University of Reading

The discourse in early digital type design technologies

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Department of Typography & Graphic Communication

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Declaration

I confirm that this is my own work and the use of all material from other sources has been properly and fully acknowledged.

Ferdinand P. Ulrich

Abstract

This thesis is concerned with the development of digital type design technologies and the discourse around them through new environments during a period of radical change and transition in the type manufacturing industry. It maps the emergence of a new field by exploring environments of discourse such as trade associations, academic institutions and the publication landscape, established as a response to new communities and identifies them as catalysts of change. The research considers different numerical models of letterform description devised through academic research, corporate research and commercial endeavours during a phase of type manufacturing that spans from the zenith of phototypesetting to the introduction of office-based laserprinting, covering most of the 1970s and 1980s.

A particular event, identified as a highpoint in this discourse and as a main catalyst of change, is the Association Typographique Internationale's working seminar hosted at Stanford University in the summer of 1983. It marks a focus point in these discussions during a period of several linear and concurrent developments, and it reflects issues that maintained their relevance after the introduction of the digital PostScript format, which followed the period surveyed in this thesis. Although more than a dozen digital type design systems were developed by 1983, this study is particularly concerned with five systems considered for presentation at the Stanford working seminar. While some of these systems found no particular use, others had some commercial success or even became well established among an international list of type manufacturers. All five encapsulate the relevant issues discussed at Stanford; from a research standpoint they are equally significant in providing information on the challenges type designers faced at the time.

As this research investigates a relatively short and recent period, it is characterised by a lack of certain archival material. In addition to a handful of academic archives, this thesis heavily draws on primary source material, on records and artefacts from personal collections, on oral history as a method to record the voices of contemporary witnesses, and uses these sources as an opportunity to discover hidden figures that have been overlooked in the past.

This thesis explores debated issues such as maintaining standards, while introducing new ones; shared responsibilities, collaborations as well as conflicts between designers and engineers; challenges and opportunities for established manufacturers versus an emerging generation of independent designers; as well as implications that new technologies had on the essentials of designing and digitizing type, from learning new terminology to measuring quality, dealing with compatibility and the introduction of automated and parametric design.

Acknowledgements

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I am grateful to the following institutions and hosts for opening their doors and letting me take many photographs: Amelia Hugill-Fontanel and the Melbert B. Cary Jr. Graphic Arts Collection, RIT; Elizabeth Fischbach and the Department of Special Collections, Stanford University Archives; Frank Romano and the Museum of Printing; Stephen Coles and the Letterform Archive; Alexander Tochilovski and the Herb Lubalin Study Center at the Cooper Union; Peter Rosenfeld and URW.

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Preliminary notes

This thesis is typeset in Kai Bernau's Lyon Text No. 2 and Lyon Display alongside Christian Schwarz's **Graphik Semibold**, all by Commercial Type.

Acronyms
The following acronyms are used throughout the thesis for referencing material from archival institutions, company collections and private collections. A description of the institutions is provided in 2.2.

Archival institutions and company collections:

CC	*Papers of the 1983 ATypI working seminar* [CSC 030], Melbert B. Cary Jr. Graphics Arts Collection, Rochester Institute of Technology, USA.
CdD	ÉSAD Amiens, Centre de documentation, Amiens, France.
DTGC	*ATypI collection, Richard Southall collection,* Department of Typography & Graphic Communication, University of Reading, UK.
LfA	Emigre Archive, Letterform Archive, San Francisco/CA, USA.
MoP	Museum of Printing, Haverhill/MA, USA.
SBL	*ATypI correspondence of John Dreyfus,* St Bride Library, London, UK.
SUA	*Donald E. Knuth papers* [SC 0097], *Richard Southall papers* [SC 1002], Department of Special Collections, Stanford University Archives, Palo Alto/CA, USA.
URW	URW Type Foundry, Hamburg, Germany (no longer publicly accessible).

