

## Extending Control of Digital Typography

Peter Karow

Pleasant looking, easily readable text has been the aim of typographers since scribes began to write and Gutenberg perfected printing with movable type. Text transports information. But it does even more than this, its typographic appearance establishes the care with which it is presented — its authenticity and its persuasive power, for example. Usually text is presented in conjunction with images. Text flows into the areas unoccupied by images, individually column by column, in order to create a form that is comfortable to read. The transfer must be accomplished with a minimum of communication errors and with the typographic hierarchy intact. The goal is the creation of a harmony in which text, images and graphics are related in a controlled manner.

While diverse application programs let computers and their peripheral equipment replace the former typewriting, photo-composition or hot metal printing, the digital era challenges us for more automation regarding typographic composition. Today's application programs output any kind of text into given layouts which can be defined and pre-described by templates or pure sets of parameters for specific projects such as structured webpages, letters, office documents, magazine articles or book chapters. Templates or lists of preferred parameters (preference) are common to all existing word processing and text composing programs.

The general layout parameters are: 1) kerning/spacing - spacing characters horizontally, 2) expanding and condensing typefaces - writing more widely or narrowly, 3) space - spacing between words or interword relations, 4) pointsize - determining the size of printed characters in a given body text, 5) line leading - determining the vertical line distance between lines, 6) paragraph leading - determining the vertical space between paragraphs, 7) column width - determining the set width and 8) column height - determining the length of the column.<sup>1</sup> The last two parameters apply if a text is typeset into a rectangular shape. In other cases, e.g., run-around text for images, run-into text for arbitrary forms like circles, a larger set of parameters is given, describing the corresponding shapes; however, even those larger sets could be controlled by just two sizing parameters for the x-direction (width) and the y-direction (height).<sup>2</sup> In what follows, the above parameters are referred to as the 'eight parameters.'

There are many other parameters not considered here, such as: the alignment of text (aligning left or right, centered or justified), the style of a typeface (selecting a typeface; writing normal, bold, or italic; handling quotes and other details, etc.), the specific language (writing in German, English, etc.) with its hyphenation rules, as well as other language, typography or technology details.

Modern application programs can handle the so-called orphan/widow problem. They avoid orphans in text where a paragraph starts with only one line as the last line of a column, or widows of text where a paragraph ends on the first line of the next column, e.g., this can be resolved by a simple change to the height of a column in order to move the widow to the preceding (plus one line of text) or an orphan to the succeeding column (minus one line of text).

While existing features like 'shrink to fit' are found in most word processing and graphic design applications, they use the page size parameter in order to enlarge or diminish a text in a linear manner as if using a zoom lens. No new fitting occurs in the existing layout and no typographic rules are applied. The result is an unpleasant and obvious adjustment. To counter this, a method to completely avoid the orphan/widow problem is needed. This can be achieved if one can manage a situation in which all columns of an article or a chapter terminate with the end of a paragraph, generating an optimal 'column-fit.' This contributes to comfortable reading because one can pause a bit at the end of a thought (end of a paragraph), while one is turning to go on reading the next column.

As the lengths of letters, documents and similar kinds of information vary arbitrarily, a document may consist of one full column and a few upper lines on the next column, or a letter that has a full or complete column, may leave no room for salutation. This creates the need for an automatic, but typographically convincing shrink or spread for a document, a so-called 'chapter-fit.' For book work, there is a need for a chapter-fit which composes a chapter with a total length of an even number of columns and generates a last column just filling a certain percentage of the total column height, such that the chapter can start on a right column (recto) and end on a left column (verso) of reasonable length.

All these automated fits have one factor in common. They leave the various text elements in typographic harmony according to the layout parameters of paragraph, column, chapter or other document identity. Documents usually have a hierarchical order and a common layout structure, which is perceived and intuitively assumed — it would be astonishing and irritating for the reader to see big, unanticipated changes among the eight parameters within a single document.

Good typography demands a constant optical appearance of the following dimensions: 1) all lines within a paragraph, 2) all paragraphs within a column, 3) all columns within a chapter, and 4) all chapters within a book. This means that only invisible changes are tolerable. It is helpful to note that ordinary readers are not able to recognize changes of up to a few percent among the eight parameters, if they are applied individually.

The *hz-engine* (named after Hermann Zapf) uses a justification per paragraph system,<sup>3</sup> along with an automated kerning of characters to expand and condense characters in order to obtain margin lines for a column that are optically straight, i.e., optical margins, and achieve typeset spaces among words within lines of text that are fairly constant in order to avoid rivers and creeks. Rivers run vertically through poorly spaced words in consecutive lines of text when the spaces between the words have the same space or greater than the distance between the baselines of the text. A creek is a less severe form, where the spaces between words are accidentally too wide within one line. Usually, the spaces between words vary between the character width of an 'i' (minimum) and a 'm' (maximum).

The basic feature of the *hz-engine* is to regard all lines of a given paragraph at once — making the 'justification per paragraph.' At first, all words or syllables are distributed to the lines altogether in a manner such that each line gets a line length nearest to its given individually parametrized width (default is the column width). This optimization is controlled by minimizing the typographical demerits (addition or subtraction of space from the norm) which are obtained from a function of the actual line lengths, given line lengths, given line widths and tolerances of the layout parameters. If hyphenation is turned on, words are replaced by syllables. The *hz-engine* has to follow a lot of exceptions and to provide solutions for them, e.g., hyphenated ligatures, consecutive hyphens and bad or good locations for hyphenation within a word. This level of text/typographic detail promotes a better fit and smooths out the reader's experience.

