreme case of reading. Solve the problems of making them readable, and you solve the problems of any text.

In the course of our work on ClearType and creating new typefaces for electronic books, we realized that the unique knowledge we have could be used to design new typefaces which took advantage of the way ClearType works.

We are committed to excellence. So it was obvious that if we wanted to create new ClearType-optimized typefaces, we should work with the best designers in the world. We asked type designers to submit draft designs to be judged competitively; we commissioned complete designs and then built computer fonts using the highest-quality technology we had—ClearType has evolved a great deal since we invented it in 1998.

The new Western fonts in this book are the result of that project.

We are also highly committed to the word "worldwide" in our mission statement. All of the many problems involved in displaying Latin-based text on a computer screen pale into insignificance when compared with the difficulties of displaying the complex written form of languages like Japanese, with their tens of thousands of characters, at the sizes at which people need to read.

We decided to take on this challenge, and recruited a world-class team of external partners. Japanese type expert Eiichi Kono worked with us to define the large character set, and to help us develop technologies to overcome the major problem of not having enough pixels available to show all the strokes in many kanji characters. We asked Matthew Carter to work with us again, so we could produce the Latin characters (romaji) used

in Japanese, designing these to harmonize with the kanji and kana glyphs. The Agfa Monotype Corporation again provided top-quality hinters.

The new Japanese font was named Meiryo™. The projects to create both it and the Western fonts were personally reviewed and approved by Bill Gates before work began. At first, he didn't believe the Japanese project was even possible with today's technology, or that a major readability improvement could be made in anything like the timeframe and cost we suggested. He's convinced now...

So I'd like to thank Bill for his interest and support over the years, and his faith in letting us proceed with this exciting project.

How well did we do? Judge the results for yourselves from this booklet. But to truly gauge the progress we've made, judge them when you see them on a PC or TabletPC running the next major version of Microsoft Windows.

Bill Hill

ClearType: *a new standard for reading on the screen*

Microsoft's ClearType and Advanced Reading Technologies team are on a mission: to make reading on-screen easier for everyone who uses Microsoft products.

ClearType is a vehicle for making that happen: a technology for improving the on-screen look of a font, especially at small sizes, through direct control of the red, green, and blue (RGB) elements of each pixel. The whole purpose of ClearType is to make reading text on a screen – on today's computer screen, not some future screen with much higher resolution – an enjoyable and practical experience, rather than a chore.

Technology: what was possible until now

Type on-screen is limited by the resolution of the screen: the number of pixels per inch. No matter how delicate and subtle the outline shapes of individual characters may be in a digital font, when they're being rendered on-screen at small sizes (the sizes we generally use for text), they have to be mapped to a fairly crude grid of pixels. The number of pixels that are available to represent the full height of the type body (pixels per em, or 'ppem') at a nominal point size is determined by the resolution of the screen and the total height of the body expressed in font units, *i.e.* the unit of measurement of the Cartesian grid on which the glyph outline is plotted. So, for example, a TrueType font with a typical font unit height of 2048, scaled to 12 point size on a 96 pixels-per-inch screen, will have a total height of 16 pixels to represent all vertical features of the design. This is barely enough to be legible, let alone render the details that give the typeface its personality.

The techniques that have been used until recently to improve the look of type on-screen involved "hinting" – instructions in the font that distort the outline at specific sizes to turn pixels on or off in order to produce a legible letterform – or "anti-aliasing," which uses the different shades of gray available for each pixel to create an illusion of better resolution. Grayscale anti-aliasing makes type look smoother, but blurs the outline and reduces contrast, both of which impede readability.

The pinnacle of readability using these techniques for the screen was the fonts Verdana® and Georgia®, developed by Matthew Carter and hinted by Tom Rickner for Microsoft,

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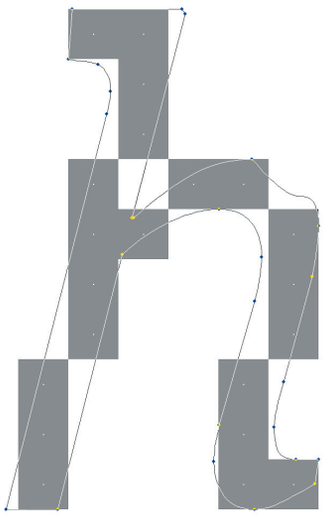
12pt and 24pt Georgia, as rendered without ClearType on a 133ppi screen and enlarged to the same size. At the smaller size, black and white rendering is used in order to maximize contrast; at larger sizes grayscale anti-aliasing is applied to make the type smoother, but notice how the contrast of thin strokes is lost.



Before ClearType: hinting of an italic letter at small size in Matthew Carter's typeface Georgia, designed for reading in black & white at low-resolution. Note how the outline is distorted by the hint instructions in order to turn on or off specific pixels.

which were designed specifically to be read on-screen. Rather than drawing an elegant outline and then rendering it in crude pixels, Carter carefully designed a bitmap for each text size first, then designed the outlines around that. These fonts were made to provide the best on-screen typography for the typical hardware of the day, including grayscale computer screens.

On a color screen, there's a third possibility, since each pixel is made up of red, green, and blue light in varying intensities. On an LCD screen, which is what most new computers now have, the square pixel is divided into three vertical stripes (subpixels): one for red, one for green, and one for blue. ClearType addresses each of these stripes independently of the other two, and uses patented filtering techniques to avoid unwanted color effects. This subpixel rendering effectively triples the horizontal resolution of type on screen.

ClearType font-rendering is designed to work on LCD screens running the Windows operating system. An early version of ClearType was built into the Windows XP operating system so that, when ClearType is enabled, Windows XP users get the benefits of ClearType technology whether they are aware of it or not. The current version of ClearType, which takes advantage of a technique called "subpixel positioning" (*see pages 13 and 14*), is built into the newest version of Windows, and the ClearType Font Collection is shipped as an integral part of the operating system.

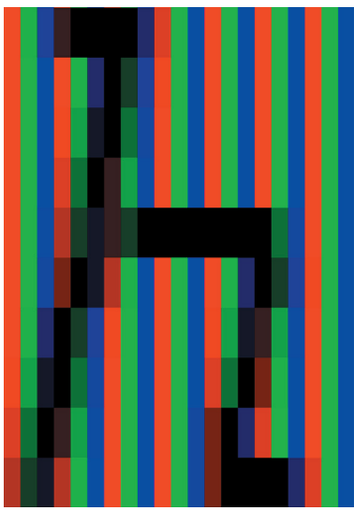
Problems & solutions

Because of the limits of a rigid pixel grid at small type sizes, the most difficult characters to render well are those with curves and diagonal strokes – which means especially the italics. Many of the very first examples shown of early ClearType technology were of italic letters, because these were the ones that caused the most problems in traditional screen rendering. Even with grayscale hinting and anti-aliasing, it was often impossible to match the true angle of italic type, and diagonal forms tended to blur and lose contrast.

The effective tripling of x-direction (horizontal) resolution in ClearType subpixel rendering allows much greater fidelity to the true angle of italic type, and ClearType's patented color-filtering

This technology, and the fonts developed for it, will improve the visual readability, clarity, and legibility of type on screen, and set new standards again.

JEREMY TANKARD



ClearType: the new Constantia italic typeface, rendered at the same size as the Georgia example on page 8, showing how subpixel rendering produces smoother diagonal stems. A purely screen technology, ClearType is notoriously difficult to demonstrate in print. On screen, of course, the brightest red, green, and blue stripes would be seen as white at normal viewing distances, while the shaded subpixels would be perceived as shades of gray.

techniques maintain high contrast and so enable comfortable reading. The ClearType Font Collection is designed to avoid troublesome shapes wherever possible, and then fine-tuned specifically to take advantage of subpixel rendering. The result is remarkably sharp and readable type on-screen.

Rendering details on the screen

ClearType is designed for what's sometimes called extended or immersive reading – that is, the ordinary experience of sitting down and reading something for a while. Anyone can design a typeface that you might read a few words in, on-screen or elsewhere, but the readability of text has been the subject of intense study by typographers for centuries. The new challenges of making text readable on a computer screen, where the light is projected into the reader's eyes (rather than reflecting off the surface of a piece of paper), is given the same kind of consideration today. When the job is done right, the reader never even notices.

Most typefaces for extended reading have serifs and, although debate continues about *how* serifs benefit reading, numerous studies indicate that serif type is preferred by most readers. However, rendering serifs successfully on-screen is difficult: without the help of sophisticated hinting technologies, the fine serifs end up as big, thick slabs, which are more distracting than useful for reading. The "sweet spot" for rendering serifs, according to type programmers, is about 115–145 pixels per inch – well within the range that's being developed currently for new screens, but finer than the majority of available computer screens today. For much smaller screens, such as those on a handheld computer, sans-serif type is often easier to read.

Through experimentation, the ClearType team found that there are several characteristics that work especially well with ClearType rendering and hinting – triangular serifs, for example, or a somewhat horizontal approach to the lower bowl of a two-storey g. In developing the ClearType Font Collection, they worked closely with the individual designers to enhance their original designs so that the knowledge of ClearType and ClearType hinting would augment the final shapes.

A 5% difference in reading speed means that we're giving people three minutes back from every hour they spend reading

KEVIN LARSON

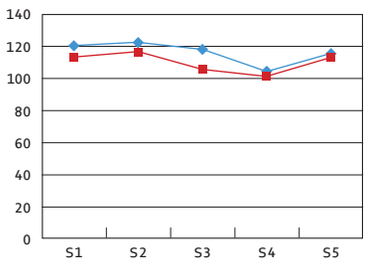
Readability: how do we really read?

People who engage in detailed technical discussions of type and legibility routinely refer to "saccades" and "parafoveal vision"—words that are not exactly part of everyday vocabulary, even among type designers. The essence of these discussions is that practical modern studies have exploded a number of received notions about how we read. The "shape" that we see is not the outline of the word, or even the outlines of individual letters, but the outsides *and* insides of each letter, taken together, as well as the more complex shape that they make up in juxtaposition. (This is why Helvetica **o** and Bodoni **o** register in our brains as different shapes, even though the shapes of their outer boundaries are almost the same.)

When it comes to ClearType, which depends on color manipulation in the pixels, different readers' sensitivity to color becomes an important factor. So does their response to fuzziness or clarity in the outlines of characters. Not everyone responds to these factors the same way. But in experiments that compared user performance on both a "normal" screen display (without ClearType rendering) and a ClearType display, the researchers found that, on average, readers read and perform common tasks more quickly when they were reading ClearType. Since the purpose of ClearType is precisely to improve the reading experience, these results are welcome news.

There is an ever-growing collection of ClearType reading research, but Microsoft's readability researcher Kevin Larson cites several recent studies from Prof. Andrew Dillon at the University of Texas as most relevant to the usefulness of the new ClearType fonts. "In these studies," Larson says, "Dillon and associates ask study participants to read text and find information in a tabular document; and they find that people are reliably faster at both tasks when ClearType is turned on." The most recent study is described in a report called "Visual Search and Reading Tasks Using ClearType and Regular Screen Displays: Two Experiments."

In the first experiment, Dillon and his colleagues asked 25 participants to scan a series of spreadsheets for target information. They found that "ClearType can improve performance in visually intensive scanning tasks." Scanning with



Graph representing results of Dillon's second experiment, showing average reading times for each of five screens of text, in seconds as indicated on the left. The blue diamonds represent reading times for black & white bitmap text, the red squares represent the consistently faster reading times for text rendered with ClearType.

ClearType was on average 7.2% faster than with normal displays. In the second experiment, they asked another 26 participants to read two articles for meaning. "Reading speed was significantly faster for ClearType," the report concludes. Reading ClearType was, on average, slightly more than 5.6% faster than reading without ClearType. "In both experiments no differences in accuracy of performance or visual fatigue scores were observed."

Five or six percent may not seem a lot, but as Larson points out, in extended reading this has a substantial cumulative effect: "Telephony companies used to get excited when they made an improvement that could shave a second off an average call in their call center because, cumulatively, that meant millions of dollars of savings per year. A 5% difference in reading speed means that we're giving people three minutes back from every hour they spend reading. When you calculate the worth of people's time × the amount of time spent reading every day × the number of people this can impact, it's a huge number."

The report also reveals "substantial individual differences in performance." Although this study doesn't measure what causes those differences, it's reasonable to imagine that part of the answer is a greater sensitivity to slight changes in color. Other studies have shown that some people do see color in ClearType letters, where others see only the effect of black or gray. And some people perceive the effect of ClearType on the edges of letters as making them look blurry rather than smooth. Although no two eyes see exactly alike (not even in the same face), for most readers the technology does improve the on-screen reading of text.

http://www.microsoft.com/typography/cleartype/tuner/1.htm

And ClearType is adjustable. Microsoft provides a website where you can compare slightly different ClearType contrast settings and can tune the way ClearType works on your system, taking into account both the display you are using and your personal color sensitivity.

Improving the improvement

ClearType is not a static technology, and since its debut the team at Microsoft has been making improvements and adding support for new rendering techniques. The latest version utilizes subpixel positioning and y-direction anti-aliasing.

With "traditional" rendering – the kind before ClearType – the person doing the hinting of the font had to make decisions about which whole pixels to turn on or off in order to make small letters look as legible as possible on the screen. ClearType greatly reduces the amount of hinting that needs to be applied to outlines in order to make them legible; indeed, even quite subtle x-direction details can be rendered simply by letting ClearType use the nearest subpixel boundary. The new subpixel positioning technique further improves both the shape of glyphs and their spacing. In the earlier versions of ClearType, the space occupied by each glyph always began on a whole pixel boundary, *i.e.* on the first, red subpixel. Subpixel positioning allows a glyph to begin and end on any subpixel boundary. This means that the same glyph is not rendered the same way every time it occurs, and yet the perception is that it is the same because the ClearType color filtering maintains the same contrast each time.

Subpixel rendering improves the horizontal aspect of the type, but not the vertical, since the red, green, and blue subpixels are vertical stripes within a pixel's square shape. At larger point sizes, the difference between the coarser vertical increments and the finer horizontal increments can draw attention to itself. In order to fix this potential problem and give a smoother vertical effect, the new version of ClearType applies anti-aliasing in the y-direction at larger sizes, in addition to using the horizontal subpixel rendering. (This anti-aliasing is font-specific, controlled by a new 'gasp' table format; different fonts may turn this function on at different sizes depending on the design of the typeface.)

These "improvements of the improvement" further enhance the core benefit of ClearType: the clarity and contrast that make text stand out against its background. "Contrast," as software architect Greg Hitchcock puts it, "is the key thing that differentiates ClearType from other rendering technologies." On the screen as on the printed page, strong contrast and clear glyphs shapes make extended reading easier and more comfortable.

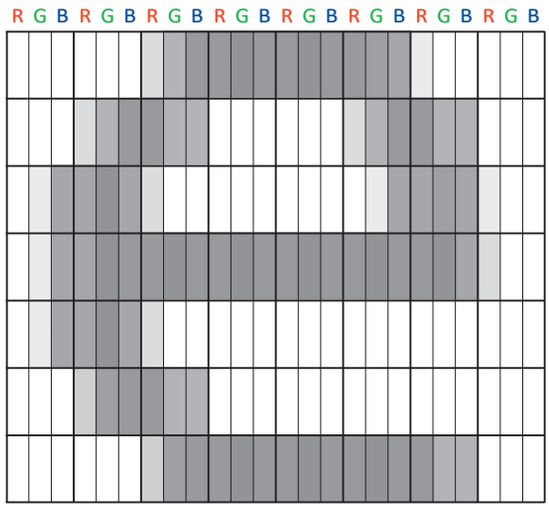
Which is what this is all about.

Subpixel rendering in detail

As the illustration on page 9 and those below demonstrate, it is extremely difficult to represent ClearType's screen technology in print. The pure colors of the individual subpixels, which at tiny sizes on screen combine to appear as white, obscure the workings of ClearType when enlarged and inaccurately represented by process print colors.

The illustration on the right diagramatically represents subpixel rendering of a letter **e** using shades of gray, with the background subpixel colors removed to make the diagram clearer. Further, the contrast has been reduced so that the effect of ClearType on individual subpixels can be clearly seen. It is important to remember, when looking at this illustration, that there is no actual gray involved in the ClearType rendering, only carefully controlled shades of red, blue, and green.