Initials that indicate private collections with information on how they were accessed:

AJP	Albert-Jan Pool, through correspondence, 2018–2021
CB	Charles Bigelow, through correspondence, 2017–2022
ES	Erik Spiekermann, through himself in his home in Berlin (Germany), 2012–2022
GL	Gerry Leonidas, through himself in his office at the University of Reading (UK) and by correspondence, 2015–2022
GU	Gerard Unger (†2018), through himself during meetings in Berlin, at the University of Reading and by correspondence, 2013–2018
GZvH	Gudrun Zapf von Hesse (†2019), through herself at her home in Darmstadt (Germany), 2014–2019
MC	Matthew Carter, at the 2017 ATypI conference in Montréal (Canada)
MM	Martin Majoor, through correspondence, 2021–2022
PvB	Petr van Blokland, through himself at his home in Delft (Netherlands) and by correspondence, 2018–2020
SSt	Sumner Stone, through correspondence, 2016–2017
FU	the author

Bibliographical material and archival sources

In order to distinguish bibliographical reference from archival material, different style come to use in the footnotes and captions. Full bibliographical references are provided at the end of this thesis; when they are mentioned in the text they follow an abridged version in the following format:

> Unger 1979, p. 134.

Literature that is referenced only once, may not be listed in the bibliography and is referenced in full in the respective footnote:

> George Didi-Huberman, *Das Archiv brennt,* Berlin: Kadmos, 2007, p. 7.

References to archival material such as correspondence, internal reports, protocols, etc. that are not mentioned in the bibliography of unpublished papers, are provided in full within each footnote, including the acronyms listed above, as follow:

> Letter by Wiseman to Bigelow, 8 February 1984 [CC, CSC 030, box 5, folder 4]

Typographic conventions

This thesis follows the spelling convention for the names of computer programmes and/or their programming languages in small capitals only when they are first mentioned as well as in the respective subsections where they are investigated, with the exception of LIP, which is an acronym:

> ELF, METAFONT, FORTRAN

Illustrations

A scale of images is generally not provided unless this is particularly relevant.

Although efforts have been made to identify copyright holders, not all reproduction rights could be obtained. While many reproductions of this thesis are assumed to fall under the copyright exception of Fair Dealing within the category of study and research, selected images are redacted from the PDF version of this thesis.

1. Introduction

In a common narrative of the canonical history of type manufacturing and typography, 500 years of printing from movable metal type end with the rise of commercial photocomposition in the 1950s and from there leap forward to digital PostScript fonts on the Apple Macintosh in 1984.[1] This narrative overlooks two decades of highly significant investigation and discourse in early digital type design technologies. This thesis sets out to investigate that period of transition and rapid change, reviewing the so-called *digital type design systems* that were developed to manufacture and encode type in numerical descriptions, and explores the environment of an emerging community that negotiated challenging issues encapsulated by those systems.

Much writing in typographic research has overlooked this comparably long, highly relevant transitional phase and therefore fails to acknowledge the lessons learned that later periods benefitted from; some of the numerical routines in use today can be traced back 50 years to discoveries made during that time. Occasional excursions into 'early digital type' of the late 1970s cherry-pick one or two digital type design systems, thus under-representing a period that is characterized by several concurrent developments and ideas floating around simultaneously. At the same time they omit the significance of the fundamental investigations into the most sustainable method of encoding letterforms. More recently, the period has been covered in the context of monographs of prominent type designers of the twentieth century, who either experienced a high point or began their career during that era.[2] While these contributions are regarded as valuable accounts, they are tied to individual careers; this thesis' aim is to cross-examine several different approaches to digital type manufacturing by shedding light on their implications for an entire field of practice.

Most of the available secondary sources that are available were published at the time, often by authors who experienced the events first-hand or who turned out to be advocates of a specific system. These are just some of the biases to consider. As a result, this thesis cannot draw on a significant body of previous work that has been written with the necessary interval and distance of reflection; it therefore shifts the attention to a great variety of original documents, oral history and primary sources that have not previously been assessed in research.

1 See for example Matthieu Lommen, *The book of books: 500 years of graphic innovation,* London: Thames & Hudson, 2002, or Friedl, Ott, Stein, *Typography,* Philadelphia: Running Press, 1998.