A comparison between the *hz-engine* and today's typical composition tools demonstrates the superiority of the former (see **Figure 1.0**, Magazine Composition). It also shows its clear benefit in a case where typesetting should be done simply, aligned left (see **Figure 2.0**, Aligned Left and compare with **Figure 3.0**). (Extensive examples of the *hz-engine*, **Figure 1.0 - 7.3** follow the body of the article and begin on page 107.)

The initial idea of the chapter-fit is to apply automation of typography to chapters of text as is available for paragraphs. The *hz-engine* handles and optimizes the layout of paragraphs/lines/words/characters. The justification per chapter handles the layout of chapters/columns/paragraphs/lines in order to optimize the presentation of text at two levels higher. This is obtained by a procedure which scans all lengths of paragraphs and lengths of columns and balances them altogether in a manner such that each individual column gets an optimal amount of paragraphs which could be managed and fitted with a minimum of demerits into its given layout.

Chapter justification has never been achieved by human agency nor is it offered in today's application programs. To get this result from a person requires varying

eight parameters continuously, testing hundreds of different compositions of the same project; consequently the goal of chapter justification would be too cumbersome and too expensive.

As performance of modern computers is growing, it is possible to let run thousands of trials within seconds. Astonishingly, this is the first time that chapter justification is possible which engages the eight parameters in a manner that allows for the search of best solutions in an eight-dimensional space of possible realizations.

Chapter justification and chapter-fit consist of several hierarchical steps for text processing. After it has been applied itself, the following steps occur: 1) paragraph-hyphenation, 2) force-justify, 3) form-fit, 4) paragraph-fit, and 5) column-fit. All steps are guided by describing parameters which could be set up by templates or lists of preferences and read from them. Then, each paragraph is handed over to and handled by the *hz-engine* or other existing technics for paragraph and word composing in order to get back the resulting measures of the text for calculation of demerits.

In particular, an appropriate composing engine has to return the so-called typographic demerit for a paragraph  $I$  on a column  $n$ . This quality parameter is the sum of several weighted measures: the degrees of deviation from normal kerning, from expanding or condensing, from normal space, normal pointsize and the change in line leading. It is essential to test a shrink or spread each time by composition of the corresponding column because of the quantization effects by integer syllables which could sum up chapterwise and generate new line counts stepping by more than one line.

### Paragraph-fit

Paragraph-fit works like a force-justify and composes a paragraph in a manner that its last line gets a certain desired length compared with the column width. For example, a range from 0.25 (minimum) up to 0.85 (maximum) is tolerable and results in a convenient typographic appearance of the paragraph. Lines which are shorter than the minimum are not desired because they open too large a space between paragraphs; they cause orphan paragraphs. Likewise, lines which are longer than the maximum are also not desired because they give no clear optical indication for the end of a paragraph. **Figure 4.0**, *His Secret*, demonstrates nicely how paragraph-fit helps while one is regarding and picking up a text as a whole.

### Page-fit

At first, all lines within the paragraphs must be processed by a text composing program according to the original parameters for typesetting, such as point size, line leadings, line width, etc. Then all lines are distributed and counted. The aim of

page-fit is to end each column with the end of a paragraph under consideration of the potential for shrink or spread of each column. Some of the last paragraphs on the columns are divided into two parts, where the second part is on the next column. A paragraph is rarely separated into more than two parts. If the next column is smaller than the second paragraph part, then the second part on the next column is treated like a complete first paragraph, is hyphenated and handled as normal by the same procedure as described above.

### Chapter-fit

In connection with chapter justification, chapter-fit is an option that tries to optimize the form of a chapter even more extensively. It avoids a chapter ending with a column which is too long, leaving insufficient room for footnotes, or a chapter having a last column which is nearly empty, containing only a few lines of text. Chapter-fit is engaged to obtain an even number of columns for a chapter to allow it to start on the recto and end on the verso in a case where the pages consist of one column.

The exemplary result of chapter-fit (see **Figure 5.1 - 5.6**) is obtained automatically with paragraphs having reasonable lengths of last lines formed by paragraph-fit. It has six pages which let it start on the recto and end on the verso. It was typeset with twenty-three hyphens, each page starts with a paragraph, and it has no widows, orphans, creeks or rivers. Whereas there were thirty-two hyphens using today's software along with fourteen typographical mistakes (as indicated in **Figure 6.1 - 6.7**) in order to achieve more pages.

### One-Page-fit

In a special project set-up, chapter-fit aims at one page of one column or several columns on one page which is useful for webpage design and composition software. In this case, the given number  $N$  of columns is a constraint. Without caring too much about the demerits from changes to the original parameters, the goal is to fill the given space reasonably according to the design of the layout with typographical balance.

**Figure 7.1** and **7.2** demonstrate one-page-fits achieved automatically by the chapter-fit program. Several constraints were followed: hyphenation was turned off, each paragraph was typeset with the option of force-justify (forming an exact rectangle) and one column had to be filled. Try to get the same result by using today's software within a day; you won't achieve the results.

**Figure 7.3** demonstrates another effect of force-justify; this feature could be used to get a headline exactly as long as the column width. In the exemplary two headlines, it used a 72pt-spacing in the first and a 6pt-spacing in the second case to begin with and achieved the exact fit by changing the kerning values. No changes to the pointsize were necessary.

### Summary

The *hz*-program and chapter-fit achieve micro-typography of a very high standard, more than we could get digitally in the past or by human craft. Computers are challenging the old standard, they 'eat electricity and no spaghetti.' Paragraph-fit, page-fit, justification per chapter, chapter-fit and one-page-fit are new achievements which did not previously exist. The examples presented here (Figure 1.0 - 7.3) demonstrate their usefulness in a convincing manner. These features belong in professional applications as well as in simple word processing software even if ordinary users aren't requesting it at this time. But similar to their purchase of cars with superior engines, they will experience the 'sound' of the *hz*-engine and enjoy text that is more readable.