The lighter shades of gray at the horizontal extremes represent very subtle rendering that helps define the outer form of the letter. The darker shades that define the body of the letter would appear, in the high contrast of the text-size rendering on

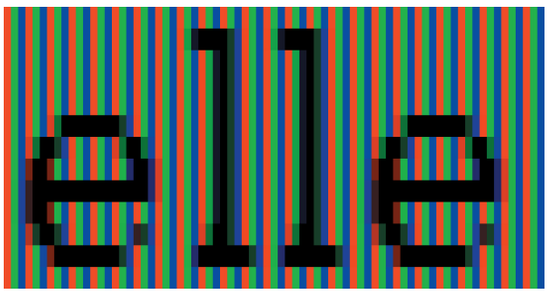


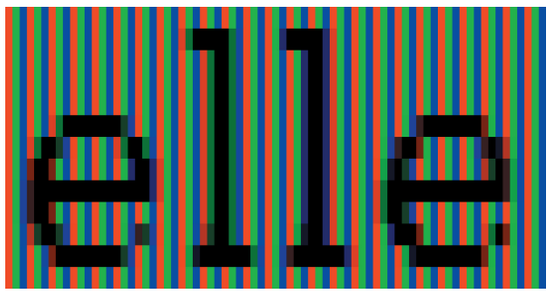
screen, as black. The lower contrast in this diagram exposes how every individual subpixel is addressed by ClearType's rendering and color-filtering technology, even those that make up the 'black' area of the letter.

Subpixel positioning in detail

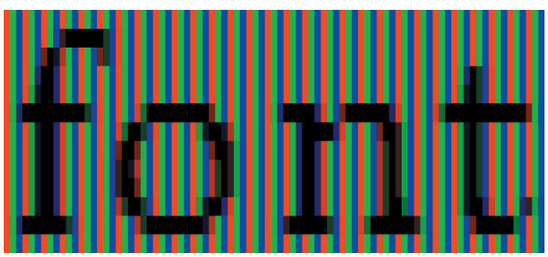
The illustrations below show how glyphs may begin on any subpixel boundary when subpixel positioning is used. The example on the left is rendered using the earlier version of the ClearType renderer, which did not employ subpixel positioning. The example on the right is rendered using the new version of the renderer, using subpixel positioning.

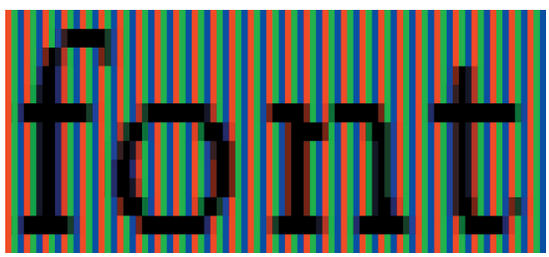
Note how each **e** and **l** in the right-hand image is rendered slightly differently because each starts on a different subpixel. At text size on screen, this difference is not noticeable because of the high contrast of the glyph image. This is only possible because of ClearType's sophisticated color filtering.





The two images below again compare the output from the older renderer, with that of the new. The subpixel positioning, shown on the right, greatly improves the spacing of type on screen, especially at small sizes where the difference between a subpixel and a whole pixel represents a significant proportion of glyph width. Note the more even spacing between the letters in the second image. The cumulative benefit of subpixel positioning to the overall appearance of a screen of text is dramatic, and represents a major new breakthrough in ClearType technology.





y-direction smoothing in detail

The combination of x-direction ClearType rendering with y-direction anti-aliasing is, if anything, more difficult to represent in print than the former alone. The image above does not show the actual subpixel rendering, but instead shows the relative color values of whole pixels, which makes it easier to study the affect of y-direction smoothing in print. The image on the lower right uses the same, diagramatic technique, only with shades of gray to *mimic* the visual effect at display size on screen.

Both images show ClearType rendering only (left) and ClearType combined with y-direction font smoothing (right). Compare the top and bottom portions of the letter *C* above, where the shallow horizontal curve produces a jagged, high-contrast step pattern on the left and a smoother progression on the right.

The y-direction smoothing is applied at larger sizes of type, and may be controlled in a font-specific way using a new version of the TrueType 'gasp' table. Font developers may determine at what sizes the new renderer will apply y-direction smoothing. It is important to note that this smoothing should not be applied at typical text sizes on screen, because it reduces the overall contrast of the glyph image. This makes text type appear blurred and undermines readability.

At display sizes on screen, as simulated below, this new improvement of the Windows font renderer produces smoother and cleaner-looking type. By combining horizontal subpixel rendering with vertical anti-aliasing, Microsoft is able to apply all the benefits of the former to display type in headings and other large-size settings, while providing the smooth curves familiar from traditional anti-aliasing techniques.

Clear Clear

A collaborative project: *aesthetics meets technology*

Microsoft decided that the best way to take advantage of ClearType technology and improve the reading experience was to design a set of text fonts that were specifically created to work with ClearType. To do this, they put together a "virtual team" of type designers and technical specialists, who worked closely together even though some of them were dispersed around the globe. The result is the ClearType Font Collection: six font families (Calibri™, Cambria™, Candara™, Consolas™, Constantia™, and Corbel™) with Latin, Greek, and Cyrillic character sets, and one (Meiryo) with full support for Japanese.

The Microsoft team took a holistic approach to the project. Everything about the ClearType fonts was thought through from the beginning, with great attention to detail and a ferocious commitment to quality. Within Microsoft, the project was managed by Geraldine Wade, with technical support by Mike Duggan, both of whom have a wealth of practical experience in the creation of digital type. Among the independent type designers, John Hudson was the lead coordinator and defined the base glyph set that his colleagues would design. In every way, this was a team effort.

The ClearType Font Collection is the result of a successful collaboration of designers and engineers, working together with respect and flexibility and curiosity. Every typeface, from the first days of Gutenberg, has been a combination of solutions to aesthetic and technical problems; but the ClearType fonts, unlike some compromises and adaptations in modern typeface design, were conceived from the outset as a marriage of technology and the best in design expertise, and they were executed in that manner.

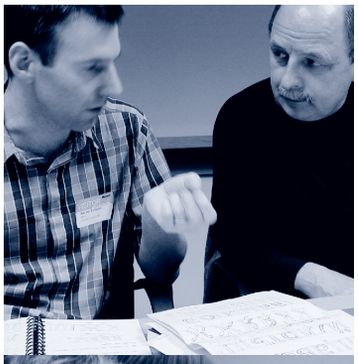
The fonts: designing from the ground up

In order to get the best possible typeface designs for the project, Microsoft invited a selection of talented type designers to submit proposals for new fonts that would work well for screen text. Microsoft wanted a variety of styles for different uses; in the end they chose two serif designs, two sans-serif designs, one "informal" design, and a monospace design for software code and other technical matter.

It's a matter of the structure of the letters, where it's important to keep them open and clear, and to space them so they read well in small sizes. ClearType helps immensely with this, but the underlying design has to want that help!

GARY MUNCH

These pages: images from the kick-off meeting at Microsoft, January 2003



All six Western typefaces would be developed simultaneously in three scripts (Latin, Greek, and Cyrillic), with regular, italic, bold, and bold italic styles in each family, and extended glyph sets that could take advantage of the sophisticated typographic features of OpenType fonts. A basic glyph set was developed that each font would cover; some include extra features and alternates particular to the design.

The Japanese side of the project was developed separately, in parallel, since the challenges of designing an on-screen text face for Japanese are quite different from those for any alphabetic system. Since modern Japanese routinely includes several different writing systems—kanji, two kinds of kana, romaji (Latin script), and many math and other symbols—the new typeface, Meiryo, comprises all of these elements, harmoniously designed, in a single font. The process of developing Meiryo and the team involved are described in detail in a separate section of this book, starting on page 60.

The type designers of the ClearType Western fonts are a diverse crowd. Jelle Bosma works for a long-established type foundry (Agfa Monotype), but the others are all independent type designers: John Hudson (Tiro Typeworks, Vancouver), Luc(as) de Groot (FontFabrik, Berlin), Jeremy Tankard (Jeremy Tankard Typography, Lincoln, UK), and Gary Munch (Munchfonts, Stamford, Conn.). All of the designers except Jelle Bosma, who had another commitment, met at Microsoft's headquarters in Redmond in January of 2003 to be briefed on the ClearType technology and the scope of the project. They were joined by two consultants, Maxim Zhukov and Gerry Leonidas, who have long experience in advising type foundries on the design of, respectively, Cyrillic and Greek type. That was the kick-off point for the development of the ClearType Font Collection.

Characters and glyph sets

The new fonts needed to provide a rich typographic set, a glyph repertoire and layout feature set that extended far beyond what most digital fonts could cover before the advent of OpenType. Since OpenType is based on the Unicode standard, and OpenType fonts can contain up to 65,536 glyphs, the

possibility presents itself of including support for multiple languages and multiple writing systems (scripts) in a single font. The new fonts for ClearType would include pan-European language support—not just all the languages in Europe that use the Latin alphabet (including such sometimes-neglected elements as the double-acute accent required for Hungarian), but also all the Slavic languages of Europe that use the Cyrillic alphabet (Russian, Ukrainian, Belorussian, Bulgarian, Serbian, Macedonian (FYROM)), as well as Greek. Besides these multi-script elements, the fonts include many layout features, such as smallcaps, ligatures, and different kinds of numerals, which are necessary for rich typographic communication.

Since these are intended to be text typefaces, not adventurous display faces, most of them include fewer stylistic alternates and oddities than a display face might. The exception is Luc(as) de Groot's Calibri, which is suited to both text and display settings, and is exuberant with variants and logotypes and extra characters such as a suite of directional arrows.

The robust, carefully thought-out glyph set that was developed for these ClearType fonts provides a standard of typographic control and expression across three major writing systems. The OpenType font format encourages diversity and typeface-specific glyph sets, as the additions to the basic set made by De Groot and some of the other designers demonstrates. The basic set defined for this project represents a solid functional level of support on which to build. Each type designer began with a spreadsheet of the basic glyph set, and with support files created by Hudson for the typeface-development tool FontLab®.

The important task of hinting the fonts was divided among experienced hinters. John Hudson's and Jeremy Tankard's fonts were hinted by Ross Mills at Tiro Typeworks. Gary Munch's and Jelle Bosma's were hinted at Agfa Monotype. Luc(as) de Groot opted to hint his own fonts (with Niels Poppe).

All of these were to be brand-new fonts, not retreads of existing designs. They were to be developed on an aggressive schedule, by a variety of skillful and sometimes willful type designers, and coordinated into a single program of new fonts for Microsoft users that would seem natural, logical, and transparently usable.

GERRY LEONIDAS
Greek script consultant.

Latin, Greek, Cyrillic

One of the unique aspects of this project is the fact that the Greek and Cyrillic designs were created at the same time as the Latin; from the beginning, the three scripts were developed together. This stands in contrast to the usual haphazard process, where Greek and Cyrillic complements get added onto an existing Latin typeface, often causing unpleasant compromises in the non-Latin characters. In the ClearType Font Collection, there would be no such compromises.

Although all of the individual typeface designers working on the ClearType font collection had experience in designing for multiple scripts, Microsoft wanted to involve an extra level of experience and advice right from the start, so the team availed itself of the expertise of Gerry Leonidas and Maxim Zhukov to review the Greek and Cyrillic designs respectively.

Gerry Leonidas is a lecturer in typography at the University of Reading, where he runs the master's program in type design; Maxim Zhukov served for many years as typographic advisor to the United Nations, in New York. Both of them have worked with a variety of type manufacturers on developing Greek or Cyrillic complements to existing Latin typefaces, but this was a rare opportunity to be directly involved in the process from the start. Each of them has a deep historical knowledge of his respective script, and its development in both handwriting and type over the 500-year history of printing.

Leonidas and Zhukov have a strong commitment to making sure that typefaces for their native languages are not simply add-ons to Latin type designs. "Plainly speaking," as Maxim Zhukov puts it, "they have to feel natural and authentic: not an afterthought, but custom-designed for those 'other' scripts."

John Hudson, who designed Constantia (the typeface you're reading now) and coordinated the design side of the project, appreciated the input of both Gerry and Maxim on the development of his own Greek and Cyrillic. He notes that the two consultants had slightly different approaches to reviewing the designs as the process went forward: "Gerry is very precise—'move this bit to the left, make this bit here heavier'—while Maxim seems to want to give designers just enough suggestion

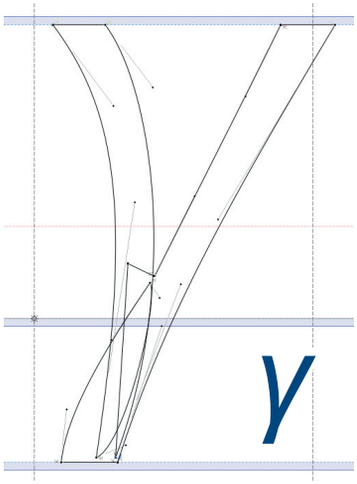
I use a musical metaphor when talking about the inherent visual characteristics of different scripts. *The Latin and Cyrillic scripts, especially in their upright forms, are very rhythmic: they are all about repetition of a small set of modular forms—vertical strokes and bowls—and counters of roughly even size and similar shape. The Greek script is what I would call melodic: there is much greater variation in form, much less modularity, with great variation in the size and shape of counters.*

JOHN HUDSON

to help them find a solution—'overall a bit wider, make the terminals stronger.' Both approaches are very useful and seem to suit the scripts: Cyrillic type design can leverage more knowledge from Latin design than Greek, so it is easier to adapt to and understand what needs to be done, while Greek is more foreign and you have to train yourself to see the importance of different kinds of details."

The different scripts "share a common, carefully balanced overall appearance when set in text," as Hudson puts it. "There are times when one wants text in different languages to be distinguished, *e.g.* by difference in weight or through the use of italics, but there are many situations in which multilingual text needs to give the same overall appearance in terms of typographic 'color.' This is particularly true when one is producing multilingual versions of the same document, which is very common in many countries, and which tends to be forgotten about when people talk of multilingual documents in terms of single texts that contain some words in different languages. A well-balanced multiscript typeface is especially useful for establishing a particular look and applying a particular typographic arrangement across multiple languages."

Hudson is eloquent about the relationships among the three related but distinct scripts. "I use a musical metaphor when talking about the inherent visual characteristics of different scripts. The Latin and Cyrillic scripts, especially in their upright forms, are very rhythmic: they are all about repetition of a small set of modular forms—vertical strokes and bowls—and counters of roughly even size and similar shape. The Greek script is what I would call melodic: there is much greater variation in form, much less modularity, with great variation in the size and shape



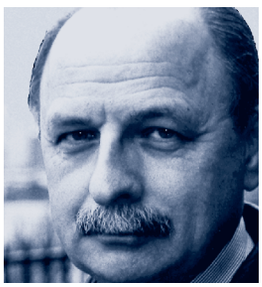
Sketch outline provided by Gerry Leonidas as part of his review of Jeremy Tankard's Corbel typeface, showing a possible construction for the italic lowercase gamma *and the complex relationship of the two strokes. Tankard's final form for this letter is superimposed in the lower right.*

of counters. These characteristics don't have much impact on the relative readability of the scripts – unless one ignores them and tries, for example, to force the characteristics of the Latin script onto the Greek – but they help me to understand how to make a design attractive: the beauty of rhythm is not the same as the beauty of melody."

"In relation to Latin," says Gerry Leonidas, "Greek has more round counters; counters of various shapes, often with a strong 'directionality' (*i.e.*, a teardrop shape); and far fewer terminals perpendicular to the baseline and the vertical. This makes it more difficult to ensure that the right pixel clusters are bright enough (since we can't talk about 'on' or 'off' anymore). Also, since Greek has diacritics (two for monotonic, up to fourteen for polytonic), the space that a typically large-x-height typeface will allow between the x-height and the ascender line becomes critical."

Designing the italic or cursive forms is "one of the trickiest decisions for anyone planning a Greek typeface family," according to Leonidas. "Whereas in the Latin two separate and distinct sets of scribal sources exist for the upright and italic variants, the Greek typographic script saw upright and inclined versions of the same paradigm being developed and used in parallel: a primarily French upright style, and a primarily German inclined style. Therefore the designer needs to identify more subtle routes to distinguishing between the two variants. Of course a slanted axis is the default option; the difference being that whereas in the Latin you switch paradigms as you incline the axis, in the Greek the upright variant already looks like a cursive typeface – almost like an uprighted italic to begin with. So we explored using different levels of 'cursiveness' as the three scripts switch from the uprights to the secondary variants, as well as utilising alternate forms (for example, using a more formal *phi* for the upright, and a more cursive one for the inclined variant)."