2 This includes published monographs about the work of Adrian Frutiger (Osterer 2014), Hermann Zapf (Weichselbaumer 2015) and Gerard Unger (Burke 2021), who were all successfully active during this period, having designed several typefaces for different manufacturers who employed varying techniques of numerical letterform description.

In the early 1960s, the improvement of memory power on computers that no longer filled an entire room, but comfortably fit into a corner of that space, and the availability of cathode ray tubes or vector displays, enabled graphic interfaces and 'computer-aided design'.[3] Soon letter-like shapes began to be explored and described through these new technologies. By the end of the 1960s, small teams of engineers devised some of the earliest digital type design systems. While these activities still took place outside of the type manufacturing industry, the domains of computer science and electrical engineering were slowing beginning to discover intersections to typography. This study explores the convergence of the disciplines that eventually led to fruitful collaborations, with particular attention to the contributions of type designers during this period of change.

The period under investigation spans roughly two decades, from the earliest applications of numerical letterform description in the second half of the 1960s to a high point in the first half of the 1980s. With the introduction of mechanical typesetting towards the end of the nineteenth century, the industry had established a competitive environment in which fonts from one manufacturer could only be used on proprietary composing machines, a practice that was continued in photocomposition. With the introduction of numerical encoding, type lost its physical manifestation and became 'dematerialized'.[4] It was freed from metal bodies and film matrices and their technical implications — this fundamentally game-changing step in twentieth-century type manufacturing alone calls for an in-depth study such as this one. Numerical descriptions allowed type to be easily revised, customized, modified and interpolated, aspects that were fiercely discussed at the time. These developments raise the question of how a dematerialized environment can be researched most appropriately and have sparked the consideration of a methodology that is elaborated on in this study.

In an attempt to capture these significant changes, this thesis does not merely consider technical reports and manuals, but aims to explore a much broader picture that is able to capture the discourse in the new environments formulated in response to new communities. This is achieved by considering *environments of discourse*: emerging publication formats engaged in developing type systems, reform in education at academic institutions, and the establishment of associations, with a particular focus on the *Association Typographique Internationale* (ATypI). A special case is made for the 1983 ATypI working seminar, an experimental conference format with discussions and hands-on demonstrations, organized by Charles Bigelow and the Digital Typography Group at Stanford University. At the heart of

3 The term emerged with such computers as the TX-2, released by Lincoln Laboratory at MIT in 1958, and with the programmes that were developed for them. For example, Ivan Sutherland's Sketchepad was one of the first computer graphics programmes, enabled by new memory capabilities and a graphical display, see Sutherland 1963.

4 A term used by Richard Southall to describe this phenomenon, see Southall 2005.

discussions during this working seminar were five digital type design systems: ELF, METAFONT, FRED, IKARUS and LIP. Manufacturers, designers, educators, journalists, computer scientists and engineers negotiated aspects of typographic quality with the demands and challenges of the latest technology, epitomized in these five systems. This thesis investigates the environments in which they were conceived and sheds light on the mathematical models that they rest on, while exploring the key question of what the essentials of a digital type design system are.

2. Methodology and approach

As mentioned in the introduction to this thesis, a period of type manufacturing in the twentieth century is explored here that has previously been overlooked. Much of the material investigated in the following study has not been considered and reviewed in existing studies of typographic research, even though it provides evidence of a significant transitional period between technologies that tend to receive more attention in the existing canonical history: metal type, phototype and digital PostScript. Matthew Carter, who was interviewed in the course of this study, refers to this relatively short time span as 'digital incunabula' as a reference to the earliest stage of this development, one 'that is entirely forgotten as a period'.[1] As a result of the significant lack of secondary accounts, this thesis does not begin with a conventional literature review; there simply is not enough material and the few accounts that contain relevant information on the period are often delivered by figures who lack distance to the subject. For example, Richard Southall's *Printer's type in the twentieth century* (2005) offers one of the most relevant accounts on manufacturing and design methods, from metal type to numerical techniques, yet the final chapter on early digital type is informed by Southall's involvement with Digital Typography at Stanford University (see 4.2.2). In fact the final section of his book is a case study of his own work (produced in Metafont), which offers insights from a primary source, yet embodies some bias. Similarly, Charles Bigelow, who has written extensively on the subject, was involved first-hand in many of the aspects he recounts and draws on examples of his own work in several publications. Secondary sources considered in this research are those that cover specific aspects: reviews of conferences, of typefaces and of type design systems, usually not very critical, but written favourably — possible biases need to be considered here as well. Some of these sources are reviewed in 3.3 and cross-examined against other records throughout chapter 4 when they are relevant.