### R E F E R E N C E S

- 1 Listings and explanations of 'all typesetting parameters' can be found in the literature, e.g., Martin Douglas. 1989. *An Outline of Book Design*. London: Blueprint/The Publishers Association, 21.
- 2 All relevant outline formats are described in detail in the literature, e.g., Peter Karow. 1994. *Digital Typefaces*. Berlin: Springer Verlag, 139. Typefaces or fonts are mainly described digitally as PostScript fonts, and as TrueType fonts. In the same way graphic elements like rectangles, circles and other shapes are stored. All have in common stored outlines and "hints" of characters and graphic elements along with the so-called "metrics" which relate to their composition in order to form words and lines of text and to layout complete pages with imaging information.
- 3 Knuth, Donald E. and Michael F. Plass. 1982. "Breaking paragraphs into lines." *Software-Practice & Experience*, 11:11, 1119-1184.  
—, 1984. *The TEX Book*. Reading, Massachusetts: Addison-Wesley Publishing Company.

Figure 1.0

## Magazine Composition

Hermann Zapf 1986:

*left two columns:*

*ℒ-program (most left) compared with today's software,*

*narrow columns, hyphenation on.*

*right two columns:*

*ℒ-program compared with today's software (most right),*

*narrow columns, hyphenation off which is unusual and used as a test.*

Writing is the visual reproduction of the spoken word, its primary objective being to convey a text to the reader without difficulties, or distraction, and without disturbing the flow of reading with unnecessary embellishments. The letters have no self-fulfilling purpose, neither are they a medium for self-presentation of a designer. Everything which makes reading difficult or time-consuming, or is detrimental because of its unusual form, has to be avoided.

The new technical possibilities of type composition - with all its limitations - also determined the form of the letters. The infinite possibilities provided by today's electronics are used for example to develop types of our time, without historical hangovers. Ideally, the ℒ-program comprises (1) kerning on the fly, (2) optical spacing, (3) expanding and condensing plus optical scaling from Multiple Master fonts and (4) justification per paragraph. It is the non-plus-ultra in typography.

Writing is the visual reproduction of the spoken word, its primary objective being to convey a text to the reader without difficulties, or distraction, and without disturbing the flow of reading with unnecessary embellishments. The letters have no self-fulfilling purpose, neither are they a medium for self-presentation of a designer. Everything which makes reading difficult or time-consuming, or is detrimental because of its unusual form, has to be avoided.

The new technical possibilities of type composition - with all its limitations - also determined the form of the letters. The infinite possibilities provided by today's electronics are used for example to develop types of our time, without historical hangovers. Ideally, the ℒ-program comprises (1) kerning on the fly, (2) optical spacing, (3) expanding and condensing plus optical scaling from Multiple Master fonts and (4) justification per paragraph. It is the non-plus-ultra in typography.

Writing is the visual reproduction of the spoken word, its primary objective being to convey a text to the reader without difficulties, or distraction, and without disturbing the flow of reading with unnecessary embellishments. The letters have no self-fulfilling purpose, neither are they a medium for self-presentation of a designer. Everything which makes reading difficult or time-consuming, or is detrimental because of its unusual form, has to be avoided.

The new technical possibilities of type composition - with all its limitations - also determined the form of the letters. The infinite possibilities provided by today's electronics are used for example to develop types of our time, without historical hangovers. Ideally, the ℒ-program comprises (1) kerning on the fly, (2) optical spacing, (3) expanding and condensing plus optical scaling from Multiple Master fonts and (4) justification per paragraph. It is the non-plus-ultra in typography.

Writing is the visual reproduction of the spoken word, its primary objective being to convey a text to the reader without difficulties, or distraction, and without disturbing the flow of reading with unnecessary embellishments. The letters have no self-fulfilling purpose, neither are they a medium for self-presentation of a designer. Everything which makes reading difficult or time-consuming, or is detrimental because of its unusual form, has to be avoided.

The new technical possibilities of type composition - with all its limitations - also determined the form of the letters. The infinite possibilities provided by today's electronics are used for example to develop types of our time, without historical hangovers. Ideally, the ℒ-program comprises (1) kerning on the fly, (2) optical spacing, (3) expanding and condensing plus optical scaling from Multiple Master fonts and (4) justification per paragraph. It is the non-plus-ultra in typography.

*ℒ: 10 hyphens, 3 lines less*      *Today's software: 12 hyphens, 3 more lines, bad in line 11 and 12*

*Today's software: spaced out words are worst typography.*

## Aligned left

*The hz-program sets an ideal raggedness, even if hyphenation is turned off.*

Peter Karow

For over 2,000 years the tools of thought have changed little in essence; basically it has been ink, paper, and the means of applying one to the other. But the computer will surely give intellectual activity a new shape. The question is, what shape will emerge? And what form for the printed word? There are now more than five million computers in the United States, and for some time the amount of computing power has been doubling every two years. The average computer user now has access to information that would fill the Library of Congress and can control as much computing power as a large university computing center. Will this reduce the need for books, or make it unnecessary to print and distribute books in the ways of the past?

There are laser printing units using xerography that can print a complete book from the digitised type page stored in disk memory banks. Such a custom book printer can churn out pages, verso and recto, at the rate of a leaf every second. A complete book of 124 pages would be ready for binding in sixty-two seconds. It takes little imagination to envision a bookstore of a decade hence filled with 'sample' volumes only. One would need only to pick a title and the book would be printed and bound on the spot. Such a bookstore could readily keep on hand three or four times the number of titles now stocked at a fraction of present costs, since there would be no shipping charges, no overstock or understock problems, and no returns.

