

which had been produced in England, with whose quality Knuth was not at all pleased.

That was the beginning of METAFONT,<sup>1</sup> a type font for scientific typesetting, on which he had been working since 1978. In a lecture on “Mathematical Typefaces” in 1979 he had reported on his ideas. This was published in the “Bulletin of the American Mathematical Society”.<sup>2</sup>

Knuth’s original intention was to base a new type shape on imitating electronically the strokes of a broad-nibbed pen. He even tried to simulate the effect of pressure on the nib in the resulting calligraphic shape. But our alphabet is not structured systematically; with *N*, *M* and *Z*, for example, the normal pen stroke breaks down at an angle of about 30 degrees. In 1980, with Stanford University students — among them David Siegel, whom I will mention again later — we employed METAFONT to develop Knuth’s conception of Computer Modern. I stayed at Stanford for two weeks. It was extraordinary how fast Don Knuth grasped rather complicated details, as if he had previously worked on the design of letterforms.

In “Der Spiegel”<sup>3</sup> of 23 June 1980, there appeared an article about our research work with the obscure headline “Lieber Butter”.<sup>4</sup> It is still a mystery to me how these people learned of the project and how they acquired the nice photograph of the two of us from the Stanford photographer. This article, with such a silly headline, has certainly never been read by any scientist; perhaps some farmers were interested. But one is simply amazed by the information sources and connections of this magazine. The headline “Lieber Butter” had been chosen according to “Der Spiegel” because Don Knuth had once said that he refused to eat margarine instead of butter.

About T<sub>E</sub>X, “Der Spiegel” wrote that it is a fundamental computer program to transform texts of arbitrary content or in any language into an optimal form — type size, a combination of different fonts, line spacing, appropriate hyphenation and distribution of words over complete paragraphs could all be controlled. End of citation.

Digital word processing originated with Dr. Rudolf Hell in Kiel.<sup>5</sup> He is regarded as the father of digital word processing. He started already in

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## My collaboration with Don Knuth and my font design work

Hermann Zapf

The story of my collaboration with Don Knuth and a few thoughts on typography. Since 1977 I have been teaching typographic computer programs at Rochester Institute of Technology. That was about the time when Steve Jobs and Stephen Wozniak were tinkering with their first Apple computer.

RIT was the first university to investigate typographic programming. The idea was to build a logical structure of typographic rules into repetitive functions of a program structure.

My collaboration with Don Knuth started in 1979, when he was working on his Computer Modern design. An extended correspondence preceded our first meeting. In 1980, I was invited to Stanford University, to work within the Computer Modern project.

Knuth was one of the first scientists to think about the appearance of mathematical text pages. The motive was one of his mathematical books

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This is a translation of the article “Meine Zusammenarbeit mit Don Knuth und meine Schriftentwürfe”, which appeared in *Die T<sub>E</sub>Xnische Komödie*, 1/2000, pages 37–44. Reprinted with permission. The translation was prepared by Dieter Glötzl. Footnotes and figures added in the translation.

<sup>1</sup> Editor’s note: more likely Computer Modern, although work started on both at about the same time.

<sup>2</sup> Donald E. Knuth, “Mathematical Typography”, *Bull. Amer. Math. Soc. (New Series)* **1** (1979), 337–372.

<sup>3</sup> a political weekly magazine in Germany

<sup>4</sup> this means “Butter preferred”

<sup>5</sup> a German town on the Baltic Sea

1925 with his so-called “Hellschreiber”.<sup>6</sup> The letters were reduced to a set of small dots in order to transmit them. In 1964 he invented the “Digiset”, the first electronic photocomposition machine, and thus began the era of digital resolution of type. In recognition of his pioneering work he was awarded the Gutenberg Prize of the International Gutenberg Society in Mainz in 1977. I designed the first digital alphabets for the Hell Digiset machine. These were “Marconi” in 1976 and “Edison” in 1978. Initially the resolution of the characters was relatively coarse, but after a just few years, the staircase-like structures along oblique lines had disappeared.

As a book designer one continues to try to find new ways to make production more rational and less costly. This led me to consider the idea of processing typographic information with computer programs.