In each of the ClearType font families, the Greek has to function both as a natural-looking contemporary Greek typeface and in conjunction with the Latin and the Cyrillic. "The Greek would need to stand on its own design merits, and project an independently contemporary texture to readers: not reminiscent



MAXIM ZHUKOV
Cyrillic script consultant.

of an adaptation from an existing typeface, but one that would work well alongside the paired Latin (and Cyrillic, hopefully). Therefore the validation process involved looking at a variety of test documents: stand-alone Greek texts, parallel texts of several paragraphs' length (*e.g.*, as in a literary work with translation), and both flavors of embedded texts: preponderantly Greek texts with a few Latin words, and vice versa."

In the twentieth century, Greek type design had to pass through the narrow eye of technology. The constraints of type-setting systems, most of them designed by and for the Western printing trade, tended to force the Greek alphabet to simplify, both by eliminating alternate forms and by making the letters look more like their popular Latin equivalents. (This latter trend was especially strong in the early 1970s, and again from the late 1980s onwards.) But the potential of OpenType fonts, with their large glyph sets and their basis in the Unicode standard, makes it possible to get beyond those limitations. The new ClearType fonts take advantage of this potential.

As Leonidas point out, "The Greek fonts have alternate *beta*'s, *theta*'s, and *phi*'s, something which we have not really seen throughout the problematic years of 8-bit fonts (but which was commonplace in hot-metal and phototypesetting typefaces)."

Maxim Zhukov mentions the recent history of combining Latin, Greek, and Cyrillic designs in the same typeface. "The scripts of this 'extended family' are related by origin: both Latin and Cyrillic are derived from the Greek script. They share a number of character shapes. (Some of them, like **A**, **E**, **I**, **K**, **M**, **O** and **T**, even stand for more or less the same sounds.) No wonder that those shared glyphs – even when they represent different characters of various alphabets – have the very same look in the three scripts. And naturally, the balance of the respective glyph sets is styled to harmonize with them."

No type designer is fluent in every language and every script, but designers are constantly being called upon to design type for a language that is foreign to them. "Historically," says Zhukov, "most 'foreign' typefaces were developed by non-native designers: the names of Claude Garamond (Grecs du Roi), Guillaume le Bé (Hebrew), and Miklós Kis (Armenian) come to mind first. However, non-Latin type design was

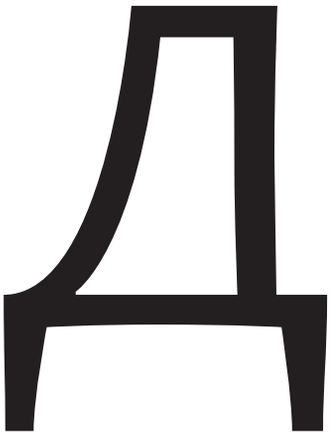
always considered a special genre. A different set of skills, and a knowledge of design conventions that are not always, if at all, applicable to Latin-based type design, was required. Most designers develop typefaces based on those scripts they use in their daily reading and writing. Today 'foreign-script' type design is quickly becoming mainstream – a standard, industry-wide practice.

"To a large extent, the challenge is psychological. Every person, designers included, has his or her own cultural background, even though in the age of globalization the notions of 'native' and 'domestic' are getting somewhat fuzzier. The notion of 'foreign' is still relevant, though – for a great number of reasons (human facility to assimilate is still limited). These days it looks like the entire world speaks with a foreign accent..."

Although Zhukov observes that "the more 'local color' a typeface possesses – the more script-specific it is – the more gets 'lost in translation,'" he also points out that "harmonization is by no means standardization." This is the pragmatic observation of someone who has worked for many years in the multilingual environment of United Nations headquarters in New York. "It is like idioms: they are very hard to translate to foreign languages, so if you want your text/speech 'convertible' to other languages, you'd better refrain from using them."

The visual features of the three alphabets have to be compatible enough to look like they belong to one coherent typeface, but they don't need to be identical.

Below right: comments from Maxim Zhukov to Gary Munch on an early form (*below*) *of the uppercase Cyrillic* De *in his Candara typeface.*



To me this shape feels foreign in the context of your design. I think the diagonal will look more natural slightly convex, not concave. In fact, a slightly bulging diagonal is conventional in certain styles of Russian type, as shown in the examples below, and it would rhyme well with your arched К and Ж.

Of course, it should be much subtler than the second of these examples. Its top may even be almost pointed (well, reasonably blunted: no narrower than the main stroke, of course), or flat (but short, in order to keep the shape of the Д triangular, not trapezoid). Regarding the hanging terminals: they better not be mirrored. This pattern would be more in tune with the calligraphic flow of the design

The latter is true for the descenders in д, Ц, ц, Ц, ц, Щ, and щ.

Devising a multilingual, multiscript typeface can be compared to negotiating a complex multilateral treaty.

MAXIM ZHUKOV

"The degree of the homogenization, and the subtle differences in treating similar – but not identical – letterforms, are the key to developing a viable multilingual typeface. They present the most challenge, especially to newcomers to the brave new world of non-native type design."

Gerry Leonidas sums up the sometimes-contradictory role of a consultant on multilingual typefaces: "For the consultant, the litmus test is to find the best compromise between maintaining – and even promoting – the designer's style and vision for that typeface, and his understanding of what constitutes 'well-formedness' for that script and that style; then to temper all within the given timeframe, which often imposes unwanted expediencies of its own on a project."

Maxim Zhukov acknowledges the practical realities of doing the impossible. "Devising a multilingual, multiscript typeface is indeed a fine balancing act; compromise plays an important role in it. This process can be compared to negotiating a complex multilateral treaty. In the ClearType project, Microsoft took upon itself the role of a cross-cultural coordinator (a United Nations of sorts?), and, in my opinion, handled it quite well."

Constantia | Κονστάντια | Константция

Designed by John Hudson
John Hudson is a full-time type designer and font developer based in Vancouver, Canada. His company, Tiro Typeworks, was co-founded in 1994 with Ross Mills, and specializes in custom font solutions for clients including Microsoft Corp., Adobe Systems, Linotype Library, IBM, and other software companies, as well as scholarly and governmental organizations. Tiro Typeworks is known for the technical quality of its fonts as well as design expertise, and for its involvement in multilingual type design and typography. To date, Hudson has designed or collaborated on typefaces for the Arabic, Cyrillic, Ethiopic, Greek, Hebrew, Latin, Ogham, and Thai scripts. Several of these typefaces have been recognised for their excellence in international design competitions.

DESIGNER'S DESCRIPTION: Constantia is a modulated wedge-serif typeface designed primarily for continuous text in both electronic and paper publishing. The design responds to the recent narrowing of the gap between screen readability and traditional print media, exploiting specific aspects of the most recent advances in ClearType rendering, such as subpixel positioning. The classic proportions of relatively small x-height and long extenders make Constantia ideal for book and journal publishing, while the slight squareness and open counters ensure that it remains legible even at small sizes. This font is suitable for book typesetting, email, web design, and magazines.

A typeface for e-periodicals

The brief for John Hudson was "to design a serif typeface that would be appropriate for use in e-journals," a typeface that could be used not only in the online versions of printed magazines, but in periodicals designed entirely to be read on the screen—and perhaps, ideally, in printed magazines as well.

With this many-sided potential use in mind, Hudson decided to try to push the boundaries between screen and print typography. He was already well versed in the technical limits and possibilities of digital type on-screen, especially in Windows. "I've watched screen resolution and the ClearType renderer improve over the past few years," he says, "and seeing what the next version of the renderer would be capable of, I was keen not to limit my design to the current or imminent state of the technology, but to anticipate further improvements. In simple terms, this meant including details that reveal themselves as size and resolution increase."

Hudson paid close attention to how details of type design are resolved on screen at different sizes and resolutions. Since ClearType's primary visual benefit is in the horizontal direction, he designed the letters to avoid vertical problems. "When I came to design Constantia, I began with the idea that the forms should be slightly squarish, to avoid the kind of curves that would produce jagged y-direction rendering. Next, I looked at a lot of different typefaces rendered in ClearType to see what kind of details worked well with the technology and which did not. One of the things that really impressed me was how well certain

spiky serifs responded to the renderer. This observation inspired the very sharp triangular serifs that are a feature of Constantia."

One of the notable differences between Constantia and the other serif typeface in the ClearType font collection, Cambria, is in the x-height: Constantia has a smaller x-height, and correspondingly longer ascenders and descenders. "In this respect, Constantia has more the proportions of a book face, and this was a deliberate response to the idea of something that could be used in journals." Cambria, by contrast, is intended more for business and technical documents, and has a larger x-height.

In deciding how to approach designing the italic of Constantia, Hudson looked at Eric Gill's Perpetua italic (originally called Felicity). "I've never been a big fan of Gill's italics on aesthetic grounds, but they have some interesting functional virtues. I was very impressed by the clarity of Felicity on screen, and realized that this was due to the regularity of its slant and the reduced cursivity of some letters, *e.g.* the lowercase **z**, which are close to being sloped roman forms. I wasn't going to do anything quite so rigid myself, but this idea of selectively reducing cursivity is an interesting one that can resolve problems with the y-direction rendering in ClearType."

Constantia has the same basic set of characters and features shared by all the ClearType fonts, plus sets of small-cap lining figures (both proportional and tabular). There is also a stylistic variant of the Greek uppercase *iota* with diaeresis (**Ϊ**), and corresponding smallcap variant, that is suited to all-cap display settings and headings, *e.g.* ΣΤΑΪΚΟΣ.

Text in Latin, Greek, and Cyrillic

Hudson dealt with the challenge of designing simultaneously for three different scripts by working on all three at the same time, going back and forth from one script to another. "After I had worked out initial ideas for a subset of Latin letters, I immediately began work on the Cyrillic and Greek, and those initial Latin forms were revised in light of what was happening in the Cyrillic in particular. For example, there are more vertical terminals among the Cyrillic letters, and these need to be strong because they are key elements of the letters, not appendages;

Για όσους διαβιώνουν σωστά ολόκληρη η ζωή περνάει γρήγορα, μα για όσους ασχημονούν και μια νύχτα είναι ατελείωτη. Για όσους διαβιώνουν σωστά ολόκληρη η ζωή περνάει γρήγορα, μα για όσους ασχημονούν και μια νύχτα είναι ατελείωτη.

working on these encouraged me to go back and make the vertical terminals of the Latin stronger, which gives the whole design more presence.

"The Greek script is probably my favourite to design for, even though it is very much harder to get right than either Latin or Cyrillic. Many Greek typefaces of the past thirty years, including designs produced in Greece, are very stiff, and suffer from trying to squeeze the Greek letterforms into Latin structures. I'm very conscious of the fact that the normative forms of the Greek lowercase alphabet developed in isolation from the Latin, in the Byzantine empire, and were influenced by Middle Eastern scripts that have a much steeper ductus than Latin; they are also traditionally written with more rotation than Latin, which varies the ductus. So I try to avoid using the typical Latin contrast pattern in the Greek lowercase, while still maintaining harmony of weight across the different scripts."

Cyrillic presents quite different challenges from Greek, especially in relation to Latin. "One of the challenges in Cyrillic type design is to find authentic details for particular styles of type, especially if the Latin companion is in a style that precedes the development of the modern Russian alphabet in the 18th Century. Constantia has some elements of Renaissance types, and applying these to Cyrillic is a bit like taking the script in a time machine. The Cyrillic script probably needed the most adaptation to screen rendering, *i.e.*, some elements of Constantia Cyrillic would be different if I'd been designing for print. The flatish upper terminals of the upper- and lowercase *zhe* (**Жж**) and *ka* (**Кк**), for example, are a fairly novel feature, and simply produced the best letterforms when rendered with ClearType." Hudson admits that Maxim Zhukov, Microsoft's Cyrillic type consultant, "wasn't very keen on this feature of the design," but the two of them "worked together very hard on these letters to make them look right, with lots of minute adjustment of weight through the terminal. Designing these letters was probably the hardest thing in the whole Constantia design."

Just as the Latin italic needed to harmonize with its roman, the italic fonts for the Greek and Cyrillic versions of Constantia had to work well with their upright companions, as well as with each other.

Ю

жж

“The Cyrillic italic follows the Latin in being generally more cursive than the roman, with more condensed forms and with calligraphic features, such as the sharp, deep cuts when the bowl of Latin letters like **b** and **h** meet the stem. Some of the fully cursive Cyrillic italic letterforms are very different from their upright correspondents, and this is followed in the Constantia design – compare, for example, the italic and upright forms of *ghe* (**г**) and *zhe* (**ж**).

“The Greek required a somewhat different solution, though, because the design of the upright is already more cursive than the Latin and Cyrillic – overall, it is less rigid, with many more curves and a greater variety of shapes and counter sizes. There was little possibility of increasing the cursivity of the Greek in the same way as I had done for the Latin and Cyrillic; and the condensed, angular forms that appear in the latter don’t look natural for Greek, which has a greater number of rounded forms. So the Greek italic is in some respects less differentiated than the others, being closer to a sloped version of the upright Greek.”

Hudson is looking forward to seeing Constantia used in e-journals, since this was the initial brief. “And I’m also expecting to see it used in documents in which people want something modern but with the smaller x-height and long ascender proportions of Constantia. Since I was interested in how the gap between screen and print typography has been reduced, and continues to grow narrower, I would be thrilled to see Constantia being used for both the print and electronic media versions of a publication. Until recently, it has not been possible to use the same typefaces in print and electronic media without compromising either the readability or the attractiveness of one or the other.”

Γs

Constantia | Κονστάντια | Константия

Designer: *John Hudson*
Type family: *4 styles* (*regular, italic, bold, bold italic*); *992 glyphs per font*
Layout features: *smallcaps, stylistic alternates, localized forms, standard ligatures, uppercase-sensitive forms and spacing, oldstyle figures, lining figures, smallcap figures, arbitrary fractions, superscript, subscript*

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Still others claim that language grew out of grunts of effort, inarticulate chants, or exclamations of fear or surprise. *Pythagoras and Plato and the Stoics all simply begged the question by arguing that language "sprang from necessity."* **As to just how it sprang, they do not say, perhaps fully developed from the head of Zeus. *Aristotle and Epicurus, without ever mentioning how it came about, stated that language was the product of "agreement."*** Για όσους διαβιώνουν σωστά ολόκληρη η ζωή περνάει γρήγορα, μα για όσους ασχημονούν και μια νύχτα είναι ατελείωτη. *Όταν μιλώ έτσι, εννοώ τον άνθρωπο ολόκληρο, χωρίς να διακρίνω το πνεύμα, τις καλλιτεχνικές προσπάθειες, το υπερπέραν και τα ρέστα.* **Τώρα βρίσκομαι πάλι σε μια στροφή: *μου είναι δύσκολο να αισθανθώ, μου είναι δύσκολο να ζήσω. Είμαι άνθρωπος με ψυχικά εμπόδια.*** В чащах юга жилбыл цитрус да, но фальшивый экземпляръ. *Сва људска бића рађају се слободна и једнака у достојанству и правима.* **Усе людзі нараджаюцца свабоднымі і роўнымі ў сваёй годнасці і правах. *Кожна людина має право на свободу думки, совісті і релігії.*** Pójdźże, kiń tę chmurność w głąb flaszy. *Zwölf Boxkämpfer jagen Victor quer über den großen Sylter Deich.* Kæmi ný öxi hér ykist þjófum nú bæði víl og ádrepa. *Flygande bäckasiner söka hvila på mjuka tufwor.* Laŭ Ludoviko Zamenhof

[Constantia 11/13.5]

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of effort, inarticulate chants,
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має право на свободу
думки, совісті і релігії.

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le 9 thermidor an 11
{ 27 July 1794 } *l'Haÿ-les-Roses*
46 5⁄16 feet of rubber hose?
hwæt! Hódmezővásárhely
a fine kerfuffle *de théâtre…*
alle Menschen! un gran virtù
¿también? Staroměstská
Timişoara *ní bhíonn súil*

[Constantia 22/26]

Cambria | Κάμπρια | Камбрия

Designed by Jelle Bosma, with Steve Matteson and Robin Nicholas

Jelle Bosma studied at the Royal Academy of Art in The Hague, designed some typefaces, and worked as type designer for Scangraphic (Hamburg, Germany) before joining the Monotype Corporation (now Agfa Monotype) in January 1992. For Monotype he was responsible for developing the ability to create high-quality TrueType fonts and to manage their production. ¶Since 1995 he has been working from home near The Hague, dividing his time between hinting, drawing outlines or bitmaps, and programming. Jelle is the author of FontDame: software to design, hint, create OpenType layout tables and generally do things with TrueType/OpenType fonts that other font tools do not (yet) do. Most of his type design projects are of a distinctly non-Latin nature. Jelle has become a bit of an expert on the complex writing systems used in India, but has experience with a wide range of scripts.