Because of these conditions great value has been placed in the consideration of primary sources, some of which were discovered and identified for the first time during this study. As the research began, only a few systems and the names of some key figures were familiar, but it was relatively uncertain what initial research would or could unfold. In an attempt to avoid focusing on individual achievements of company histories, it was necessary to investigate environments where common challenges and issues were discussed. In applying a *synchronoptic view* to linear and concurrent threads it was possible to identify some of these 'environments of discourse'; this approach is discussed in the following section 2.1.

After identifying the ATypI and its conference formats as one of these significant environments, research began deep in the uncatalogued primary sources of the Association, unknowing what was to be looked for and what could be found.

1 Matthew Carter in an interview with the author, 14 September 2017 [audio file 01, 07:35].

The fortunate proximity of these records at DTGC enabled a thorough review, while slowly unfolding the messy history of 'digital incunabula'. In order to indentify documents of relevance it was necessary to dig through the extremely partial and 'dirty' layers of material, some of which was never meant to be investigated. Many of these records offer hints that things existed, but are not representative of how they were done or who they were for. Unlike documentation from industrial type manufacturers, there are very few representative records of what was being developed and designed by typically small-scale operations that emerged during this early digital period. Only as elements of a narrative began to slowly unfold, was it possible to establish a framework for research questions. The examination of these recods also sparked a re-assessment of what kind of material can be identified as a primary source for interpretation as evidence in a study as this one. The uneven distribution of primary sources in the few available archival institutions and the challenges attached to investigating non-textual things in private collections are explored in 2.2.

Due to the significant lack of secondary accounts and in order to cross-interrogate multiple primary sources, this thesis also draws on first-hand records through interviews with key figures who were active at the time, had either developed digital type design systems, had worked as independent designers or for one of the emerging manufacturers at the time. These accounts add invaluable perspectives to a subject that has previously not been explored to this depth and contribute to the oral history of the field. In a method developed for this research, interviewees were confronted with specific material and asked to respond to unusual archival findings. These aspects are discussed in 2.3.

Finally, as in any study of research, the author's subjectivity must be acknowledged here; a different approach in other places and different decisions could have resulted in other evidence that may have informed a slightly different understanding and narrative. While it was not a all clear what kind of narratives would unfold at the beginning of this research, the methods explored in this chapter become contribution to knowledge themselves as they informed the way research was conducted and what questions were being asked.