At the TH Darmstadt,<sup>7</sup> where I have taught typography since 1973, nobody was keen on such ideas, and also the industry was not interested in typographical problems and tried instead to achieve higher typesetting speeds with their machines. So I talked about my intentions in the United States.

In 1964 I was invited to lecture on programmed typography at the Carpenter Center of Harvard University. A few years later I received a generous offer from the University of Texas. I was ready to move to Austin, but my wife would not, although everything looked rather attractive. During my stay in Austin I was appointed an “Honorary Citizen of the State of Texas” with all privileges. Presumably I would have been exempted from paying state taxes. But the dream was over.

In 1976 the Rochester Institute of Technology offered me the chance to be the successor to Professor Alexander Lawson, who had been teaching typography there since 1947. I would teach typographic computer programs for the first time. This was before MIT in Cambridge or Stanford in California started similar activities. We devised the most beautiful solutions, but in the end the realization failed at IBM and Xerox because of the huge amount of memory we would have needed for our programs.

In 1977, with some friends, I founded a company in New York which was to develop practical solutions with a menu-based user interface. We planned to develop programs with a simple structure in order to penetrate the American office market.

Back to Computer Modern. I regarded this type as a little too thin for a text font, but we

could easily produce a stronger version from the METAFONT data later on. In particular, I foresaw problems with greatly reduced documents. As soon as we had digitized a structure of the type everything went rapidly.

The next extensive project together with Don Knuth was the type family “Euler” for the American Mathematical Society ( $\mathcal{AMS}$ ) which started in 1979. It was the critical test for the first version of METAFONT. Knuth wanted to have alphabets fully adapted to mathematical typesetting which would fit nicely into a text. Several visits to Stanford and an extended exchange of letters accompanied the Euler project, which should have been finalized for the 200<sup>th</sup> anniversary of Euler’s death. You will surely know Leonhard Euler. He was born in Basel<sup>8</sup> in 1707 and died in St. Petersburg<sup>9</sup> in 1783. But it took us until 1985 to finish the type family named after him. Based on the experience with the representation of type characters, Don Knuth developed an improved version of METAFONT which included also an outline method for producing complicated type shapes.

David Siegel together with other students of Knuth worked with us again on the digitization of the Euler type. In 1985 he wrote the report “The Euler Project at Stanford” for the Department of Computer Science of Stanford University.

A further documentation on the complete Euler type family, which included in addition to the Latin alphabet also a Greek, a Fraktur and an italic, was edited by Don Knuth and myself in 1989. It was published in Canada under the title “ $\mathcal{AMS}$ -Euler. A New Typeface for Mathematics”.<sup>10</sup>

A quite unusual task was the Bible project “3:16”, which I worked on with Don Knuth starting in 1989. It was an unusual effort finding all Bible verses starting with 3:16 and then interpreting these anew. He had been working on this project since 1977. We had a lot of fun, and it ended with publication of the book “Donald E. Knuth. 3:16—Bible Texts Illuminated”. When the book appeared, a series of exhibitions was organized, which showed the work of calligraphers from all over the world who had shaped calligraphically the Bible texts selected by Don Knuth.

It remains inexplicable how this man always finds enough time, besides his teaching profession and publishing comprehensive books on the “Art of Computer Programming”—one volume has been dedicated to me. Then to study the whole Bible

<sup>6</sup> “Hell-writer”; Editor’s note: “hell” means bright, as light—a particularly apt name for a machine that does its work with a beam of light.

<sup>7</sup> Technical University of Darmstadt, Germany

<sup>8</sup> Switzerland

<sup>9</sup> Russia

<sup>10</sup> *Scholarly Publishing* 20 (1989), No. 3, 131–157.

and on top of that his frequent travels. At home he has an organ on which he loves to play to relax — if he finds time and is not busy working on a difficult problem. When he visited Germany we had always to find a beautiful organ for him to play. And in spite of all that he is always available for technical discussions.

You all know my work as a type designer. Some of my alphabets, such as Optima Antiqua and Palatino, are today part of the standard equipment of your PC or printer.