DESIGNER'S DESCRIPTION: Cambria has been designed for on-screen reading and to look good when printed at small sizes. It has very even spacing and proportions. Diagonal and vertical hairlines and serifs are relatively strong, while horizontal serifs are small and intended to emphasize stroke endings rather than stand out themselves. This principle is most noticeable in the italics, where the lowercase characters are subdued in style, to be at their best as elements of word-images. This font is suitable for business documents, email, web design.

A sturdy typeface for business

When the call for proposals came from Microsoft, type designer Jelle Bosma says, he had been doing heavy-duty programming for four or five months straight, and he was eager to get back to design work. Some of his colleagues at Agfa Monotype had just been in a meeting with Microsoft about the need for a set of fonts for a variety of purposes, all of which would be designed to take advantage of ClearType rendering to look good on screen, while still being useful in print. "So my wish was granted," says Bosma, "and I was put to work." He found, however, that he had come into the process a bit late: Microsoft wanted proposals by the end of the week.

"I tried my hand at a proposal for a monospaced and a serif font in two variants: one variant as an e-book font, and a version adapted as a business document font: what could be a Times New Roman replacement." It was the latter that turned into Cambria. "The other bit of information was a list of fonts, mostly traditional old-style fonts, which Mike Duggan recommended looking at, because they worked well. I must confess that once I got started, things developed in another direction."

He studied how different geometric shapes were rendered by ClearType on the screen, and what the effects on them were of hinting. He also looked at the fonts shipping with Microsoft Reader, since he knew they had been hinted for ClearType.

"The result was that at the smallest sizes, the effect of hinting did make a difference, but for most types of shapes, except long diagonal lines near horizontal, shape detailing mattered little. However, starting at slightly above 20 pixels per em,

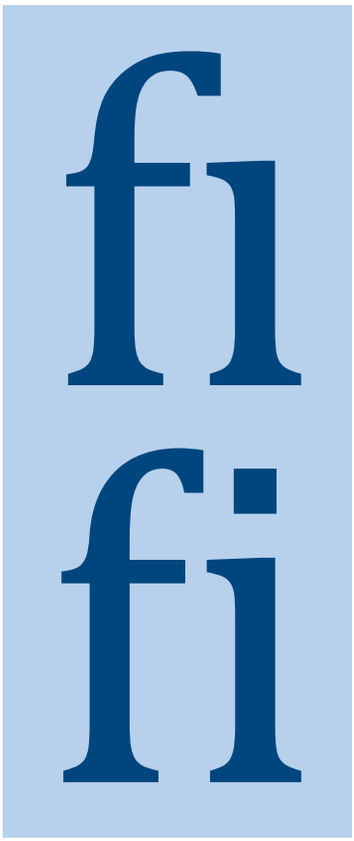
some shapes worked better than others; it seemed best to use curves that turn away from the horizontal extreme as quickly as possible.

"The next step was to draw a lowercase **n** in all sorts of variants, hint them, and select those properties with the 'best statistics.'

"At the smallest sizes, ClearType gives the effect of 'dressed up' bitmaps. I do have some experience in that field, including bitmap design proposals that were the subject of a legibility study where various design parameters were tried out. So once the **n** had been established, I had some idea about the proportions and spacing which would create a suitable pattern of black and white shapes that scores well in a legibility test. So starting from an **n**, I gradually built the rest, trying to keep things in harmony."

Designing typefaces for the screen, Bosma points out, is very different from designing for the printed page—or from designing for the screen just a few years ago. "Within the TrueType format, hinting is part of the design. The outline drawings you make in Fontographer or FontLab are the outlines used when you have no pixel limitations. With hints, you draw the outlines that express the design at lower resolutions. In the ClearType rasterizer with subpixel positioning, you have fewer options to influence the appearance with hints, because in the x-direction, hints are mapped to a make-believe higher resolution. But it is possible to force some things, if need be. For example, when the top horizontal of the **5** and **7** has to be one pixel, because two pixels is much too heavy, I compensated to make the horizontal hairlines a bit heavier, to prevent the top half of the characters from becoming too light.

"In black and white bitmaps, you are by nature forced into certain proportions. But if your font doesn't have these, you can hint them to be that way. The price for that is that the screen appearance may give a false impression of what it will look like in print. In ClearType you still have the limitation that you need to separate vertical features clearly. Therefore proportions are even and spacing open, even between round stems (**oo**). So in that sense, you are a bit more limited than when you draw outlines for black and white hinting, because there the hints take over completely."



Careful attention to detail

The features that make Cambria uniquely suited to its role as a robust, all-purpose workhorse text face have been carefully and precisely thought through.

"For ClearType," explains Bosma, "one designs monoline fonts best. At small screen sizes, hints make the horizontal hairlines heavy, and if your horizontal hairlines are thin, they remain thin and look silly. You also want to make narrow characters relatively wide. In metal type terms: your serifed ClearType font should be made from the drawings for the 7-point. But that looks rather dull at large sizes, and not much like a Times New Roman alternative.

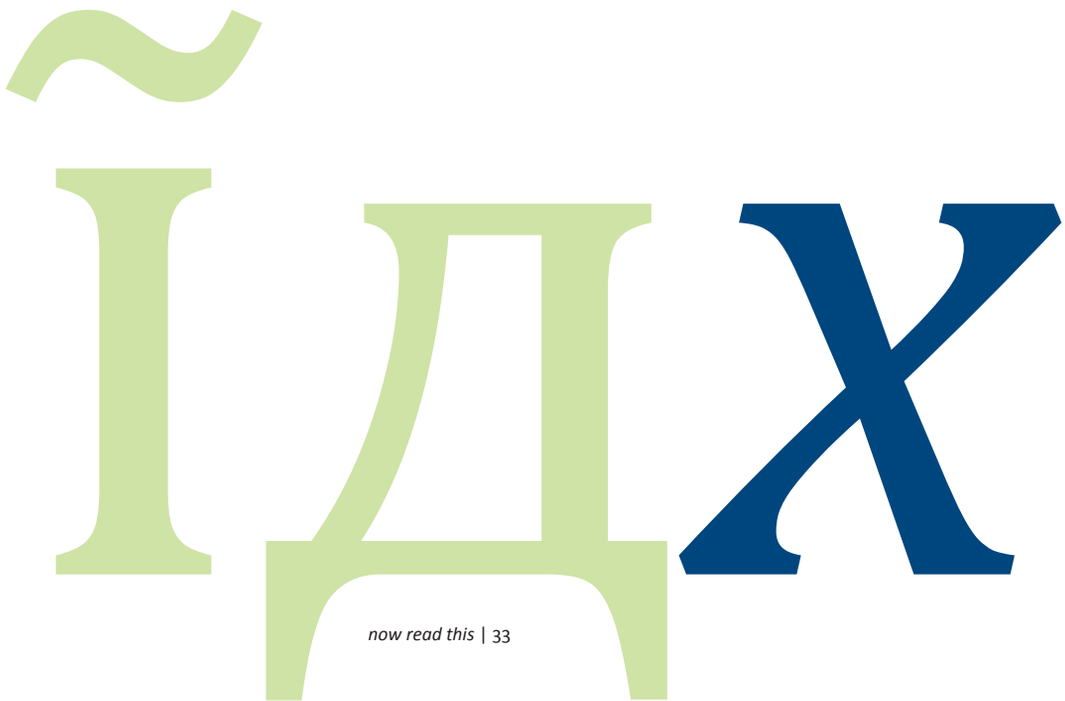
"So in order to have a bit of both worlds, the design has a relatively low contrast in the x direction, and a high contrast in y. With the given proportions, this makes the image heavy enough for it to survive being used at 8 pt printer sizes, while not looking dull and heavy at 16 or 18 pt. At these relatively small sizes, the perception of equally thick horizontal and vertical hairlines is making the verticals look lighter. A bit of exaggerated compensation for this goes unnoticed. Of course when used at really big sizes, it will start to look strange – but with such wide spacing, I don't see a big future for Cambria as a headline font anyway."

Bosma has done something unusual in the f-ligatures, by using the possibilities for contextual glyph substitution in OpenType. "The implementation of the OpenType ligature doesn't use the drawn ligatures, but an alternate drawing of the **f** only. This has a narrower and lighter top and is used as a substitute not only in front of the **i**, **b**, **h**, **k** and **l**, but also when it is followed by any other lowercase glyph that has something sticking out in 'f space': narrow characters with top accents, anything with a left-side ascender."

Cambria comes with a large extended set of mathematical glyphs, to support math setting in Microsoft Word. This supports an additional 2,000 math, scientific, and technical characters from Unicode 4.0. Bosma describes some of these: "a full set of combining marks, additional punctuation marks, the letterlike symbols, arrows, math operators. There is also a set of mathematical alphanumerical symbols which contains a variant

of the italics. The lowercase has diagonal stroke endings rather than horizontal serifs. These characters are drawn to stand on their own, rather than as part of a word image."

The design of Cambria's Greek and Cyrillic complements was the most difficult of all the new ClearType typefaces. Although the x-height and the cap-height are consistent across all three scripts, conflicting ideas about consistency dogged the project. (Which is more important: keeping details the same across scripts, or making each conform to the standards of that script? There is no one answer to this question, nor to the questions of style in designing a successful text face.) In the end, Bosma was responsible for the Latin design of Cambria, and the Greek and Cyrillic were designed by Robin Nicholas and Steve Matteson at Agfa Monotype with contributions from, respectively, Gerry Leonidas and Maxim Zhukov. The result of this joint process should be a family of fonts for business, math, and technical documents that will function seamlessly for users in many languages and all three scripts.



Cambria | Κάμπρια | Камбрия

Designers: *Jelle Bosma, with Steve Matteson and Robin Nicholas*
Type family: *4 styles* (*regular, italic, bold, bold italic*)*; 992 glyphs per font* (*plus special math set*)
Layout features: *smallcaps, stylistic alternates, localized forms, contextual alternates, uppercase-sensitive forms, oldstyle figures, lining figures, arbitrary fractions, superscript, subscript*

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STILL OTHERS CLAIM that language grew out of grunts of effort, inarticulate chants, or exclamations of fear or surprise. *Pythagoras and Plato and the Stoics all simply begged the question by arguing that language "sprang from necessity."* **As to just how it sprang, they do not say, perhaps fully developed from the head of Zeus. *Aristotle and Epicurus, without ever mentioning how it came about, stated that language was the product of "agreement."*** Για όσους διαβιώνουν σωστά ολόκληρη η ζωή περνάει γρήγορα, μα για όσους ασχημονούν και μια νύχτα είναι ατελείωτη. *Όταν μιλώ έτσι, εννοώ τον άνθρωπο ολόκληρο, χωρίς να διακρίνω το πνεύμα, τις καλλιτεχνικές προσπάθειες, το υπερπέραν και τα ρέστα.* **Τώρα βρίσκομαι πάλι σε μια στροφή: *μου είναι δύσκολο να αισθανθώ, μου είναι δύσκολο να ζήσω. Είμαι άνθρωπος με ψυχικά εμπόδια.*** В чащах юга жилбыл цитрус да, но фальшивый экземпляръ. *Сва људска бића рађају се слободна и једнака у достојанству и правима.* **Усе людзі нараджаюцца свабоднымі і роўнымі ў сваёй годнасці і правах. *Кожна людина має право на свободу думки, совісті і релігії.*** Pójdźże, kiń tę chmurność w głąb flaszy. *Zwölf Boxkämpfer jagen Victor quer über den großen Sylter Deich.* Kæmi ný öxi hér ykist þjófum nú bæði víl og ádrepa. *Flygande bäckasiner söka hvila på mjuka tufwor.* Laŭ

[Cambria 11/13.5]

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экземпляръ. Кожна людина
має право на свободу
думки, совісті і релігії.

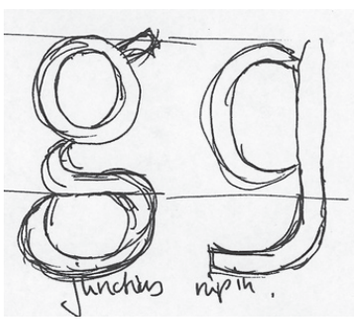
BOSTON SPA · LS23 7BQ
le 9 thermidor an II
{27 July 1794} *l'Haÿ-les-Roses*
28⅘ miles of stripmall?
HWÆT! Hódmezővásárhely
a fine kerfuffle *de théâtre…*
alle Menschen! un gran virtù
¿también? Staroměstská
Timişoara *ní bhíonn súil*

[Cambria 22/26]

Corbel | Кορμπέλ | Корбел

DESIGNED BY JEREMY TANKARD

Jeremy Tankard has gained a worldwide reputation for the high quality and unique designs of his typefaces, which include the commercial type families Bliss, Enigma, and Shaker as well as commissioned typefaces for Telstra and the Christchurch Art Gallery, among others. He initially worked with major consultancies, advising and creating typography for some of the best-known international brand names, then decided to go it alone so as to devote more time to his designs. Since establishing Jeremy Tankard Typography in 1998, he has been able to make his experience available to a wider audience by working with corporate, advertising, and television companies in many countries on a variety of typographic projects. From the outset, the aim of the company was to create, manufacture, and retail high-quality digital type, while always keeping in touch with current computer standards and techniques.



DESIGNER'S DESCRIPTION: Corbel is designed to give an uncluttered and clean appearance on screen. The letter forms are open with soft, flowing curves. It is legible, clear, and functional at small sizes. At larger sizes, the detailing and style of the shapes is more apparent, resulting in a modern sans serif type with a wide range of possible uses. This font is suitable for business documents, email, web design.

Developing the concept

"I had to develop roman and italic glyphs to show the design concept," says Jeremy Tankard about how Corbel got started. "As I normally do when I start a design, I created several letters to test ideas. I didn't want to do too much at this early stage, as my understanding of ClearType was limited; I was concerned about understanding the technology and any limitations before getting deeply into the design."

He says that his aim was to produce a clear, elegant sans that was functional but not bland. "I wanted to move away from the round i-dot sans fonts we've seen a lot of recently. Less cuddly, more assertive. I wanted the italic to be expressive, not a sloped roman as with Verdana, Arial, et al. As the font is commissioned for on-screen readability, e-books, etc., it seemed logical to approach the font style in a non-mechanical way. This became easier to do once I understood ClearType more. By 'non-mechanical,' I mean fitting the outline to the pixel grid. I'm a great believer in Eric Gill's often-mentioned quote, 'Letters are things, not pictures of things.' They fill their own space in relation to the other characters. They have their own proportion, which when modified too much results in a problematic mess.

"In the early design for the roman I had a two-bowled 'g' and a curly 'l', but these both went, after setting tests. Also I wanted the ascender and cap heights to be equal; this had to change as readability/legibility suffered, and the caps were overpowering. As the design progressed, in early 2003, many vertical measurements were balanced out across all the designers' fonts to harmonize them on the pixel grid at small sizes.

"I did it the same as all my fonts: sketch book to screen via a period of research and testing. This was different as tests needed to be carried out at Microsoft (quickly hinted), then

a screen shot emailed back; this way the design progressed equally alongside my own printouts. Primarily it is for screen, but Microsoft wanted the font to work well for print too. On the Greek and Cyrillic, I had to meet deadlines to send stage developments to Gerry and Maxim. As the fonts were drawn in PostScript beziers, the outlines had to be converted to the TrueType format. Unfortunately the PostScript and TrueType curve math differs, and even a very good conversion will not be exact; so more work had to be done to try to match more closely the original design. Points had to be removed from the TrueType outlines and curves redrawn to meet the quality requirements for delivery to Microsoft."

Designing for the screen

"As the project got going, it was obvious that we all needed to tailor our designs to meet certain restrictions: various alignment heights (*e.g.*, cap, ascender) needed to fall within certain boundaries, in order for the collection of types to appear equal at small point sizes. This was the main constraint, which isn't really a constraint – more fitting our designs to a rough scale. The biggest 'concern' was the diagonal glyphs like **w** and **v**. I tend to design these characters optically, not geometrically. I had to go against my instinct and make the **w** geometric so the on-screen pixel rendition would be even; initially the pixel version was rendering with different arms on the left and right, which at the small sizes on-screen looked bad.