What does this technology have to do with books as we know them? There are many predictions abroad today the shape of things to come in a computer age that is just emerging in the first flush of a new day. Books are only one means of disseminating information and cogitative writing in the midst of an increasing plethora of electronic options. Even the Congress of the United States seeks guidance. A recent Congressional resolution has asked for a study to explore the influence of the computer and video technologies on books, reading, and the printed word.

The result of this study will be issued in, have you guessed it, a BOOK, entitled «The Book in the Future». Perhaps that is when we shall all learn what the outlook will be for this seemingly endangered species, or at least the official outlook.

Henry Stevens of Vermont once said, «Books are both our luxuries and our daily bread. They have become to our lives and happiness prime necessities.» I have pondered this saying often – «Books are both our luxuries and our daily bread». It has become a kind of motto, one that I believe is most apt for a printer... Books embody all the humanising arts that make thought tangible and give form to ideas, so that mind can touch mind over vast distances and through the ages of time itself.

Roderick Stinehour, April 1984, proceedings of the American Antiquarian Society, Vol. 94, Part I.

Figure 3.0

## Aligned left

*Today's software sets so ragged that the paragraphs could not easily be distinguished, if hyphenation is turned off.*

For over 2,000 years the tools of thought have changed little in essence; basically it has been ink, paper, and the means of applying one to the other. But the computer will surely give intellectual activity a new shape. The question is, what shape will emerge? And what form for the printed word? There are now more than five million computers in the United States, and for some time the amount of computing power has been doubling every two years. The average computer user now has access to information that would fill the Library of Congress and can control as much computing power as a large university computing center. Will this reduce the need for books, or make it unnecessary to print and distribute books in the ways of the past? There are laser printing units using xerography that can print a complete book from the digitised type page stored in disk memory banks. Such a custom book printer can churn out pages, verso and recto, at the rate of a leaf every second. A complete book of 124 pages would be ready for binding in sixty-two seconds. It takes little imagination to envision a bookstore of a decade hence filled with 'sample' volumes only. One would need only to pick a title and the book would be printed and bound on the spot. Such a bookstore could readily keep on hand three or four times the number of titles now stocked at a fraction of present costs, since there would be no shipping charges, no overstock or understock problems, and no returns.

What does this technology have to do with books as we know them? There are many predictions abroad today the shape of things to come in a computer age that is just emerging in the first flush of a new day. Books are only one means of disseminating information and cogitative writing in the midst of an increasing plethora of electronic options. Even the Congress of the United States seeks guidance. A recent Congressional resolution has asked for a study to explore the influence of the computer and video technologies on books, reading, and the printed word. The result of this study will be issued in, have you guessed it, a BOOK, entitled «The Book in the Future». Perhaps that is when we shall all learn what the outlook will be for this seemingly endangered species, or at least the official outlook.

Henry Stevens of Vermont once said, «Books are both our luxuries and our daily bread. They have become to our lives and happiness prime necessities.» I have pondered this saying often – «Books are both our luxuries and our daily bread». It has become a kind of motto, one that I believe is most apt for a printer... Books embody all the humanising arts that make thought tangible and give form to ideas, so that mind can touch mind over vast distances and through the ages of time itself.

Roderick Stinehour, April 1984, proceedings of the American Antiquarian Society, Vol. 94, Part I.

← ?

← ?

Figure 4.0

## His Secret

*Hyphenation  
turned off.*

*To the left  
the  $\text{H}\zeta$ -program:  
38 lines,  
last lines of  
paragraphs ok.*

*To the right  
today's software:  
40 lines,  
short last lines,  
larger spaces.*

Peter Karow

What makes the Gutenberg Bible the unattainable masterpiece of the art of printing? The printing on his handpress? Can't be really, because of today's standards, the inking was not of extraordinary quality. We could order hand made rag paper also in our day. Maybe the secret of his beautiful pages is in the proportions of the columns on the paper. But this we are also able to copy. Therefore only the composition is to be considered closely.

How could Gutenberg get those even gray areas of columns without disturbing or unsightly holes between words? His secret: the master achieved this perfection by applying several characters of different width combined with many ligatures and abbreviations out of his type case. He finally created 290 characters for the composition of the 42-line Bible. An enormous time consuming job to realize his idea of good typographic lines: the justified lines of even length, compared to the flush-left lines of the works of the famous mediaeval scribes.

But with Johannes Gutenberg's unusual ligatures and abbreviations, today we can't apply this old principle for contemporary composition. Now we can get help through the versatility of modern electronic software and formats like the Multiple Masters to receive a perfect type setting in our production, to achieve Gutenberg's standards of quality: The  $\text{H}\zeta$ -program, named after Hermann Zapf.

What makes the Gutenberg Bible the unattainable masterpiece of the art of printing? The printing on his handpress? Can't be really, because of today's standards, the inking was not of extraordinary quality. We could order hand made rag paper also in our day. Maybe the secret of his beautiful pages is in the proportions of the columns on the paper. But this we are also able to copy. Therefore only the composition is to be considered closely.

How could Gutenberg get those even gray areas of columns without disturbing or unsightly holes between words? His secret: the master achieved this perfection by applying several characters of different width combined with many ligatures and abbreviations out of his type case. He finally created 290 characters for the composition of the 42-line Bible. An enormous time consuming job to realize his idea of good typographic lines: the justified lines of even length, compared to the flush-left lines of the works of the famous mediaeval scribes.