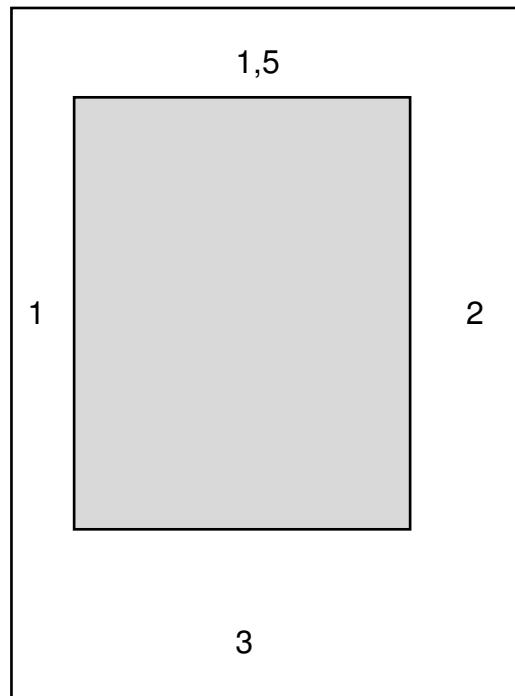
Maybe you've been annoyed with my Palatino Roman on your PC or Macintosh, because it does not provide enough special characters and accents. But be consoled, Microsoft will deliver an extended Palatino and then you will get 1200 characters for each of the Roman, Italic, Demibold and Demibold-Italic variants — a total of 4800 characters. Bill Gates was crazy enough to want all glyphs one could imagine including special variants of Latin letters as well as Greek and Cyrillic alphabets.

On a digital basis, today this is no longer a problem, because technically you can develop letters relatively fast on the computer screen. This also has a dark side. Unfortunately there are only a few authentic versions of Palatino. Many have been forged unscrupulously, and moreover, forged poorly. Palatino has the sad reputation to be the most often copied Roman font world wide. But that is a topic I don't want to discuss.

A few words on my new font, which has its own story. It is not intended for scholarly typesetting, but there are other areas for using type. It got the name Zapfino from an American who thought of the original idea. The history of this type started, as before, in Stanford with David Siegel. After he had finished his studies with Don Knuth, he wanted to start a business as a type designer based on his experience with METAFONT and Euler, and I should help him with his plans.

The project started in 1993. First he wanted to use some of my calligraphic work from 1944 to develop a novel script font. David Siegel developed for this purpose a kind of chaos program which he called Derrick. This was supposed to mix the different variants of letters within a word automatically. He wasn't able to find enough different instances of the individual letters to realize his idea. Theoretically everything worked fine, but how should an ordinary PC user manage such a technique, how should he select critical ligatures and insert these at the right position?

The complicated system soon became incomprehensible and, unfortunately, David Siegel sud-



**Figure 1:** The classical proportions of the margins in a book: 1 - 1.5 - 2 - 3

denly lost all interest in our project when his girl friend ran away.

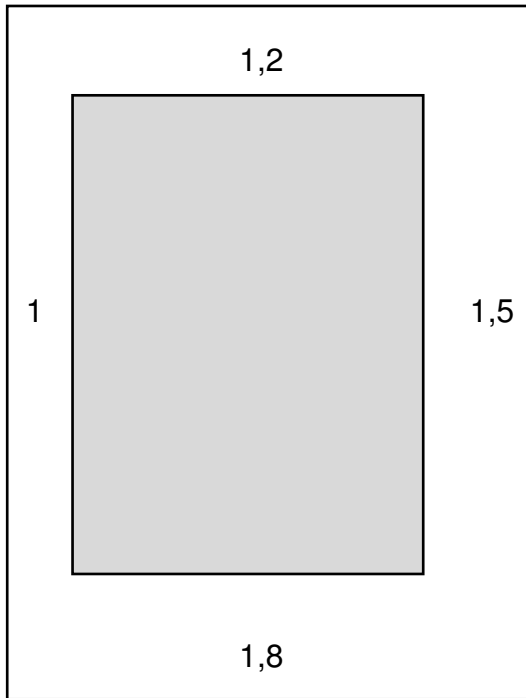
The type then stayed for quite some time in my drawer until one day I showed it to Linotype Library GmbH in Bad Homburg.<sup>11</sup> We dared to continue to work on this unfinished program code. First we had to reduce the storage for characters to a reasonable size. We ended up with four alphabets with ligatures and extra large calligraphic flourishes, as well as 100 ornaments and special characters. By 1998 the work was finished, and it is now available on CD-ROM together with a movie about my work in calligraphy.