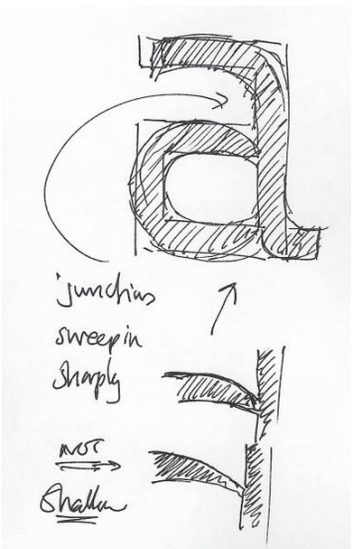
"Early in the project, there was some talk of harmonizing the sans design with one of the new serif faces, so that they would share some details and general proportions. In the event, we moved away from this idea, and the types were developed independently, but they share common alignment on screen."

When asked what made Corbel's design unique among the new ClearType fonts, Tankard said, "The nature of the project and initial brief was to design a type for reading on-screen, not to make it too individual. The type needs to function across a wide range of applications and environments, being read by a huge range of peoples with varying appreciation of Latin, Greek, and Cyrillic. 'Unique' could be that it is designed for ClearType, for the next level of the Windows OS, with OpenType features.

Less cuddly, more assertive.

hamburgefons
hamburgefons uu
hamburgefons
hamburgefons aaaaa
hamburgefons
hamburgefons eefff
hamburgefons
rough demo
rough demo
rough demo demo

Early tests of possible alternate forms of some letters.



This technology, and the fonts developed for it, will improve the visual readability, clarity, and legibility of type on screen, and set new standards again."

"I was initially trying various forms for the italic. I knew what I didn't want—a sloped roman. Since I was designing Greek and Cyrillic at the same time as the Latin, it was important and obvious to look at all three scripts as a whole, letting each influence the other. By doing this I felt I could reach an even approach to the roman and italic styles. In the Latin, I kept the roman less emotive; the italic I let flow more. [*See opposite.*] This helped balance with the Cyrillic, where the roman is quite static and the italic uses more cursive forms, some of which are specific to its italic style. Greek is more cursive in its roman than Latin and Cyrillic; here I tried to reduce the movement of the roman without killing it, with the aim of making the italic more visually distinctive. I also used the alternate forms of *beta* (**ϐ**), *theta* (**ϑ**), and *phi* (**φ**), which are visually softer.

"Corbel has some additional glyphs beyond the core set required by Microsoft. There are small-cap-height figs (0–9) and small-cap-height @ [{ ( ) }]."

When asked how he had approached designing simultaneously for three scripts, he replied, "With lots of coffee! Gerry and Maxim were great with feedback as the scripts developed. I kept an eye on how the three scripts looked together: color, consistency, and so on.

"Care was taken to maintain some degree of uniformity in feel and look among the three scripts. Terminal endings and curves are consistent where the structure of the form allows. As all three scripts were developed together, sometimes the Latin was adapted to match the Greek and/or Cyrillic more closely. Having said that, though, they are each individual, and hopefully they don't suffer from the treatment found in some of Gill's and Van Krimpen's types, where the Greek follows the Latin far too closely and the Greek italic is too close to the upright Greek.

"They are their own scripts; I hope that, with the help of Gerry and Maxim, they function well in their native languages as well as alongside the Latin."

The roman structure is more static. Here the arm of the *n* joins the left stem at an angle.

n p *n p*

The italic flows more. Here the branching stroke flows smoothly from the initial stem.

b d k l y *b d k l y*

The forms of these five letters differ in the italic...

...to balance the three scripts by making the Latin italic visually more cursive.

Traditional variation of roman and italic, typical of Latin text types.

a e f *a e f*

The Greek uses similar ideas where it can. The upright forms are more static...

γ λ *γ λ*

...while the italic has different, more cursive forms

Traditional alternate forms are available in each font...

β θ ϕ *β ϑ φ*

...and become the default forms in the italic.

в г и д п *в г и д п*

Some letters of the Cyrillic upright...

...take very distinctive traditional forms in the italic...

я ж к *я ж к*

л м ф *л м ф*

ц ш щ *ц ш щ*

...while other static forms simply become more cursive.

Corbel | Κορμπέλ | Корбел

Designer: *Jeremy Tankard*
Type family: *4 styles* (*regular, italic, bold, bold italic*)*; 985 glyphs per font*
Layout features: *smallcaps, stylistic alternates, localized forms, standard ligatures, uppercase-sensitive forms and spacing, oldstyle figures, lining figures, smallcap figures, arbitrary fractions, superscript, subscript*

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[Corbel 11/13.5]

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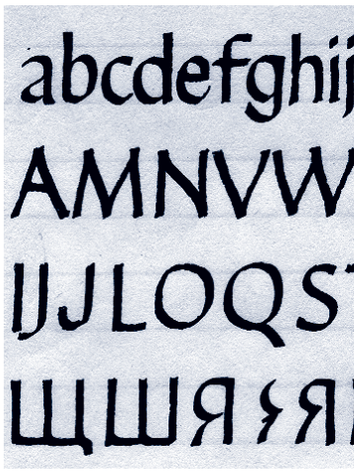
Timişoara *ní bhíonn súil*

[Corbel 22/26]

Candara | Καντάρα | Кандара

Designed by Gary Munch
Gary Munch's type design work leans towards text faces, though an occasional display face is known to wander his hard drives. His previous designs include UrbanScrawl, Nanogram, Linotype Ergo, and Linotype Really. ¶He studied graphic design at the University of Oregon, where his love of letterforms was heightened in Chuck Bigelow's typography courses. He now makes typefaces in a small studio in Connecticut, and teaches calligraphy and typography, graphic design, and computer graphics to students in area colleges. ¶As a board member of the Type Directors Club (New York) he has served as Treasurer and Vice President, and was the chairman of the TDC² 2002 type design competition and of the 2004 TDC50 typography competition.



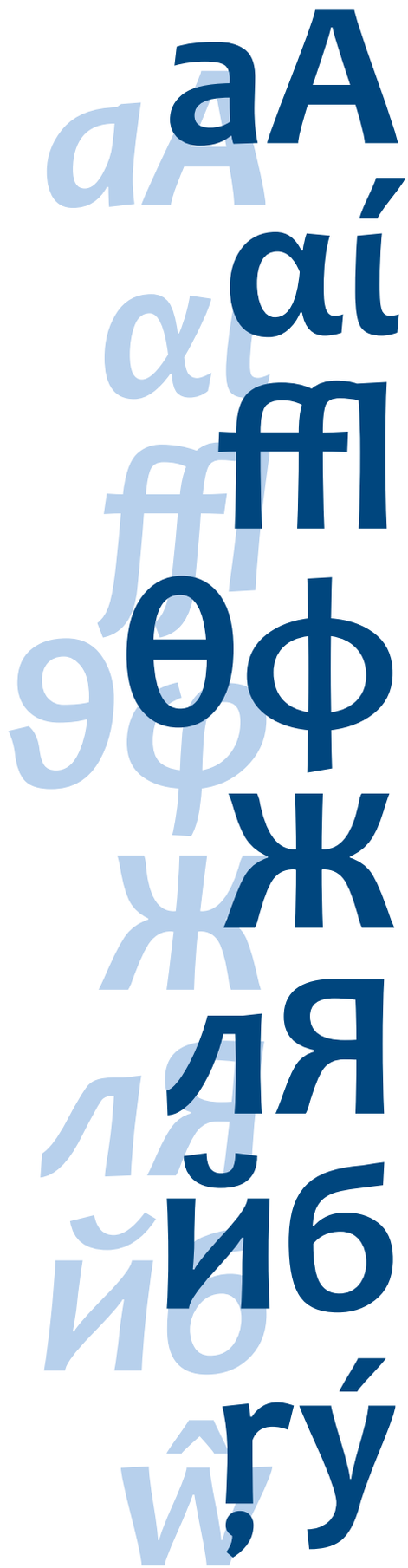
DESIGNER'S DESCRIPTION: A humanist sans with verticals showing a graceful entasis on stems, high-branching arcades in the lowercase, large apertures in all open forms, and unique ogee curves on diagonals. The resulting texture is lively but not intrusive, and makes for a friendly and readable text. This font is suitable for email, web design, magazines, and informal settings.

How is Candara different?

Microsoft was looking for an informal sans serif typeface with subtle details that could not have been rendered on-screen at text sizes before the advent of ClearType. "They wanted something with a casual feel, with some softness," says Gary Munch. "They were especially interested in shapes that featured entasis, the architectural detail where a column swells under pressure. In type, the colors are the same—white marble, dark doors; white space, dark stroke. I happened to have a couple of sketched-out fonts tucked away, so I sent those along."

Munch describes the origins of Candara: "I started with an idea that I'd toyed with since college; to add what the Victorian-era art critic John Ruskin called the most beautiful of lines, the ogee, to a classic letter structure. I'd written a similar calligraphic style for years, but had never gotten around to committing the concept to typographic drawings. The diagonals have a subtle double-curve, like a soft 'S' curve; this helps to harmonize them with the entasis curve of the stems. Then, knowing that the screen would be an important part of the display environment, I made the horizontals sturdier than in a typical edged-pen design. The result is a low contrast of stroke weight.

"The models were in my hand, pretty much, as they were originally hand-written. There's a starting point, but it was necessary that the typical thins of edged-pen work be made heavier so they'd work as type and retain their connections to the stems—otherwise at small sizes the joins at the arcades and on bowls tend to fade out. With the two end masters built, it was then a matter of finding the best points of interpolation. There were hours early on in Fontographer, and a steep learning curve in FontLab 4.6."



What makes Candara work particularly well on the screen? And how will that translate into print? "I knew that the faces would also go to print, so the differences would be in the details. Some details will show at screen resolutions, such as the entasis, but others, such as the obliquely-trimmed stems of the italics, won't. It's more a matter of the structure of the letters, where it's important to keep them open and clear, and to space them so they read well in small sizes. ClearType helps immensely with this, but the underlying design has to want that help!"

The most unusual aspects of Candara are its delicate ogee'd diagonals, and the slight flare of the stems caused by the entasis on the strokes. The mix of the classic chancery structure for the italic and cursives with the neo-grotesque-humanist of the romans also distinguishes this from other typefaces.

The design of the italic presented some challenges. "At first I proposed an oblique italic, with little structural change; something like the relation of most grotesques to their italics. Geraldine and Mike convinced me to try a more cursive italic, so the final italic is structured with a chancery arcade. That works well with the Humanist-inspired roman structure, and also makes the distinction of roman and italic more noticeable, something that's very important on-screen, where an oblique might not be clear enough, especially with the very modest slant that I like to use for my italics."

Unlike most designers of text typefaces, Munch didn't do the basic weight first. "The very first variant of the face was a super-duper black that was then thinned down to a text weight. I'd intended the black to stand on its own, but the concept was too interesting to leave there. The Microsoft faces are the resultant text weight, and an interpolation from the two end designs for the bold."

Candara features full ligatures for **f**; smallcaps for each of the three scripts; four sets of numerals (proportional oldstyle and lining, tabular oldstyle and lining); cursive alternates for several Greek *beta, theta,* and *phi;* a small set of math and physics symbols. "When it came to the numerals," says Munch, "I recommended lining tabular as the default, as this style is least prone to disaster in the hands of untutored users." In the end, Microsoft opted for default proportional oldstyle figures as the ClearType fonts are intended mainly for immersive reading.

Greek is much more gestural than the other two in its lowercase, and so wants to swing along more loosely. There are so many round bowls that need to be restrained from being too dominant, and there's a wide range of shapes that give Latin concepts such as baseline and x-height only passing nods.

GARY MUNCH

τδεγλ

α β γ δ ζ ϑ ξ
ς χ ψ ω ύ η ι
α β γ δ ζ θ ξ ς
χ ψ ω ύ η ι

а е м н о р с
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а е м н о р с
т у к б в г э

НЦПЩ

Munch has a good deal of experience working with Greek and Cyrillic as well as the Latin alphabet. How does he design all three at once? "By way of the capitals: they offer a stable and familiar territory of shapes, with the divergent Greek and Cyrillic letters adding spice and interest. With the three lowercases, it's important to remember not to over-unify some shapes that are only outwardly similar, but unify the others. Often that means the stylistic themes need to be applied differently to the shapes. The ogee curves on the diagonals lent themselves nicely to the three scripts' diagonal letters.

"Greek is much more gestural than the other two in its lowercase, and so wants to swing along more loosely. There are so many round bowls that need to be restrained from being too dominant, and there's a wide range of shapes that give Latin concepts such as baseline and x-height only passing nods. We all had the expertise of Gerry Leonidas to draw on, and his help made it possible to get shapes that worked well in rhythm and form.

"There are many shapes in the Cyrillic that are identical to Latin shapes, even though they often represent different sounds, so there's a large subset of the Cyrillic done there. Many of the remaining are architecturally structured—the opposite of the Greek—and so follow some basic construction principles. Maxim Zhukov helped out here, with critiques of the more difficult and distinctive shapes. He made it possible to move beyond the most conservative forms to more adventurous yet readable shapes.

"You might notice that the lowercase of the Cyrillic has a very nice directionality in its stems, where the entasis flares out to the left. This is a slight hand-written hint of an asymmetrical serif, which gives a dynamic texture that is sometimes not evident in a traditional, fully-serifed Cyrillic lowercase; it helps distinguish the lowercase shapes further from the uppercase without disturbing the pattern of the counters.

"The small capitals for the Cyrillic guided the proportions for the others; they are rather like medium caps. They are noticeably larger than the lowercase, so they will be distinctly different from the lowercase when displayed on-screen."

In the Candara fonts, "the Latin is by far the most extensive; there are over 400 glyphs for Latin in uppercase, lowercase, and

α A δ Δ ι I ε E
a A д Д p P
SMALL CAPS
i I d D f F g G

smallcaps. Eventually I'd like to add more extensive support for the Asiatic Cyrillic, and of course polytonic Greek is essential for scholarly work and for those communities that didn't go monotonic. The Greek already has a few alternate forms, but it would be nice to add some archaic forms such as *stigma, digamma,* and *qoph."*

Designing italics for the Greek and Cyrillic was a bit different from designing a Latin italic. "After the attempt at the oblique instead of cursive, I knew the Greek and Cyrillic versions would need to be as cursive as possible. The Greek, being already fluid in the upright, got even looser and more gestural. The Cyrillic, so architectural in its upright, took on the same format as the Latin wherever tradition dictates that shapes are shared – Latin ***m*** is Cyrillic *te,* ***u*** is *i,* ***n*** is *pe,* ***p*** is *er,* etc. The most distinctive shapes of Cyrillic cursive got full treatment as unique to the script. And all three cursives have deeper nicks and smoother interior branchings than the upright variants, which are rather flatter in the arcades; the cursives are deeper and more parabolic. I think this helps distinguish the two usages, especially in moderate resolution uses where more subtle cues must fall out. ClearType helps there too, as its hinting can retain larger details at lower apparent resolutions."

Munch has notions about how Candara may get used in practice, but he doesn't want to tell people how to use it. "As with all typefaces, there aren't limits that can be imposed by the maker; it's up to the user to decide. I think that these will be useful where a readable face is needed that has a friendly personality but isn't intrusively so." He's been putting it to use himself in practical ways: "I've been using Candara for my browser font, and it seems to do well at all sizes; the bold is impactful but not overbearing, and the italic is emphatic and still readable." Candara's informal style also makes it ideal for e-mail correspondence.