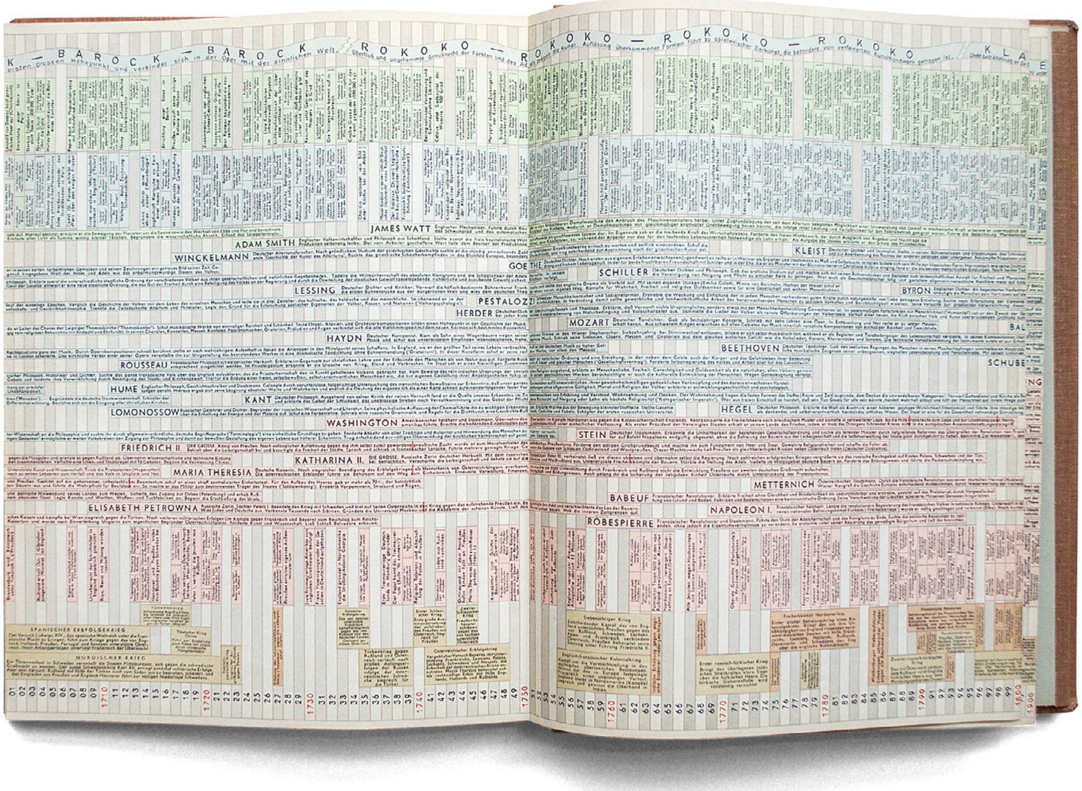


Fig. 2.1 *Peters Synchronoptische Weltgeschichte,* synchronoptic view applied for use in educational programmes. Peters 1952, photographed by the author [ES].

2.1. Synchronoptic view

In an early attempt to avoid a narrative that is focused on biographies or company chronicles, but that sheds light on aspects of a larger community in transition and its environments that undergo significant change, it was necessary to switch the view from a linear thread to concurrent developments and issues that are discussed in different places at the same time. Such a view has been described as an example of *parallelism,*[2] others have coined the term *synchronoptic*.[3] It is a visualisation method used to display entities that are literally *visible at the same time,* revealing a model for complex information, which can often be described as a diagram, chart or map. Each entity is displayed in its own timeline, though the parallelism of threads unfolds connections, common grounds, relations and causalities in synchronous manner. As Tufte describes:

> Connections are built among images by position, orientation, overlap, synchronization, and similarities in content. [...] Parallelism is not simply a matter of design arrangements, for the perceiving mind itself actively works to detect and indeed to generate links, clusters, and matches among assorted visual elements.[4]

Examples of parallelism laid out by Tufte include all visual things that appear 'simultaneously within our eyespan' and enable sorting, identifying, selecting or reviewing of new connections among images, text, charts, and also letterforms.[5] The principle can be found as early as in the 1070s in the Bayeux Tapestry, though purely pictorial; it has been established as a relevant methodology at least with M. Jacque Barbeu Du Bourg's *Carte chronographique* (1753), an early example of history told in synchronoptic charts rather than in a coherent text.[6] In this piece a continuous (six and a half metres-long) horizontal axis of time is placed against changing categories in vertical arrangement. American educator Emma Willard added a third dimension and the element of colour to distinguish between categories in her remarkable design of *The temple of time* (1846) — design solutions that had an influence on similar charts in the following decades. The term 'synchronoptic' and its underlying method received significant, yet controversial attention during the middle of the twentieth century through a collection of world history charts titled *Synchronoptische Weltgeschichte* (1952, **fig. 2.1**) by Anneliese and Arno

2 See Tufte 1997, pp. 78–104.

3 See Peters 1952.

4 Tufte 1997, p. 82.

5 Ibid., p. 98. Tufte describes Edward Catich's investigation of the Roman letters of the Trajan Inscriptions, in which outlines of letters are overlapped rather than reviewed side-by-side, as 'superimposed parallelism'. Also see 4.1.2 in this thesis.