But with Johannes Gutenberg's unusual ligatures and abbreviations, today we can't apply this old principle for contemporary composition. Now we can get help through the versatility of modern electronic software and formats like the Multiple Masters to receive a perfect type setting in our production, to achieve Gutenberg's standards of quality: The  $\text{H}\zeta$ -program, named after Hermann Zapf.

← too short

← a creek

← too short

Figure 5.1

## Johannes Gutenberg

500 years ago, Johannes Gutenberg entered into direct competition with renowned scribes. His goal was to set his type as the scribes wrote.

When writing by hand, it is practical to vary the width of words without the writing appearing too light or too dark, consequently disturbing the reader's eye. In earlier times, handwritten lines were rarely of equal length, an art which began with the type of Gutenberg.

Gutenberg employed intelligent methods to adjust lines and spaces, such as cutting of several punches for varying widths of characters, depending upon their application. A large variety of ligatures and abbreviations were also prepared to save space according to demands of a typeset line.

These same ligatures saved considerable time by allowing compositors the luxury of setting two or more characters plus the following space with a single piece of type. In examining his alphabet below we recognize, for example, two choices for lower case a, and the same number for lower case b, not to mention eight ligatures using lower case b. A large number of abbreviations are available to save even greater space than do ligatures. Gutenberg had cast four abbreviations, looking like different accented b characters. A total of 290 unique characters were required in a single alphabet to typeset the entire 42-line Bible.

Having reviewed the font available to Gutenberg, we can more clearly imagine how he must have worked. Most likely he would have set a line of type without use of ligatures, special widths or abbreviations. If there was a reasonable «fit» to the line, he could move on to the next. If, however, a spacing problem arose, he would scan the possibilities for replacing, say, abbreviations to increase readability in keeping with reading habits of that time. When a line was too long, he could consider also ligatures or condensed characters. His lines were left with «no remainders».

Of course it is not possible today to use the variables available during Gutenberg's time. Would ligatures be practical as devices to adjust spacing in text? Experiments have been carried out. In 1991, Hermann Zapf designed ligatures for the typeface Zapf Antiqua.

It has been concluded that new ligatures for character pairs like ba, be, da, de etc. tend to disturb legibility today, word processing programs could not elegantly handle them as they currently exist. Finally, the existing and broadly distributed font formats cannot easily store them in a font without eliminating to buy a new version of these fonts.

### After Gutenberg

After Gutenberg printing proliferated at a rapid rate, and with the emergence of the industrial age, printing of all kinds flooded the Western world.

Later developments mechanized printing even more with the manufacture of hot metal type. Typesetting became, so to speak, less material to a large degree with the introduction of photo typesetting techniques in recent years, and further abstracted today, with electronic typesetting developed by Rudolf Hell with his Digiset 1965 and desktop publishing, introduced by Adobe, Aldus and Apple, the three A's. Digital typesetting don't use physically existent objects called type, but instead process digital formulae, coding fonts in order to form visible characters.

Italic font typesetting was a continual problem with hot metal type. Only in the rarest cases would one attempt to reduce spacing (kern) between characters. As a common rule, you lived with whatever spacing came about through normal character spacing unless a luxurious budget would allow special setting or the use of special matrices.

Figure 5.3

Hot metal type presented no basic problem in design of various bodysizes, since separate «punches» had to be cut for every different size anyway. This was, and is still, called «optical Scaling». In relative terms, 8 point, 12 point and 18 point characters were not simply cut so that, for example, 8 point was one third smaller than 12 point or that 18 point was one and a half times larger than 12 point type. Smaller size type was tighter and more detailed than smaller sizes.

Photo typesetting provided a linear scaling for small to large size characters, unfortunately replacing optical scaling. This step backward was due largely to commercial considerations; competitive marketing coupled with user ignorance made optical scaling's partial demise a fairly short event. A definite positive characteristic of photo typesetting, however, was a freedom from any restrictions on spacing and kerning. Negative left and right side bearings became useful along with kerning tables to accomplish true and consistent kerning of characters. Typeset text became noticeably improved as a result.

Digital typesetting evolved from photo typesetting. Cathode ray tubes were used initially, then highly focused laser beams traced text forms onto film or paper. Essentially, with few exceptions, former restrictions concerning character fitting in em boxes, numbers of glyphs in a font, as well as kerning problems became meaningless.

Prices of equipment dropped significantly due to the fact that various manufacturers contributed their «piece of the puzzle» to the overall systems. Equipment used today is comprised of products from many suppliers, i.e. PCs, laser printers, typesetters, PostScript, application software, fonts, scanners, and other operating software. This industry, using all kinds of equipment and software, is quite new, so it is no surprise that many have not completely understood its implications, nor utilized new capabilities.

Remaining from Gutenberg's day, a tool is missing permitting automatically justified column setting of text in the gray value «à la Gutenberg», eliminating those annoying «rivers» of white across a printed page.

## The Copying Syndrome

We should be aware of that computer publishing did nothing else than copying analogue photo typesetting so far, and that photo typesetting was copying hot metal printing in essence before. In all its consequences copying was too slavishly.

Of course, there are many good excuses. After Gutenberg, hot metal printing as it existed in the first half of this century, was driven by accelerating the conversion of news into printed information which was distributed broadly. Normal human beings are very tolerant against the various ways in which information as text is offered to them.

We know how bad our own handwritings look sometimes, e.g. the writings on the doctor's prescriptions. We know that nearly everybody excuses himself for his ordinary and sometimes ugly handwriting. Therefore, no wonder, hot metal printing got faster, but also could escape from Gutenberg's standards easily. We as consumers were not punishing the publishing companies, we were happy to get the news fast and still readable.