Typesetting with Zapfino is not so easy and needs a good feeling for the calligraphic features of the type. On the screen you have to check continually for overlapping characters because with the huge ascenders and descenders you easily get intersections of letters.

I was asked to present some thoughts on typography. There are enough typographic textbooks for sale from which to learn the basics. I will now talk about what you cannot learn from these books and give you some hints.

Do not invent a new type area — this has been developed with the experience of hundreds of years.

<sup>11</sup> a town close to Frankfurt



**Figure 2:** Proposal of the type area for a magazine: 1 - 1.2 - 1.5 - 1.8

If you are a mathematician, you may be tempted to position it in the geometric center. But you need functional margins of different widths. As a rule of thumb a progression of 1–1.5–2 and 3 is a good starting point. [See Figure 1 for the classical proportions of the margins in a book; Figure 2 proposes an adaptation for a magazine.] The inner margin for binding depends on the method of binding, whether you have a thread, wire or glue binding. With glue binding a wider inner margin is advantageous because you often need a flush cut. The outer margins also have a function. A wider outer margin is quite useful not only to be able to hold the book comfortably, but also to be able to make notes or annotations, and not just for controversial texts. In a scientific book at the Herzog-August-Bibliothek in Wolfenbüttel<sup>12</sup> I found marginal annotations with rather drastic terms, such as *Unfug* and *Quatsch*.<sup>13</sup> From the old historic shape of the letter *Q* one could determine that these were old annotations and had not been written by today's students.

Another point. When you have accumulated a thousand or more alphabets, you should not arrogantly try to display as many alphabets as possible

in one document. Always seek the simplest and most significant form. A book is above all meant to be read and should not be a sandbox for typographic experiments.

An important typographic issue is the title on the spine of a book. You have to fit it onto the most narrow volume. How will you find your T<sub>E</sub>X periodical “Die T<sub>E</sub>Xnische Komödie” on your bookshelf? [Figure 3 suggests an approach for narrow booklets.

Figure 4 extends this to coping with loose sheets.] Whether the title on the spine runs from bottom to top, or from top to bottom is not that important, but whether a title is present on the spine at all, is. If you like, you can take part in the endless quarrel in Germany whether the title should run from the bottom up or the reverse.

But I ask you: Do you lay your book face down on your bedside table, when you put it away? This will answer any discussion whether the title should run up or down.

For “Die T<sub>E</sub>Xnische Komödie” perhaps you could send out adhesive-back labels with the next issue; this would solve the problem.<sup>14</sup>

There remain many other things to be done in the digital world. Look closely at the characters on your computer screen. Most letters are corroded, without the fine details one needs to be able to recognize correctly the desired font. Here is an important job that remains to be done, although some technical prerequisites are needed to accomplish it. But when one can represent millions of colours, one should also in the future pay somewhat more attention to the presentation of the forms of alphabets.