Candara | Καντάρα | Кандара

Designer: *Gary Munch*
Type family: *4 styles (regular, italic, bold, bold italic); 968 glyphs per font*
Layout features: *smallcaps, stylistic alternates, localized forms, standard ligatures, uppercase-sensitive forms and spacing, oldstyle figures, lining figures, arbitrary fractions, superscript, subscript*

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[Candara 11/13.5]

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має право на свободу
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{ 27 July 1794 } *l'Haÿ-les-Roses*
57⅗ bottles of moonshine?
HWÆT! Hódmezővásárhely
a fine kerfuffle *de théâtre…*
alle Menschen! un gran virtù
¿también? Staroměstská
Timișoara *ní bhíonn súil*

[Candara 22/26]

Calibri | Καλίμπρι | Калибри

Designed by Luc(as) de Groot
Luc(as) de Groot studied at the Royal Academy of Fine Arts in The Hague under Gerrit Noordzij. He then spent four years with the Dutch design group BRS Premsela, mainly on corporate identity work. In the meantime, he taught at the Art Academy in Den Bosch and freelanced before moving to Berlin in 1993 to join MetaDesign for four years. Since then he has founded his own digital type company, FontFabrik. Still in Berlin, he occasionally finds time for sleep between work, reading, writing, and drawing. At regular intervals he is asked to deliver one of his trademark lectures: inspiring mixtures of education, self-promotion, and fun, which may take up to four hours.

GIJ

DESIGNER'S DESCRIPTION: Calibri is a modern sans serif family with subtle roundings on stems and corners. It features real italics, smallcaps, and multiple numeral sets. Its proportions allow high impact in tightly set lines of big and small text alike. Calibri's many curves and the new rasterizer team up in bigger sizes to reveal a warm and soft character. This font is suitable for documents, email, web design, and magazines.

A sans serif with rounded ends

"In late 2002, I was working on the monospaced Consolas for Microsoft," says type designer Luc(as) de Groot. "I was then asked to quickly supply a new proposal for a sans serif, because they wanted to have more options to choose from. I started off with some sketches I had once made with TV broadcasting in mind. It had rounded corners and stem endings, which looked particularly bad in ClearType. So I removed the round elements and redesigned the character forms while checking character feature recognition on a subpixel-driven flat screen.

"Before sending off the proposal, I decided to send a sample with re-attached roundings as well, and wrote, 'I like the look of it, but as you see these rounded tops look real ugly in ClearType; don't choose this.' Some years before, at the ATypI conference in Copenhagen, Greg Hitchcock and Mike Duggan had been showing their amazing ClearType stuff. I took a close look and said, 'It's OK, but I don't like it yet.' I referred to some sizes in Arial where the vertical stems were maybe 1⅔ or 2⅔ pixels wide, but the horizontal stems had already jumped to the next whole pixel step, in effect rendering them darker than the verticals. I didn't like the fact that all the more-or-less horizontal stems were always rounded to whole vertical pixel borders; that might look good for Arial, but not for more humanistic fonts. In my fonts I might want to have 1½ or 2½ pixels for horizontal stems with normal grayscale anti-aliasing; I would like to control that through something like the 'gasp' table.

"To my astonishment, Microsoft chose the proposal with rounded corners. As I soon found out, the rasterizer had indeed improved, and rounded tops and bottoms could be rendered smoothly now." (*See page 14.*)

De Groot had ambivalent feelings about working on a rounded typeface design, even though it had been his idea. "I had worked on fonts with rounded corners before, and I knew that there were going to be an immense number of points to handle. I decided to design the two weights as a Multiple Master. Even though this was more work than designing the weights separately, it had good effects on the design's consistency. This also allowed me to change the weight of the regular slightly, late in the process, to be more in line with the rest of the ClearType fonts.

He wasn't going to leave the hinting of his fonts to anyone else. "Many years ago I had commissioned a company to hint some of my fonts, but I was so unhappy with the results that from then on all my hinting was done in-house. Hinting, especially for black and white, is redesigning the fonts in bitmaps, and therefore is a serious design challenge. As I was also going to hint the Microsoft fonts myself, I did not want to hint the same glyph construction twice, so I figured that by making the Regular and Bold point-by-point compatible, I could re-use the complicated hinting constructions of one for the other. The large number of off-curve points made setting the hint instructions extra difficult."

There are built-in problems in using multiple-master technology, which was designed for PostScript fonts, to develop fonts that will end up as TrueType. But De Groot likes to push the technological limits. And necessity bred invention; he worked with the developers of current font-production software to find ways to make the two technologies work together.

"So at a certain point the Calibri family existed as two True-Type MultipleMaster fonts, Roman and Italic, a good format for setting basic hints and playing with stem widths in pixels. In this format I cleaned up outlines, removed thousands of points, and even designed glyphs directly in TrueType curves. That is not as easy as handling PostScript's bezier curves, but has advantages in certain situations."

A complex and well-funded project like the ClearType font collection, made for a demanding customer like Microsoft, can drive font technology developments and lead to improvements in tools and work processes that will eventually benefit all font makers. To meet the needs of the ClearType designers,

new features have developed for the commercial font software FontLab; a new version of Microsoft's OpenType Layout tool, VOLT, has been released; and a number of small tools for editing font tables have been made or extended.

De Groot comments: "I had already sent Yuri Yarmola [of FontLab] my ideas about kerning some years before, when I presented the 'Kernologica' lecture at a technical font conference. Right in the middle of the ClearType project, he found time to implement some significant improvements. So I could actually get many of my remaining wishes implemented: class kerning, exceptions, automatic context, sorting and filtering of tables. I hired a Dutch programmer, Niels Poppe, who helped me overcome the technical difficulties to get the kerning into Microsoft's VOLT application. Niels also managed to overcome the limitations of Microsoft VTT, by building a database structure on top of it, so we could still change the order of succession of glyphs in the fonts, and share hint structures between the two weights. Additionally, he built CVT controls mimicking FontLab's interface, and more; yet getting the CVT to behave properly took most of the time.

"As the basic hint structures were finished rather early, I spent some time adding hint 'strokes,' and the fonts were starting to look pretty good in black and white, and in grayscale as well—until I discovered some strange behavior with these strokes in ClearType, and thousands of strokes had to be removed. Niels accomplished this with clever programming in just a few days; by hand it would have taken weeks. I was surprised to find that my two families were the first of the ClearType fonts to be checked in—a pleasurable closure for an exciting year."

The technical problems and the complex process of developing Calibri influence the way the design turned out, but of course what matters to users is how it looks and how it functions on their screens.

"Calibri is particularly good at showing the strength of the new rasterizer; the rounded tops of stems are well controlled in small sizes, and zooming in, they gradually reveal their real smoothness."

De Groot is known for putting extras and alternates into his fonts, and Calibri is no exception. "On top of the default character set, Calibri contains extra ligatures, some

Hinting, especially for black and white, is redesigning the fonts in bitmaps, and therefore is a serious design challenge.

discretionary ligatures including a Dutch *lange ij* (**ij**), small-cap figures, some extra fractions, an alternate lowercase **g**, direction arrows, and a swash ampersand" in honor of his 1994 typeface TheSans.

"The italic Calibri lowercase is constructed to the italic hand, with upstrokes and downstrokes for a classic distinction to the roman. The family has a generous width that makes reading easier by emphasizing the reading direction; as a result, lines can be set tight if compactness is needed. This need arises in small print—a pocket Bible? try Calibri!—as well as in display sizes. A two- or three-line headline or subheadline? Try Calibri again."

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Για όσους διαβιώνουν σωστά ολόκληρη η ζωή περνάει γρήγορα, μα για όσους ασχημονούν και μια νύχτα είναι ατελείωτη.

Calibri | Καλίμπρι | Калибри

Designer: *Luc(as) de Groot*
Type family: *4 styles (regular, italic, bold, bold italic); 1,119 glyphs per font*
Layout features: *smallcaps, stylistic alternates, localized forms, standard ligatures, uppercase-sensitive forms and spacing, oldstyle figures, lining figures, smallcap figures, arbitrary fractions, superscript, subscript*

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ΓΙΑ ΟΣΟΥΣ ΔΙΑΒΙΩΝΟΥΝ

σωστά ολόκληρη η ζωή *περνάει γρήγορα, μα για όσους* **ασχημονούν και μια νύχτα** ***είναι ατελείωτη.***

В ЧАЩАХ ЮГА ЖИЛБЫЛ

цитрус да, но фальшивый *экземпляръ. Кожна людина* **має право на свободу** ***думки, совісті і релігії.***

BOSTON SPA · LS23 7BQ

le 9 thermidor an II {27 July 1794} *l'Haÿ-les-Roses* 9⁵⁄₁₈ firkins of India pale ale? HWÆT! Hódmezővásárhely a fine kerfuffle *de théâtre… alle Menschen!* un gran virtù *¿también?* Staroměstská Timișoara *ní bhíonn súil*

[Calibri 22/26]

Consolas | Κόνσολας | Консолас

Designed by Luc(as) de Groot
A biographical note for Luc(as) de Groot can be found on page 48.

DESIGNER'S DESCRIPTION: Consolas is intended for use in programming environments and other circumstances where a monospaced font is specified. All characters have the same width, like old typewriters, making it a good choice for personal and business correspondence. The improved Windows font display allowed a design with proportions closer to normal text than traditional monospaced fonts like Courier. This allows for more comfortable reading of extended text on-screen. OpenType features include hanging or lining numerals; slashed, dotted, and normal zeroes; and alternative shapes for a number of lowercase letters. The look of text can be tuned to personal taste by varying the number of bars and waves.

Making a really usable monospace typeface

Luc(as) de Groot has had experience in designing a monospace typeface before—as part of his large, popular family of typefaces known collectively as Thesis. "Back in 1995, when I designed TheSansMono, I couldn't find any good examples of monospaced fonts. All had serious design problems—too thin, bad spacing, no more than the two standard weights (Regular and Bold). The nicest monospaced fonts were found on real typewriters with a fresh ribbon."

One of the biggest problems was width. Since all of the characters, no matter what their design, have to be the same width, this is the crucial element in a monospaced typeface.

"Traditionally," says De Groot, "monospaced fonts have been rather wide. A common typewriter would be 10-pitch, ten characters to the inch. This would give a comfortable number of words per line on a sheet of letterhead.

"This can be simulated with any personal computer by using Courier in 12 point type size. The width of a character in Courier is 60% of the type size.

"Of course, the design of Courier is too thin; it used to work well on low-resolution printers, but it has a severe case of anorexia on today's 1200 dpi laser printers and subpixel-guided displays. Pictures of words exist as interactions between black and white forms; a certain amount of black is needed for optimal reading.

The nicest monospaced fonts were found on real typewriters with a fresh ribbon.

"Soon after I had designed the 10-pitch TheSansMono, more complicated paper forms asked for a narrower variation, so I made TheSansMonoCondensed to be a 12-pitch font family, twelve characters to the inch at 12 point; character widths are 50% of the type size or em. It is 80% narrower than TheSansMono.

"When I needed some monospaced characters in the normal TheSans, I found that a width of 55% worked best, and the 11-pitch TheSansMono I finally made is indeed the one whose width seems to be closest to normal reading text. Of course, the number 55% will be different for fonts that are drawn on a different scale."

He considered a wide range of alternate forms for common letters, especially those that tend to get confused with each other, or that look unusually awkward when forced to fill the same space as every other letter.

The monospaced i

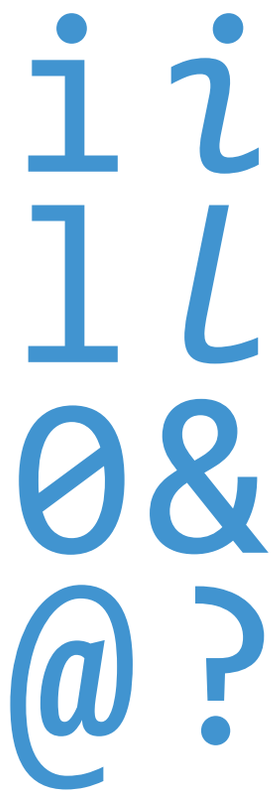
"It is obvious that a monospaced **i** or **l** should be more than just a vertical bar. Imagine the word *Himmlisch* (German for 'heavenly'), in which the six vertical bars of the two **m**'s fill the same horizontal distance as the two vertical bars of the **l** and the **i**. It does not work. The word falls apart; big white holes destroy the rhythm.

What's needed is a way to fill up more of the space, without distorting the letterforms into something unrecognizable.

"There are several ways to make **i**, **l**, and **r** fill up the white space better.

"In TheSansMono, I added horizontal bars to the tops and bottoms of these characters. On the top of the character, the bars extend to the left only; at the bottom, to left and right – the way serifs would stick out if it were a serif font. Even though this sounds like an obvious solution, none of the monospaced fonts I could find at the time had this solution." De Groot found that that was not a perfect solution, however. "I find the lowercase **r** in TheSansMono not so easy to read, as it is in Courier; it looks a bit like **t** or an old-style **1** (one).

"Consequently, when using the bars in **i**, **f**, **l**, and **r**, their readability suffers. The glyphs become too much alike."



These are the final default forms of several glyphs in Consolas, chosen after real-world testing as a programming font by developers at Microsoft. The alternate forms can be accessed through the font's OpenType features.

So he tried applying different solutions to the characters. For the lowercase **i** and **l**, he first tried forms that referred to handwriting in their construction. "A successful way of teaching handwriting is to make use of sharp beginnings and round endings, as our dear colleague Rosemary Sassoon points out. The sharp beginnings bring readability to the top of the x-height; the round endings glue the words together. In the monospaced design, such rounded upstrokes in **i** and **l** could fill the x-height area with some black weight. Also, I was pleased by the look of the word Monostil [the working name for the typeface] at large size, where **t**, **i**, and **l** all had round bottoms."

He also tried out various ideas for making clear visual distinctions among uppercase **I**, lowercase **i**, lowercase **l**, and the number **1**.

"Numbers are read differently than words: numbers are read one by one, words at once; hence, the rhythm is less of an issue with numbers. Numbers read better when they are spaced generously, so, of the glyphs mentioned, the one can leave the most white space around its body.

"The lowercase **l** is definitely the most problematic character in a monospaced font. Rhythm is mainly defined within the x-height, and as usual, the top of the x-height is more important than the bottom part. The **l** does not have a feature around the top of the x-height; it is just a naked bar. So it must be wide at the bottom. If you curve the bottom bowl upwards, the **l** encloses some white space, and its word-glue-ability is enhanced. It is also clearly distinguishable from the number one."

But not, apparently, from the uppercase **L**. When the test fonts were given to several software developers at Microsoft to try out, they found the round-bottomed **i** and **l** distracting, and the **l** too easy to confuse with a uppercase **L**. So De Groot created more traditional barred forms as the default shapes for these letters in the basic roman font, and reserved the cursive forms for the italic. "These round bottoms have moved to the more curved italics, where they feel well at home."

He tried other approaches to problem letters, some of which ended up as alternates in the font but not as the default forms. He experimented with angled endings on the upward curved stroke in his round-bottomed **i** and **l**. He tried giving some

In display sizes, monospaced fonts can’t help having a punkish radiation, a voice to solve many a design problem.

of the problem characters a wavy form, “as if written with one stroke,” but he found that they tended to look awkward, especially the **f** and **r**.

Some of De Groot’s innovations strayed too far from accepted forms, but the experimentation that went into Consolas strengthened the end result.

In the final fonts, says De Groot, “all alternative forms of these few important characters are available, so you can do hip or dead serious, wavy or barred. In display sizes, monospaced fonts can’t help having a punkish radiation, a voice to solve many a design problem.” But Consolas is also supremely useful for its core purpose: for programmers setting code. “Having a programmer involved, I could preview hardcore use on the lightweight notebook chosen to represent his species’ preferred tool,” says De Groot with a smile.