6 The full title is *Chronographie universelle et details qui en dependent pour la chronologie et les genealogies,* Paris, 1753.

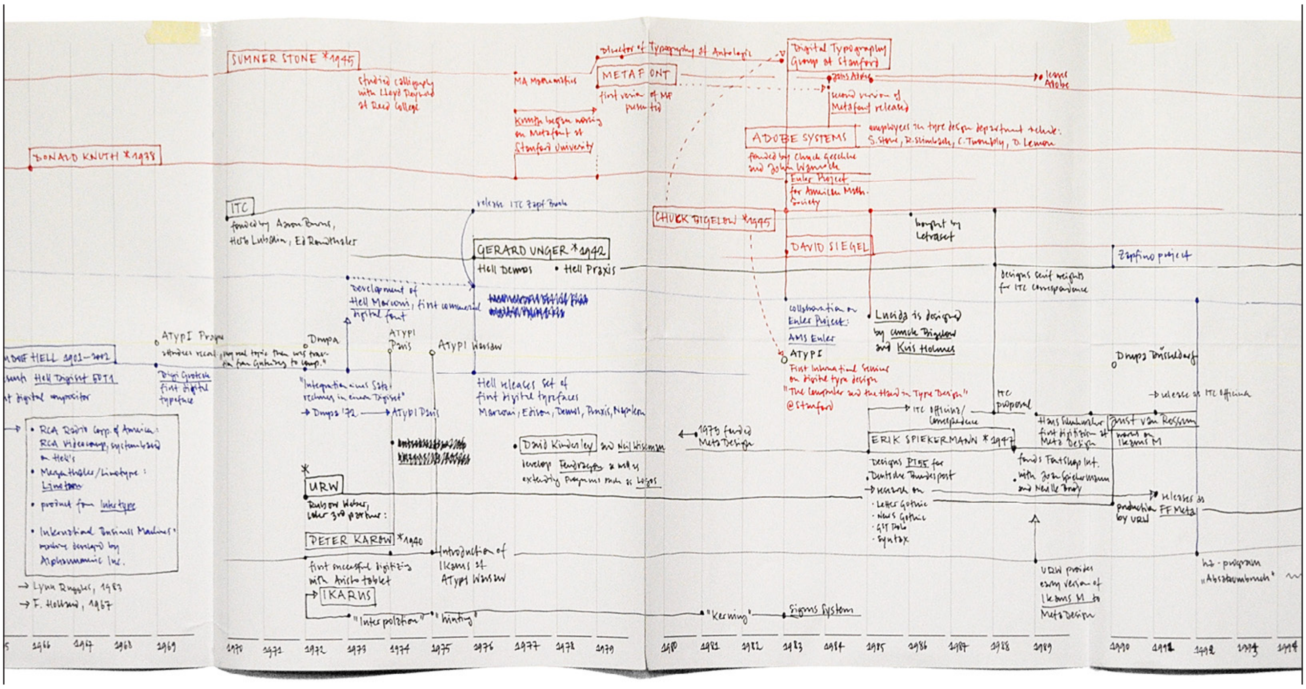


Fig. 2.2 Synchronoptic view as an approach to identify simultaneous developments, crossroads and intersections of different threads to discover what has been identified as 'environments of discourse'. Diagram by the author.

Fig. 2.3 Timeline of the manufacturing process of 'Correspondence' (the working title for the typeface ITC Officina, 1987–1991), compiled by the author from previously unsorted material from the collection of ES.

Peters.[7] Commissioned by the American Division of Cultural Affairs in West Germany and thirteen years in the making, it was initially compiled in an attempt to provide a history book that could be used in East and West, but eventually ended in a scandal, which is to underline the political dimensions of reviewing history.[8] The book is still being revisited today, more so by educators in information design than by secondary school teachers.