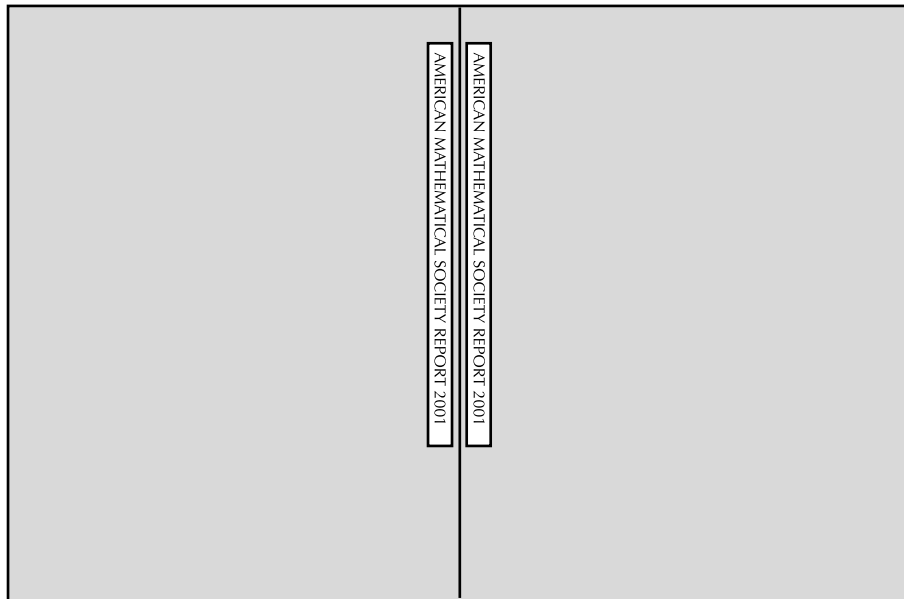
If you want to learn more about the work of a font designer and what I have done in all these years, I recommend that you visit my permanent exhibition in the Herzog-August-Bibliothek in Wolfenbüttel. This proves that you do not have to die before you are awarded a permanent exhibition in a library.

◇ Hermann Zapf  
Seitersweg 35  
D-64287 Darmstadt  
Germany

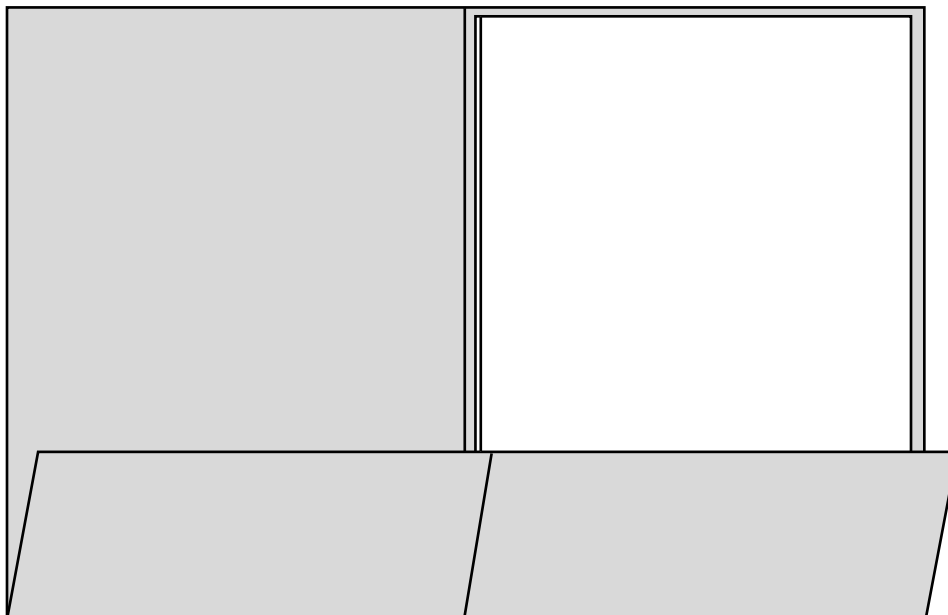
<sup>12</sup> a scientific library in Wolfenbüttel, Lower Saxony, Germany

<sup>13</sup> “nonsense, rubbish”

<sup>14</sup> Since 2001 DANTE has published “Die T<sub>E</sub>Xnische Komödie” with a nicely printed title on the spine.



**Figure 3:** If no space for a title is on the spine of a booklet, paste a title on both sides of the fold. Put it onto the shelf of your library so that it stands out a quarter of an inch for easy finding.



**Figure 4:** To keep loose sheets of cutouts from magazines, etc., put them in a folder of stiff colored paper and fold a pocket at the bottom. Paste titles as described above.