One final detail: “These fonts adhere to the common ClearType x-height, but are the only ones allowed to have a different default linespacing, to accommodate the monospaced proportions better.”

himmlisch

```
the quick brown fox jumps over the lazy dog himmlischer fluitjes  first version
the quick brown fox jumps over the lazy dog himmlischer fluitjes  angled Jfijlrt
the quick brown fox jumps over the lazy dog himmlischer fluitjes  barred filr
the quick brown fox jumps over the lazy dog himmlischer fluitjes  wavy fijlr

the quick brown fox jumps over the lazy dog himmlischer fluitjes  first version
the quick brown fox jumps over the lazy dog himmlischer fluitjes  angled Jfijlrt
the quick brown fox jumps over the lazy dog himmlischer fluitjes  barred filr
the quick brown fox jumps over the lazy dog himmlischer fluitjes  wavy fijlr
```

Consolas | Κόνσολας | Консолас

Designer: *Luc(as) de Groot*
Type family: *4 styles (regular, italic, bold, bold italic); 713 glyphs per font*
Layout features: *stylistic alternates, localized forms, uppercase-sensitive forms, oldstyle figures, lining figures, arbitrary fractions, superscript, subscript*

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz0001234567890
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ΑΒΓΔΕΖΗΘΙΚΛΜΝΞΟΠΡΣΤΥΦΧΨΩ
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АБВГДЕЖЗИЙКЛМНОПРСТУФХЦЧШЩЪЫЬЭЮЯ
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ΑΒΓΔΕΖΗΘΙΚΛΜΝΞΟΠΡΣΤΥΦΧΨΩ
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АБВГДЕЖЗИЙКЛМНОПРСТУФХЦЧШЩЪЫЬЭЮЯ
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Still others claim that language grew out of grunts of effort, inarticulate chants, or exclamations of fear or surprise. *Pythagoras and Plato and the Stoics all simply begged the question by arguing that language "sprang from necessity."* **As to just how it sprang, they do not say, perhaps fully developed from the head of Zeus. *Aristotle and Epicurus, without ever mentioning how it came about, stated that language was the product of "agreement."*** Για όσους διαβιώνουν σωστά ολόκληρη η ζωή περνάει γρήγορα, μα για όσους ασχημονούν και μια νύχτα είναι ατελείωτη. *Όταν μιλώ έτσι, εννοώ τον άνθρωπο ολόκληρο, χωρίς να διακρίνω το πνεύμα, τις καλλιτεχνικές προσπάθειες, το υπερπέραν και τα ρέστα.* **Τώρα βρίσκομαι πάλι σε μια στροφή: *μου είναι δύσκολο να αισθανθώ, μου είναι δύσκολο να ζήσω. Είμαι άνθρωπος με ψυχικά εμπόδια.*** В чащах юга жилбыл цитрус да, но фальшивый экземпляръ. *Сва људска бића рађају се слободна и једнака у достојанству и правима.* **Усе людзі нараджаюцца свабоднымі і роўнымі ў сваёй годнасці і правах. *Кожна людина має право на свободу думки, совісті і релігії.*** Pójdźże, kiń tę chmurność w głąb flaszy. *Zwölf Boxkämpfer jagen Victor quer über den großen Sylter Deich.* Kæmi ný öxi hér ykist þjófum nú bæði víl og ádrepa. *Flygande bäckasiner söka hvila på mjuka tufvor.* Laŭ Ludoviko Zamenhof bongustas freŝa ĉeĥa

[Consolas 10/12.5]

```
<TextPanel ID="root"
  xmlns="http://schemas.microsoft.com/2003/xaml"
  xmlns:def="Definition"
  FontFamily="Calibri">

    <Paragraph><SmallCaps>Μυθιστορημα,</SmallCaps>
        <Inline Typography.NumeralStyle="OldStyle"
         Typography.NumeralAlignment="Tabular">  1
         </Inline></Paragraph>
    <Paragraph><SmallCaps>Γυμνοπαιδια,</SmallCaps>
        <Inline Typography.NumeralStyle="OldStyle"
         Typography.NumeralAlignment="Tabular"> 61
         </Inline></Paragraph>
    <Paragraph><SmallCaps>Τετραδιο Γυμνασματων,
        </SmallCaps><Inline Typography.NumeralStyle=
         "OldStyle" Typography.NumeralAlignment=
         "Tabular"> 71
         </Inline></Paragraph>

</TextPanel>
```

```
public override FrameworkElement CreateFlyout()
{
  Text flyout = new Text();

  flyout.TextContent = "Hello World Flyout";
  return flyout;
}

public override FrameworkElement CreateProperties()
{
  DockPanel mainPanel = new DockPanel();
  Text property = new Text();

  property.TextContent = "Hello World Properties";
  DockPanel.SetDock(property, Dock.Top);
  mainPanel.Children.Add(property);

  // Add OK button to Property View.
  Button ok = new Button();

  ok.Content = "OK";
  ok.Click += new ClickEventHandler(OnClick);
  DockPanel.SetDock(ok, Dock.Right);
  mainPanel.Children.Add(ok);
  mainPanel.Height = new Length(75, UnitType.Pixel);
  mainPanel.Width = new Length(125, UnitType.Pixel);
  return mainPanel;
}

// When OK button is clicked, close property window.
private void OnClick(object e, ClickEventArgs args)
```

[Consolas 10/12.5]

Meiryo | メイリョウ「明瞭」

kanji | hiragana | katakana | romaji

Meiryo

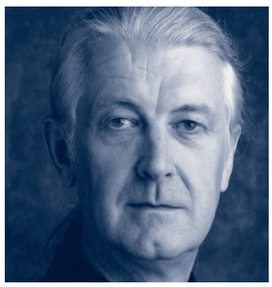
明瞭

ビデオやコミックが氾濫し、映像文化とか活字離れとか云われて久しいが、本は巷にあふれている。文字がなければノートパソコンや携帯電話だって使えない。高度な意志伝達のために「読む」という人間特有な能力は、数千年の歴史を経ながら、絵文字から表意文字や表音文字をつくり、紙や印刷を発明し、活字からデジタル文字へと進化(?)させてきた。そして今、自然環境の保護が叫ばれ、石油や紙パルプ偏重依存を押さえるためにも、電子出版や電子ブックへの移行が差し迫った現実となっている。「読みやすいスクリーン・フォント」は、ビル・ゲイツ自身が個人的にも達成すべき5大目標の一つに掲げている。

現状のスクリーンにおける限られたピクセル数では、印刷文字のような鮮明でバランスが良い文字を写し出すことは非常に難しい。スクリーンの可読性向上のため1995年、マイクロソフトが著明な書体デザイナー、マシュー・カーターを起用して開発したVerdanaは、今おそらくスクリーン上で最も読み易い文字と評価されWeb上の標準フォントになっている。1998年、マイクロソフトの可読性技術開発チームART(Advanced Reading Technology)は液晶画面のピクセルを細分する光の3原色を調整して文字の鮮明度を上げるクリアタイプClearTypeを開発。既に欧文のウインドウズXPでは、その画期的な効果を見ることができる。ARTチームはクリアタイプの効果を最大限に生かせる最適なフォント開発を進めているが、ここに紹介された欧文6フォントのデザインはそのプロジェクトの一環である。徐々に一般化してきた高解像度のSXGA+, UXGAの画面上ならば、読書に最も適した文字サイズ(9から11ポイント前後)がまるでプリントされたように読みやすいスケーラブル・フォントである。

次に、ARTチームは、欧文フォントに比べると画数も文字数も桁違いに多い漢字を使う日本語にも目を向けた。まず「現状のクリアタイプ技術で、日本語の可読性向上が可能か」リサーチするために、私がシアトルに呼ばれたのは2年前の2002年4月であった。昨今のWebページやパソコンによる事務書類の傾向から横組に適した和文フォントを重点に、可読性、組版操作、欧文との混植などを調べたところ、多くの基本的に改良すべき点があり、既存のフォントではクリアタイプの効果を充分発揮させるのは困難と結論。新しいフォントデザイン作成を前提にし、幾つかのテストフォントを試作して可能性を見た。実際、クリアタイプの効果で、本文用レギュラーと見出し用ボールドにウェート差を十分持たせることや、欧文との微妙なテクスチュアの調整を計ることができた。クリアタイプの適用に、漢字の画数省略が有効な際、草書や行書の特徴を巧みに捉えていると思えるC&Gの高品質なドット文字が適切な参考になった。

良好な試作結果に確信を得て、本格的なフォント制作を2003年1月に開始。新しいJIS規格等に添って、日本語環境の電子ブック出版に広汎に対応できるフォントとして、レギュラーとボールドを併せ4万字以上を目標どうり18ヶ月で完成。単一の欧文フォントとしても、ギリシャ文字、キリル文字、数学や科学記号など1000字以上を含み、グローバルな電子文書交換にも対応する真に実用的なフォントとなった。長い経験と新しい技術、東西の固有な文化の理解と協調が集積して生まれた新フォントは、文字どおりメイリョウ(クリア)と命名された。



Designed by C&G, Eiichi Kono, and Matthew Carter

Left: C&G. Probably the most experienced and widely reputed specialist digital-font developers in Japan, with expertise in printer and screen fonts, bitmap fonts, icons, and illustrations for major electronics manufacturers. Their experience in the development of font-related software accelerated the production of Meiryo. Right to left: Satoru Sakamoto, managing director; Takeharu Suzuki, type director; Yukiko Ueda, senior font designer.

Middle: Eiichi Kono. First-hand experience of the pitfalls of multi-language text composition in Japan took Eiichi to London to study, research, and work in typography. After working on New Johnston and British Telecom's directory, and teaching at Middlesex University, he stayed on to set up a graphic design company, now International Type Associates. Much and varied English and Japanese typography-focused work has followed; advising the *Economist* and becoming involved with Microsoft among the most pleasing. Many airmiles have been earned.

Right: Matthew Carter. A type designer with more than forty years' experience of typographic technologies ranging from hand-cut punches to computer fonts. After a long association with the Linotype companies, he was a co-founder in 1981 of Bitstream Inc., the digital typefoundry, where he worked for ten years. He is now a principal of Carter & Cone Type Inc., in Cambridge, Massachusetts. His type designs include ITC Galliard, Snell Roundhand and Shelley scripts, Helvetica Compressed, Olympian, Bell Centennial, ITC Charter, Mantinia, Sophia, Elephant, Big Caslon, Alisal, Miller, and faces for Greek, Hebrew, Cyrillic and Devanagari. Since the mid '90s, Carter has worked with Microsoft on a series of "screen fonts" designed to maximize the legibility of type on computer monitors.

DESIGNER'S DESCRIPTION: Meiryo is a very versatile modern sans serif type designed to give an exceptionally clear appearance on screen, as well as in print. It is optimized for on-screen reading. The letterforms are generously open and well proportioned; legible and clear at small sizes; and dynamic at larger display sizes. The beauty of this face is that it sets text lines in Japanese with Latin seamlessly and harmoniously. The balanced inter-letter spacing enhances horizontal alignment, facilitating smooth reading flow. Meiryo has a very large character set, with Japanese and Latin combined, fully scalable outline technology, making it extremely functional for all aspects of communication and publishing. It is a robust, legible typeface yet compact enough to enable tight inter-line spacing, which is good for space economy.

Project Meiryo Eiichi Kono

Despite the hopes and demands of 120 million potential readers for better on-screen readability, the quality of on-screen Japanese text has hardly changed since the introduction of the desktop PC. Even though screen definition has improved and font rendering technologies have advanced in recent years, this seems to have had little impact, and design and production of a new font, or even making minor modifications to an existing one, is still extremely time-consuming and costly. A Japanese font needs so many characters, many thousands even for a minimum standard, and accurate rendering on screen has been extremely difficult because of complicated stroke structures.

The Microsoft ClearType & Advanced Reading Technologies team was aiming to provide the best possible on-screen reading environment by working on available Japanese fonts with ClearType technology, and in April 2002 the group appointed me as typographic advisor to conduct research and feasibility studies and to produce trial fonts for testing. The investigation covered currently available Japanese fonts, text-composition and page layout, devices and screen sizes, various typographic constraints in different publishing fields, and trends. At this stage, starting from scratch with a completely new font was not being considered for the obvious reason (or popular belief): too

A typical passage of modern Japanese text (left), with the proportion of kanji shown in red (second from left), then the analysis of the proportions of all characters in the passage: kanji, kana, Japanese symbols, and Latin (romaji). Modern Japanese routinely uses all of these character sets.

many characters and too many strokes to handle against viable time and cost for design and production.

It is often said that the Japanese writing system is unique in the world, with its mixture of ideograms and phonetic scripts. The Japanese font consists of four different character sets: kanji, the ideograms, form about 25% of the average text; two sets of kana, with about 75% of the text hiragana (mainly for grammatical inflexion), and katakana for foreign words; and Latin (roman alphabet with arabic numerals). Depending on the text, the incidence of katakana and Latin might increase significantly. Pick up any Japanese newspaper or magazine, for example, and any day you will see plenty of "foreign" characters scattered around.

Looking at the characteristics of each set, the kana, with just under 100 characters each, have simple stroke structures, similar to Latin glyphs. The kanji can vary from a single stroke to complicated structures of some thirty-odd strokes. As for the number of characters, the minimum publishing standard (*e.g.*, for a newspaper) is for at least 7000 kanji characters, while more comprehensive standards (*e.g.*, for academic texts) require over 20,000. This is the seemingly awesome obstacle for the type designer and font foundry, and for anyone wanting to buy a new font – it's expensive!

In continuous text, the characteristic mix of characters gives rise to a "bitty" or spotty texture, but in fact this contributes to readability, as kanji, the principal parts of words and phrases, are picked out more easily. (This is the reason why kanji cannot be easily reduced or eliminated). Significantly, there is no "inter-word" space, except where Latin is used, so kanji have to be distinguishable against their kana counterparts. Nevertheless, all the characters in a text should be well-balanced in terms of weight and size ratio, presenting an harmonious whole, neither too bitty nor too flat. The trouble is that this subtlety is impossible to obtain on lower-resolution screens. (It would be possible, however, up to certain type sizes if ClearType were utilized.) Some existing Japanese on-screen fonts have associated bitmap fonts for the smaller type sizes with which rasterization cannot cope. On the down side, these bitmaps hugely increase the font data size. This burden, together with coarse screen resolution, has meant that up to now it has only

毎年五十万人もの日本人がロンドンを訪れると聞くが、ヨーロッパの中でも観光やビジネスや英語の勉強にも一番人気のある都市に違いない。私もその一人として生まれて初めてここに来たのは三十年近くも前のことだった。喧噪な人込みの街中を戸惑いがちに歩く時、バスや地下鉄を表示するラウンデル Roundel と称される丸い単純で覚え易いシンボルがよく目立ち助かったことを今でも思い出す。この口ゴマークに少しばかり古めかしい感じのシンプルでエレガントなアルファベットが付添っていた。これこそ正真正銘、エドワード・ジョンストン Edward Johnston 作の世界的に有名なサンセリフであった。

世界で最初の地下鉄がロンドンで開通したのはビクトリア時代の1863年であった。いくつもの私鉄路線を統合し発足したロンドン交通局にとって、雑多な駅名や行き先をいかに利用者に判り易く表示するかは苦労の種であったようだ。将来を見抜く洞察力と積極的な行動力に加え、芸術的な感性にも富んだ人物と評されている当時の交通局長フランク・ピック Frank Pick がジョンストンに依頼した文字デザインの基本形は1916年にはじめて導入され、今もなお人々に親しまれている名作書体である。

その美しく均整のとれたスタイルは、紀元二世紀までに極限に達したといわれるローマ時代の石碑文字を規範にして、新しい二十世紀の科学の進歩と機械文明に発する機能美を昇華させた「気品のある、読み易い」画期的なサンセリフ体として評価されている。そして、作者不明の傑作ロゴマーク「ラウンデル」と、原型が1930年代にハリー・ベック Harry Beck によって作成された路線マップと共に情報デザイン史上で特に意義ある成功例として、今日まで多くのデザイナーに強い

really been feasible for a font to have one weight. With "regular" only and no "bold," layout style has been limited – the text appearance is bound to be monotonous and unfriendly (that is why most web pages look tacky, with too many type sizes and colors). Also, the appearance of text on screen becomes so different from a printout that it is misleading for page layout. It is a nightmare for book designers and publishers.

Print publishing is still at a transitional stage, but vertical setting is giving way to horizontal setting almost everywhere else. Web pages, mobile phone displays, and the vast majority of office documents use horizontal setting, and young people prefer to write and read horizontally. However, horizontal setting in Japanese doesn't look good – spaces between those characters (we can't call it inter-character spacing, since it certainly is not that) are mostly too wide and irregular, disrupting the horizontal linearity needed for smooth reading flow. The reason stems from the old days of hot-metal type composing: every individual kanji (or kana) character was placed (cast) in the visual center of an "imaginary" square (the metal body), so that they neatly lined up either vertically or horizontally. This problem is more pronounced for Latin characters, as inter-letter spacing and horizontal alignment are particularly unconsidered (or perhaps well-considered for "vertical" setting, as the Latin characters are also placed in the visual center of the square, in an effort to align optically with the Japanese text). Either way, Latin glyphs are contorted to fit into the square, or overstretched to fill in the square. This leads to the baseline of imported Latin fonts appearing too high, requiring cumbersome manual adjustments. Also, many critical Latin glyphs are often missing from Japanese fonts, because of the limitations of the Japanese Industry Standards, which causes more serious problems in document exchange.