Following a first review of names, companies and some case studies of projects considered relevant at an early stage of this research, roughly sketched out threads for each of these entities in one time chart revealed a recurring theme during the 1970s and 1980s (**fig. 2.2**): international gatherings such as conferences are connecting dots, places of mutual interest often hosted at academic institutions, particularly those organised by the ATypI, including annual meetings as well as other less regularly organized formats, the ATypI working seminars. These places, the people who moved within them and the issues they discussed are identified as *environments of discourse,* a central theme of investigations in chapter 3. Recurring mentions in literature include the ATypI congresses in 1969 and in 1975 (at the time the only congresses outside of Western Europe), which sparked an interest in exploring the history of the Association (see 2.2).

Additional timelines (linear, not synchronoptic) shed light on potential case studies in an attempt to draft type manufacturing that is challenged by changing technology, e.g. switching from one type design system to another during the process over a longer period of time. Although some of these case studies were later abandoned (such as the example seen here, **fig. 2.3**), the excercise sparked a re-interpretation of what kind of non-textual primary sources should be considered in addition to conventional archival documents, a challenge that is discussed in the following subsection.

7 See Peters 1952.

8 Although Arno Peters had disclosed that he was a socialist, only shortly before publishing, independent historians discovered alleged criticism of capitalism and favourable mentions of communist leaders in his work, causing a scandal in the American and British occupation zones, cf. 'Aus sozialistischer Sicht', in *Der Spiegel,* vol. 6, no. 47, Hamburg, 1952, pp. 26–28.

2.2. Challenges of archival research and private collections

The lack of secondary sources and the significance that is assigned to primary accounts as a result has been explained at the beginning of this chapter. To rely on primary records also means to acknowledge certain challenges that arise in collection-based research and in pursuing a historical assessment of evidence. A primary step is to identify places that hold relevant material, e.g. institutional archives or private collection that have not been made public and may not be easily accessed. During the course of this research several research journeys were made abroad to access archives, libraries and private collections.[9]

The identification of environments of discourse sparked the interest in the activities of the ATypI during that time.[10] The fortunate availability and proximity of ATypI-related records at DTGC allowed the author to take much more time with this collection than with the material available anywhere else. Deep into these primary sources, early research unfolded a cosmos of *messy history*[11]: random correspondence, an illegible remark stapled to a conference programme, yellowed notes that were never meant to be interrogated. Occasionally, a conference tag or a calligraphic keepsake emerges in-between membership applications and financial reports, as if no one had touched these things in the past thirty, forty or even fifty years. Unlike common archival material that typically follows a predefined structure, these disparate sources do not explain themselves. As more relevant documents emerged, such as conference protocols and correspondence between key figures of the Association's committees, narratives began to slowly unfold. Therefore, one of the aspects to contribution of knowledge in this thesis is rooted in the assessment of these and other records, in unfolding and identifying their meaning within a broader narrative. The gaps between them are the nature of this research: it is not merely about the things that are, but about those things that could not be considered — Didi-Huberman goes a step further:

> The substantial characteristic of the archive is its lacuna, its riddled nature. These lacunae are often the result of arbitrary and unconscious censorship, destruction.[12]

9 The author is most grateful for to the Design Star DTC for providing an additional Research Training Support Grant to pursue a research trip to North America in September 2017, including archival research, interviews as well as a paper delivered at the ATypI conference in Montréal.

10 Records of the ATypI are in different locations: documents of the early years can be found in the collection of ATypI founder Charles Peignot at the Bibliothèque Forney, Paris, as well as in the collection of his successor John Dreyfus at SBL in London. DTGC holds records of the presidencies that followed Dreyfus, while CC archives the papers of the 1983 ATypI working seminar.

11 The term is Martha Scotford's, originally used in a slightly different context, but comparable to the complexity of circumstances and categories. See M. Scotford, 'Messy history vs. neat history', in *Visible Language,* vol. 28, no.4, Autumn 1994, pp.367–387.