Then photo typesetting tried to replace hot metal printing. It did the typesetting as good, could even let touch and overlap characters, and after a short period typeshops were growing and could offer job printing. Newspapers and books were left as the domain of hot metal however, but brochures, leaflets, hand-outs and other smaller documents were conquered by photo typesetting.

This new technology allowed a linear scaling based only on one font for all the many possible pointsizes and played this out as its dominant feature compared with hot metal; where one had to cut punches for new pointsizes anyway which was a costly and time-consuming procedure. The participating manufacturers of photo typesetters decided to use their font production facilities rather for increasing the number of different fonts than for producing only different pointsizes.

Figure 5.5

While this happened and made people excited about it, they forgot the advantages of especially cut point sizes, namely the implied optical scaling. Optical scaling vanished before most of us got aware of it and had a chance of sharing its reading comfort.

With desktop publishing, computers played the role of the typesetters. At first, this new technology had to gain ground, so it did copy the photo typesetting, therefore it applied its linear scaling. No typographic innovations took place during these first exciting years of desktop publishing.

All contributing people had enough to do with organizing the existing work places, tooling, and work flows into digital. Partly, they installed the historical ideals as constraints involuntarily.

All these kinds of copying and stepping into the boots of the predecessors reminds to the beginning of the automobile industry. The first mobiles they did were coaches! So, the idea was to replace the horses. Well done, but narrow minded. Later, people recognized that they were able to do mobiles independently from former models.

It was Adobe Systems Inc. being aware of this fact and introducing Multiple Masters enabling optical scaling and typographic expanding & condensing of letters, besides interpolation of the weight of typefaces. This was just a first step to get rid of the limitations of photo typesetting and of hot metal printing.

### **The Aims**

Typographically, we have in our hands the fine tuning for fonts which was achieved by Multiple Masters, but also have in hands the fine tuning of other ingredients such as point size, column width, leading, spacing, kerning, and hyphenation.

Basically, we know how far we can go by our typographical training. If we wanted to, we could go very far on the other hand. As an excuse we could take our own, sometimes indecipherable handwriting and tolerance against badly written documents; once already proven by hot metal printing.

We have an enormous computing power available. We can calculate the size of books, pages, and paragraphs in advance and make decisions on the results, e.g. whether to shorten or to lengthen them in order to achieve more reading comfort. Nobody could do this before. Even, after having done a composition, we can renew it without losing money or time in order to optimize our outputs.

We can apply millions of subtle variations which only computers can do because it is not costing our sweat and time. One day, somebody expressed this as: they eat only electricity, but no spaghettis.

Since and before Gutenberg typographers, printers and designers were always concerned with the answer to following questions: What is helping the flow of reading? What is the best way to layout a text for the reader? The answer seems to be simple:

- write no hyphens,
- layout justified text,
- start each page  
    with a paragraph,
- start a chapter recto,
- end it verso.

We have modern computers which can do a lot of virtual trials of typesetting and which let us choose from the best and most convenient solutions for a given page of text.

We can apply subtle changes which the readers can't see; meaning that they are not disturbed during reading. The rules of good typography could and should be kept as they are delivered by Johannes Gutenberg.

Figure 6.1

## Johannes Gutenberg

500 years ago, Johannes Gutenberg entered into direct competition with renowned scribes. His goal was to set his type as the scribes wrote.

*orphan paragraph*

When writing by hand, it is practical to vary the width of words without the writing appearing too light or too dark, consequently disturbing the reader's eye. In earlier times, handwritten lines were rarely of equal length, an art which began with the type of Gutenberg.

*creeks*

Gutenberg employed intelligent methods to adjust lines and spaces, such as cutting of several punches for varying widths of characters, depending upon their application. A large variety of ligatures and abbreviations were also prepared to save space according to demands of a typeset line.

*widow paragraph*

These same ligatures saved considerable time by allowing compositors the luxury of setting two or more characters plus the following space with a single piece of type. In examining his alphabet below we recognize, for example, two choices for lower case a, and the same number for lower case b, not to mention eight ligatures using lower case b. A large number of abbreviations are available to save even greater space than do ligatures. Gutenberg had cast four abbreviations, looking like different accented b characters. A total of 290 unique characters were required in a single alphabet to typeset the entire 42-line Bible.

Having reviewed the font available to Gutenberg, we can more clearly imagine how he must have worked. Most likely he would have set a line of type without use of ligatures, special widths or abbreviations. If there was a reasonable «fit» to the line, he could move on to the next. If, however, a spacing problem arose, he would scan the possibilities for replacing, say, abbreviations to increase readability in keeping with

reading habits of that time. When a line was too long, he could consider also ligatures or condensed characters. His lines were left with «no remainders».

Of course it is not possible today to use the variables available during Gutenberg's time. Would ligatures be practical as devices to adjust spacing in text? Experiments have been carried out. In 1991, Hermann Zapf designed ligatures for the typeface Zapf Antiqua.

It has been concluded that new ligatures for character pairs like ba, be, da, de etc. tend to disturb legibility today, word processing programs could not elegantly handle them as they currently exist. Finally, the existing and broadly distributed font formats cannot easily store them in a font without eliminating to buy a new version of these fonts.

*widow paragraph*

Peter Karow

### After Gutenberg

After Gutenberg printing proliferated at a rapid rate, and with the emergence of the industrial age, printing of all kinds flooded the Western world. Later developments mechanized printing even more with the manufacture of hot metal type. Typesetting became, so to speak, less material to a large degree with the introduction of photo typesetting techniques in recent years, and further abstracted today, with electronic typesetting developed by Rudolf Hell with his Digiset 1965 and desktop publishing, introduced by Adobe, Aldus and Apple, the three A's. Digital typesetting don't use physically existent objects called type, but instead process digital formulae, coding fonts in order to form visible characters.