Font design in Japan is struggling to respond well to the particular demands of a horizontal world, and we found that none of the existing Japanese fonts could be adapted for on-screen reading and horizontal text-setting. So, we began to consider the feasibility of building a complete Japanese font from scratch, tackling all these inherent problems head-on.

First, we investigated stroke-reduction, so the next step was to design small sets of experimental Japanese fonts for

A clean, simple, straightforward sans serif typeface with a Verdana "feel"

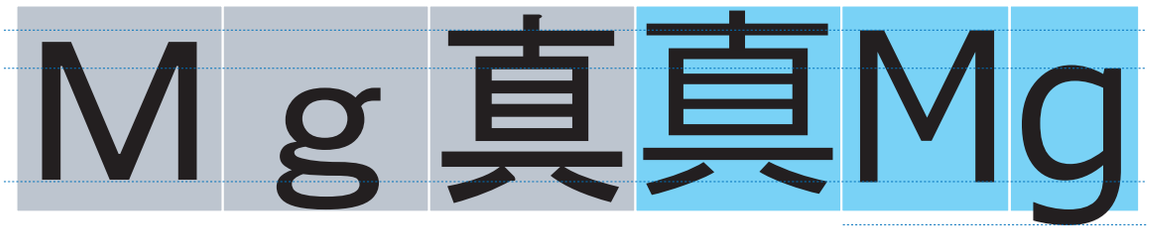
EIICHI KONO

Stroke reduction, which aids the legibility of complex kanji at small sizes by reducing the number of strokes that have to be shown, has roots in a long calligraphic tradition of simplifying the strokes. Here is the same character in three small sizes of bitmap fonts (top row) and handwritten in three different calligraphic styles (bottom row).

comparison, and to test them with ClearType hinting. I was aiming to optimize horizontal legibility on-screen, and the one font with a reputation as the most legible, and therefore the most popular for on-screen reading, is Verdana, designed by Matthew Carter. Its clear and straightforward style was a reference for the new design I had in mind: a clean, simple, straightforward sans serif typeface with a Verdana "feel"; maximum use of the square boundary (em-body) to gain a large face (appearance) for better legibility/visibility, and a wider counter, giving more tolerance for rasterizing and hinting; and tighter inter-letter space, to gain horizontality for better readability in line composition.

This idea would work with kana and the simpler kanji, but it would take a lot of effort to make it work with the fussy kanji with so many strokes. However, I was confident for three reasons. Firstly, we could manage more subtle adjustments with Japanese characters in today's friendlier typographic environment, with ClearType and higher-resolution screens and hinting technologies. Secondly, I was already familiar with Verdana's well-tested design principle, clearly stemming from Bell Centennial, which had also been designed by Matthew. (My feasibility study in readability and space-saving for the redesign of the British Telecom phonebook in the 1980's concluded that Bell Centennial was exceptional.) Thirdly, the small-size bitmaps commonly used for small electronic devices in Japan provide a wonderful reference for stroke reduction to produce pseudo-kanji. (And it is nice to know that bitmaps may themselves be referenced from the elegantly spare styles of master calligraphers.)

Japanese digital font makers have, of necessity, become masters of bitmapping. Current Japanese on-screen fonts have many bitmap fonts along with the outline data, such as 16×16, 18×18, 22×22, and 24×24 for on-screen reading sizes, somewhat equivalent to 9, 10, 11 and 12 point type sizes (the Japanese standard reading size is equivalent to 10.5 point). Even smaller bit maps are common for the (mostly obsolete) dot-matrix printers, and for public display panels and screens, the smallest being 10×10, although a minimum of 16×16 dots are needed to show the skeleton of kanji, and at least 24×24 dots to show some differences in style and weight. At the other end



Alignment: a typical Japanese type from the old days (left) and the Meiryo solution (right).

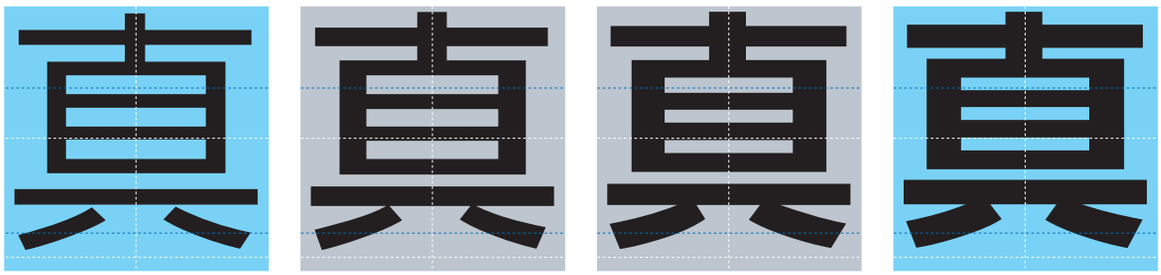
of the scale, it has been found that stroke reduction applied to some kanji characters enhances the legibility of directional signs on motorways, suggesting that stroke reduction may be contributing to better pattern recognition rather than hampering it.

Using Verdana as a benchmark for testing sample fonts, Mike Duggan and I experimented with adjustments to the weight, contrast difference between regular and bold, character height, counter, inter-letter space, baseline and horizontal alignment, and hinting, to see if we could achieve high-quality results through a combination of outline design and stroke reduction for both low- and high-resolution screens. Some problems were peculiar to Japanese.

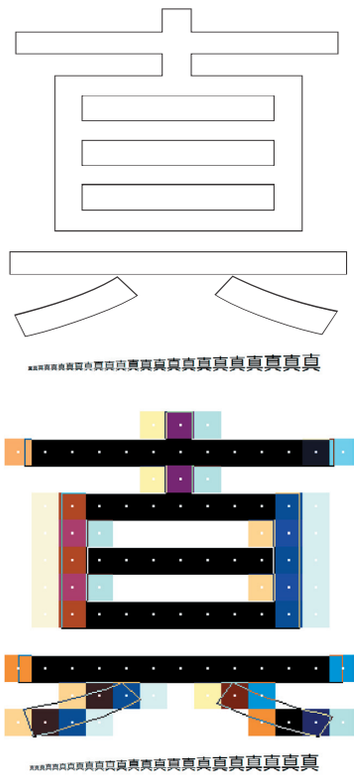
One of these is alignment. Japanese has no horizontal axis: no x-height, no cap height, no ascender, no descender, therefore no "baseline." When we used Verdana as our first base model, alignment parameters automatically came into play. We shifted the position of Japanese glyphs up 5% in the "square box," and made the proportion of the glyph rectangular, with a height-to-width ratio of 95:100. In this way, the slightly expanded glyph shape contributes to the horizontality of the text line, and gives an up-to-date look. This also eliminates the chronic misalignment of the baseline when Latin fonts are imported.

Another problem is spacing. Casting a character on a square metal body seemed for a long time to provide a practical advantage for typesetting Japanese text vertically and horizontally. Now is the time for Japanese digital fonts, including their Latin fonts, to liberate themselves. We gave the glyphs the maximum width within the imaginary square boundary, creating slightly tighter inter-letter space, which reduces the potential for white rivers and gives a more distinctive appearance, both assisting the smooth flow of horizontal reading and fitting well with proportional Latin. This tighter inter-letter space also facilitates the tighter setting of text lines, contributing to space saving: the default line space could be 20%, the same as that of Latin, whereas the most commonly used Japanese line space is 50% (though recent web page design has made a dog's dinner of it all).

The result of these experiments was extremely convincing. Good parameters were gathered for the new font specifications.



Meiryo Regular Two weights for Japanese on-screen font – ClearType has made it possible! **Meiryo Bold**



The unhinted Meiryo outline (top) renders as uneven bitmaps that collapse and become unreadable at small sizes due to the number of horizontal strokes and white space fighting to occupy the limited number of pixels. When hints are applied to reduce the number of strokes (bottom) , a clean and readable bitmap can be rendered even at the smallest sizes.

By now we had a project code name – Verdana-J. We also looked into any possibilities of having lighter and smarter hinting, more precise and efficient stroke reduction, and speedier production of outlines.

We then had a stroke of luck. I already knew C&G, a Japanese font design company with a great deal of experience in making screen fonts for OEM customers. Senior type designer Takeharu Suzuki was in the process of adapting an unfinished Japanese Gothic (sans-serif) font to horizontal setting. I saw a good potential in its clean straightforward style, and C&G agreed to make this available, and to produce outline fonts to my design specifications. Referring to our initial experimental font design, I spoke with Matthew Carter about the possibility of his designing a new Latin font to be incorporated in the Japanese font and also to work as a complete stand-alone Latin font. He agreed to work with us on a new, revised and fortified Verdana, following my design specifications. C&G were willing to work with my idea to make conscious efforts to utilize Western typographic elements as common denominators in the design details of Japanese fonts. Extensive horizontal setting is relatively new to Japan, whereas Latin (European) typography has been dealing with horizontal typesetting and reading for over 500 years; even though the languages are different, there must be many common factors contributing to readability.

The last problem was how to produce the sheer number of glyphs in a reasonable time and at a reasonable cost. A comprehensive standard font needs over 20,000 characters. Therefore, for this project, over 40,000 outline glyphs in two weights, regular and bold, had to be produced, and they had to be hinted (although this is a big task, the fonts did not require associated bitmap fonts, which reduced the amount of labor). We divided the font character set and prioritized by the frequency of kanji use – according to the data available (Professor Tadayoshi Murata, Yokohama National University, "Frequency of kanji use in Japan and China," March 2000), just under 3,000 kanji characters cover 99.9% of daily use. By adding kana and Latin characters, we could say that these "3,000" characters would cover practically all, so they were the first to be drawn and hinted, and then carefully analyzed as models to

make the subsequent production of the rest as automated as possible.

The early collaboration with C&G and Agfa Monotype meant that font design development and production were very efficient. C&G, with their expertise in bitmap making, provided a set of bitmap fonts, such as 10×10, 11×11 and 12×12, for use as a visual reference for stroke reduction. Tom Rickner, who had worked with Matthew on Verdana, was in charge of hinting the fonts. The mass production of outline work was handled by C&G using their in-house automated production method working with the analyzed data of kanji radicals.

Altogether there was great satisfaction in the bringing together of ClearType and Visual TrueType by the Microsoft Advanced Reading Technologies group; Matthew Carter's Verdana; Takeharu Suzuki's experimental Japanese Gothic; C&G's production capacity; hinting work by Agfa Monotype; and my own thirty-odd years of experience in typographic practice in an English/Japanese language environment, to produce Verdana-J, now named "clear and bright": Meiryo.

meiryo

Romaji Matthew Carter

By the time I got involved with the Meiryo project, Eiichi had decided that in terms of style Verdana would make a good companion to the "Gothic" Japanese type that was under development, but that every single dimensional aspect would have to be altered to bring it into compatibility of appearance with the Japanese. ("Compatibility of appearance" may be the wrong term, but the criterion was a visual one having to do with the two scripts looking the same size, and setting at mutually comfortable rhythms.) Eiichi himself made various experimental scalings and weight changes to Verdana in Fontographer, and made similar adjustments to the alignment, weight, and size of the Japanese to bring the two into the best possible relationship. Diagrams that combined Japanese and Latin glyphs and gave their respective stem-weights, vertical dimensions, and spacing were the first things that I received from Eiichi as guidance. I agreed completely with Eiichi about all his recommendations. Because we wanted the Latin face to fit tighter than Verdana, we originally considered basing it on an

Verdana

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Meiryo

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Tom Rickner

Tom Rickner is recognized for the highly regarded TrueType production and hinting of Matthew Carter's Georgia, Verdana, Tahoma and Nina typeface families, commissioned by Microsoft. While employed by Apple Computer, Tom oversaw the development of the first TrueType fonts to ship with Apple's System 7 and during the past 12 years, working for the Font Bureau on a freelance basis and for Agfa Monotype, he has produced custom font solutions for many companies, including Adobe Systems, Apple Computer, Hewlett-Packard, IBM, Lexmark, Lotus, Microsoft, and Nokia. Tom's design and technical experience includes hand-editing bitmap fonts, designing original outline typefaces, extending existing typefaces for new character sets and scripts, and all manner of outline font production.

interpolation between Verdana and Tahoma®, a narrower and tighter derivative of Verdana, but in the end I found it easier to work from Verdana itself.

The fact that we could even consider changing the dimensions of Verdana was of course a product of ClearType – as was the possibility of undertaking Japanese at all as scalable outlines. The Verdana/Tahoma/Nina® and Georgia series had all been produced (between 1993 and 1997) in the typographically inhospitable environment of the spatial resolutions of computer screens of the time. As "screen fonts," they had the opposite priority to that of existing typefaces, which had been designed as outlines for printing on paper and whose screen bitmaps were a by-product meant only as previews to the real thing. Now the coarse-resolution (screen) version of the font became more important than the high-resolution (printer) version, and the new faces were accordingly produced "backwards," i.e., bitmaps first. Only when the bitmaps of the three most important text sizes had been proved on the screen were the outlines designed, essentially by wrapping them around the bitmaps. It would be an over-simplification to say that screen fonts developed in this "backwards" manner were self-hinting – Tom Rickner contributed a great deal to the results – but in the interests of making the outline-to-bitmap conversion as accurate as possible it would be true to say that every single measurable feature of Verdana was determined by the prototype bitmaps: vertical dimensions (capitals, lowercase x-height, ascenders, descenders), stem-weight, spacing, relative weights of Regular and Bold, Italic angle, etc.

Although the functional needs of Verdana (and the other screen fonts) were uppermost because of the imperative of legibility on screen, I would not say that the design was a pure example of "technodeterminism." The lack of detail in the text sizes on screen reduces them to a sort of generic pragmatism, but at large sizes onscreen and at all sizes on high-resolution printers, where detail comes into focus, Verdana aims to have some visual interest. Working within constraints is not the same thing as making compromises, and understanding the constraints at the outset of a design and working within them is a very different thing from working freely at first and coping with unanticipated constraints later on. I'm sure it was

I was able to design without reference to the bitmaps, confident that good hinting would control the rasterization in a way that had been impossible during the work on Verdana.
MATTHEW CARTER

helpful to me that 20 years before Verdana I had designed Bell Centennial, another "problem-solving" sanserif typeface. Here, also, the problem (digital composition at tiny sizes in telephone directories, in that case) was severe, but not intractable, because it could be studied and understood in experimental conditions. With Verdana I had played a part in figuring out the constraints associated with low-resolution bitmaps, so I was comfortable working within them. I mention this aesthetic or stylistic quality because I think it was important in Eiichi's decision to base Meiryo on Verdana, in conditions where more detail would be apparent because of improved screen resolution, thanks to ClearType.

The working method for Meiryo Latin (and Greek and Cyrillic) was very different from the "backwards" process of Verdana and much closer to the normal way of developing outline fonts. The difference is of course due to the greater subtleties of ClearType: I was able to design without reference to the bitmaps, confident that good hinting would control the rasterization in a way that had been impossible during the work on Verdana. The diagrams made by Eiichi to explain the ideal relationship between Japanese and Latin guided me in transforming the outline data of Verdana into the new contours of Meiryo. All the measurable aspects of Verdana were changed, now that the straitjacket of conformity to pre-made bitmaps was removed, but I made a conscious effort to keep the stylistic features of Verdana that had appealed to Eiichi in the first place (and that I too was keen to preserve). I began by making trial fonts of control glyphs (a small subset of characters that embody the critical dimensions) to match the numbers suggested by Eiichi; these were then hinted by Mike Duggan and reviewed on screen. They were always studied in combination with the Japanese, not as a stand-alone Latin typeface. In practice, some of the dimensions needed to be tweaked as the result of the tests. Working in this empirical manner through a number of iterations, we fine-tuned the outline data to establish the correct size, weight, and spacing for all four members of the Latin family: Regular, Italic, Bold, and Bold Italic. The complete glyph complement of Meiryo is essentially the same as Verdana's, with a few additions and subtractions required by Japanese practices in using the Latin script.

Meiryo

Designers: *C&G, Eiichi Kono, Matthew Carter*
Type family: *4 styles in 2 fonts (regular, bold, with italic and bold italic for Western subset); 20,680 glyphs per font*
Layout features: *for kanji, hiragana, katakana, Latin, Greek, Cyrillic; includes half-width and vertical characters, annotation forms, smallcaps, old-style figures, ligatures.*

日大年国会本人中上出一町業長行金事社者合自月田分
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[Meiryo 24/30, regular & bold (top)]

[Meiryo 10/13, regular & bold (bottom)]