Italic font typesetting was a continual problem with hot metal type. Only in the rarest cases would one attempt to reduce spacing (kern) between characters. As a common rule, you lived with whatever spacing came about through normal character spacing unless a luxurious budget would allow special setting or the

Figure 6.3

*widow*

use of special matrices.

Hot metal type presented no basic problem in design of various bodysizes, since separate «punches» had to be cut for every different size anyway. This was, and is still, called «optical Scaling». In relative terms, 8 point, 12 point and 18 point characters were not simply cut so that, for example, 8 point was one third smaller than 12 point or that 18 point was one and a half times larger than 12 point type. Smaller size type was tighter and more detailed than smaller sizes.

*widow paragraph*

Photo typesetting provided a linear scaling for small to large size characters, unfortunately replacing optical scaling. This step backward was due largely to commercial considerations; competitive marketing coupled with user ignorance made optical scaling's partial demise a fairly short event. A definite positive characteristic of photo typesetting, however, was a freedom from any restrictions on spacing and kerning. Negative left and right side bearings became useful along with kerning tables to accomplish true and consistent kerning of characters. Typeset text became noticeably improved as a result.

Digital typesetting evolved from photo typesetting. Cathode ray tubes were used initially, then highly focused laser beams traced text forms onto film or paper. Essentially, with few exceptions, former restrictions concerning character fitting in em boxes, numbers of glyphs in a font, as well as kerning problems became meaningless.

Prices of equipment dropped significantly due to the fact that various manufacturers contributed their «piece of the puzzle» to the overall systems. Equipment used today is comprised of products from many suppliers, i.e. PCs, laser printers, typesetters, PostScript, application software, fonts, scanners, and other operating software. This industry, using all kinds of equipment and software, is quite new, so it is no surprise that many have not completely under-

Figure 6.4

widow  
widow paragraph

orphan paragraph

stood its implications, nor utilized new capabilities.

Remaining from Gutenberg's day, a tool is missing permitting automatically justified column setting of text in the gray value «à la Gutenberg», eliminating those annoying «rivers» of white across a printed page.

### The Copying Syndrome

We should be aware of that computer publishing did nothing else than copying analogue photo typesetting so far, and that photo typesetting was copying hot metal printing in essence before. In all its consequences copying was too slavishly.

Of course, there are many good excuses. After Gutenberg, hot metal printing as it existed in the first half of this century, was driven by accelerating the conversion of news into printed information which was distributed broadly. Normal human beings are very tolerant against the various ways in which information as text is offered to them.

We know how bad our own handwritings look sometimes, e.g. the writings on the doctor's prescriptions. We know that nearly everybody excuses himself for his ordinary and sometimes ugly handwriting. Therefore, no wonder, hot metal printing got faster, but also could escape from Gutenberg's standards easily. We as consumers were not punishing the publishing companies, we were happy to get the news fast and still readable.

Then photo typesetting tried to replace hot metal printing. It did the typesetting as good, could even let touch and overlap characters, and after a short period typeshops were growing and could offer job printing. Newspapers and books were left as the domain of hot metal however, but brochures, leaflets, hand-outs and other smaller documents were conquered by photo typesetting.

Figure 6.5

This new technology allowed a linear scaling based only on one font for all the many possible point sizes and played this out as its dominant feature compared with hot metal; where one had to cut punches for new point sizes anyway which was a costly and time-consuming procedure. The participating manufacturers of photo typesetters decided to use their font production facilities rather than for increasing the number of different fonts than for producing only different point sizes.

*creek**orphan paragraph*

While this happened and made people excited about it, they forgot the advantages of especially cut point sizes, namely the implied optical scaling. Optical scaling vanished before most of us got aware of it and had a chance of sharing its reading comfort.

With desktop publishing, computers played the role of the typesetters. At first, this new technology had to gain ground, so it did copy the photo typesetting, therefore it applied its linear scaling. No typographic innovations took place during these first exciting years of desktop publishing. All contributing people had enough to do with organizing the existing work places, tooling, and work flows into digital. Partly, they installed the historical ideals as constraints involuntarily.

*orphan paragraph*

All these kinds of copying and stepping into the boots of the predecessors reminds to the beginning of the automobile industry. The first mobiles they did were coaches! So, the idea was to replace the horses. Well done, but narrow minded. Later, people recognized that they were able to do mobiles independently from former models.

It was Adobe Systems Inc. being aware of this fact and introducing Multiple Masters enabling optical scaling and typographic expanding & condensing of letters, besides interpolation of the weight of typefaces. This was just a first step to get rid of the limitations of photo typesetting and of hot metal printing.

## The Aims

Typographically, we have in our hands the fine tuning for fonts which was achieved by Multiple Masters, but also have in hands the fine tuning of other ingredients such as pointsize, column width, leading, spacing, kerning, and hyphenation.

Basically, we know how far we can go by our typographical training. If we wanted to, we could go very far on the other hand. As an excuse we could take our own, sometimes indecipherable handwriting and tolerance against badly written documents; once already proven by hot metal printing.

We have an enormous computing power available. We can calculate the size of books, pages, and paragraphs in advance and make decisions on the results, e.g. whether to shorten or to lengthen them in order to achieve more reading comfort. Nobody could do this before. Even, after having done a composition, we can renew it without losing money or time in order to optimize our outputs.

We can apply millions of subtle variations which only computers can do because it is not costing our sweat and time. One day, somebody expressed this as: they eat only electricity, but no spaghettis.

Since and before Gutenberg typographers, printers and designers were always concerned with the answer to following questions: What is helping the flow of reading? What is the best way to layout a text for the reader? The answer seems to be simple:

- write with no hyphens,
- layout justified text,
- start each page  
with a paragraph,
- start a chapter recto, and

Figure 6.7

*widow*

• end it verso.

We have modern computers which can do a lot of virtual trials of typesetting and which can let us choose from the best and most convenient solutions for a given page of text.

*widow paragraph*

We can apply subtle changes which the readers can't see; meaning that they are not disturbed during reading. The rules of good typography could and should be kept as they are delivered by Johannes Gutenberg.

*32 hyphens*

Figure 7.1

*hz-program:  
hyphenation off,  
force justify,  
one-page-fit,  
more text*

Peter Karow

Fifteen years ago, Adobe and Aldus developed the software that launched the desktop publishing revolution and literally changed the way the world works. Today, as one company, they are uniquely positioned to make a further dramatic impact not only on how society creates information, but also on how it delivers and manages that information in the Digital Age.

The new digital world is one rich with color, movement, sound, images, text and other elements of human expression. People receive information in printed forms such as books, periodicals, brochures and reports; in projected forms such as overheads and slides; and in broadcast forms such as film and video. And because it can all be delivered electronically, the information reaches a vast, global audience in real time.

Moreover, the recipients are far from passive. They increasingly control not only what they experience, but also how, when and where they experience it. And they have access to software that enables them to create information with a level of visual sophistication once provided only by graphics professionals.

Over time, individuals and organisations will accumulate entire libraries of electronic documents and presentations, using and reusing them continuously. To satisfy this growing need to access and exchange information at will, electronic content must transcend and outlive the constraints, networks and operating systems now and in the future.

This communications picture is quickly coming together. And essential pieces are provided for defining and shaping it. More than any other developer of personal software, Adobe offers products that enable people to use the computer to express and share their ideas in imaginative and meaningful new ways, whether the choice of media is static, dynamic or a combination of the two.

Figure 7.2

*hz-program:  
hyphenation off,  
force justify,  
one-page-fit,  
less text*

Fifteen years ago, Adobe and Aldus developed the software that launched the desktop publishing revolution and literally changed the way the world works. Today, as one company, they are uniquely positioned to make a further dramatic impact not only on how society creates information, but also on how it delivers and manages that information in the Digital Age.

The new digital world is one rich with color, movement, sound, images, text and other elements of human expression. People receive information in printed forms such as books, periodicals, brochures and reports; in projected forms such as overheads and slides; and in broadcast forms such as film and video. And because it can all be delivered electronically, the information reaches a vast, global audience in real time.

Moreover, the recipients are far from passive. They increasingly control not only what they experience, but also how, when and where they experience it. And they have access to software that enables them to create information with a level of visual sophistication once provided only by graphics professionals.

Over time, individuals and organisations will accumulate entire libraries of electronic documents and presentations, using and reusing them continuously. To satisfy this growing need to access and exchange information at will, electronic content must transcend and outlive the constraints, networks and operating systems now and in the future.

*Today's software has a problem.*

## Fit This Headline to Column Width Fit Headline to Column Width

Writing is the visual reproduction of the spoken word, its primary objective being to convey a text to the reader without difficulties, or distraction, and without disturbing the flow of reading with unnecessary embellishments. The letters have no self-fulfilling purpose, neither are they a medium for self-presentation of a designer. Everything which makes reading difficult or time-consuming, or is detrimental because of its unusual form, has to be avoided.

*Both headlines are fitted with the 12-program using force-justify.*

## Fit This Headline to Column Width

Writing is the visual reproduction of the spoken word, its primary objective being to convey a text to the reader without difficulties, or distraction, and without disturbing the flow of reading with unnecessary embellishments. The letters have no self-fulfilling purpose, neither are they a medium for self-presentation of a designer. Everything which makes reading difficult or time-consuming, or is detrimental because of its unusual form, has to be avoided.

## Fit Headline to Column Width

Writing is the visual reproduction of the spoken word, its primary objective being to convey a text to the reader without difficulties, or distraction, and without disturbing the flow of reading with unnecessary embellishments. The letters have no self-fulfilling purpose, neither are they a medium for self-presentation of a designer. Everything which makes reading difficult or time-consuming, or is detrimental because of its unusual form, has to be avoided.

**Peter Karow, Ph.D.**

is a founder and partner in URW Software & Type GmbH in Hamburg, Germany. While his dissertation was in high energy physics, digital typography became his life's work. Contact with type designers, particularly Hermann Zapf, led to his development of the IKARUS program for digital type founding. Since 1988 he has worked on the hz program which uses the power of computers to improve the micro-typography of texts. Along with several books, journal articles and international presentations, he has fourteen patents for DTP related methods.



Karsten Lücke

A B S T R A C T

Articles dealing with documents on demand tend to presume a static digital format, i.e., a scanned page. In contrast, this article discusses a flexible document format subject to user specification based on particular reading needs or habits. The author argues for digitally created masters which ensure access to old, rare, out-of-print or otherwise inaccessible information at the same time they authenticate the accuracy of the data. Issues relating to format construction, the implications for the user/reader and the publisher/service bureau are explored.

Schloßstraße 50  
45711 Datteln  
Germany

*Visible Language*, 32.2  
Lücke, 128-149

© *Visible Language*, 1998  
Rhode Island School of Design  
Providence, Rhode Island 02903