12 George Didi-Huberman, Knut Ebeling, *Das Archiv brennt,* Berlin: Kadmos, 2007, p. 7.

Fig. 2.4 Examples of non-textual artefacts from archives and private collections, unconventional carriers of informtation that might otherwise remain uncovered from a larger body of knowledge: (A) floppy disc of 'Ikarus M' software [ES]; (B) photograph of a monitor running a prototype of 'Plotr' [PvB]; (C) trial drawing on graph papher for Ikarus digitization [ES]; (D) dia-positive of 'smoke mode' in Metafont [SUA]; (E) rasterized letterform on a presentation slide [SSt]; (F) frisket of a letter on Rubylith masking film [MM]; (G) slides of photographs taken of letterforms displayed on computer monitors running Metafont [DTGC].

After spending a significant amount of time browsing these records at DTGC, it became clear that while a range of specific sources are available, they were unevenly distributed. Most of the companies that emerged at the time, were small-scale operations which, by comparison, bequeath far less representative records than industrial manufacturers, such as Mergenthaler, Stempel or Haas. This sparks the question of how institutional memory can be captured or recorded, which calls for a distinction between academic research, industrial research and commercial developments (this distinction is also considered in chapter 4.2). The results of academic research tend to be sorted and stored more accurately and reliably, while examples of industrial research — unless they are released — can be more difficult to access. The significant lack of material from manufacturers of this comparably recent history, as described above, is affected by circumstances: small companies grow, move, go bankrupt, re-emerge under a different name, cease to exist or are acquired by competitors, which often results in lost or destroyed records. Saved records scattered among former employees are often the best-case scenario.

Relying on such private collections has been one of the key considerations of this research. The greatest challenge of this approach lies is the circumstance that several key people have not made their collections publicly available. While Richard Southall's (†2015) Metafont papers had been available at SUA since 2010 (where they were reviewed during this research), related materials became available to his existing personal collection at DTGC in 2018 as this thesis progressed. All other private collections considered in this research were accessed through the people that hold them, an endeavour that requires establishing connections and correspondence, sometimes travelling with less time available than for a library appointment.

Given these different preconditions and their implications for research, it is necessary to acknowledge archives and collections as separate entities. Institutional collections, like libraries, are open and accessible. As Ernst observed, the differences between archives and libraries are not so much rooted in the material that is stored, but in the archive's origin in administration-like spheres.[13] In institutions of the magnitude of the Stanford University Archives (SUA), the mechanism of how things are ordered are typically concealed from visitors.[14] Two visits to Stanford, half a year apart in March and October of 2018, made it possible to gather first impressions of the scope of material and then to return to delve deeper into selected areas of research that became particularly relevant. The valuable opportunity to review selected materials with Donald Knuth, while interviewing him in the archive's chambers, that are separate from the study hall, is discussed in 2.3.1.

13 Wolfgang Ernst, 'Das Archiv als Gedächtnisort', in K. Ebeling, S. Günzel (eds.), *Archivologie. Theorien des Archivs in Philosophie, Medien und Künsten,* Berlin: Kadmos, 2009, p. 178.

14 The author is most grateful to Elizabeth Fischbach of the Department of Special Collections (SUA) for having made arrangements to access all relevant records.

Image redacted

Fig. 2.5 Screenshooter (1983) was a cone-like apparatus which accommodated most 35-mm cameras and could shield photographs from reflecting light. Photographer unknown, NPC Photo Division, Newton Upper Falls/MA.

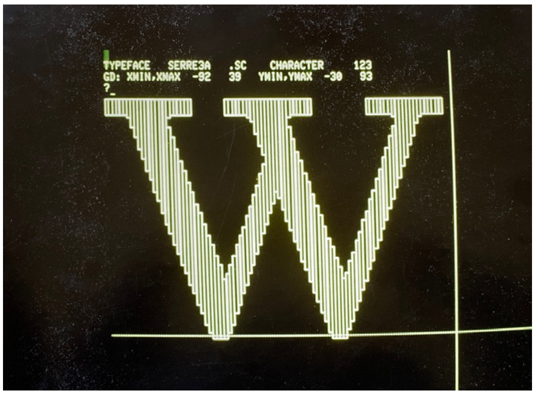


Fig. 2.6 Photograph of a numerical letterform description, displayed on the screen of an Ikarus workstation, 1984 [MM].

The access of private collection opens up another discussion on the nature of the material that is recorded. It is not unusual of designers, particularly of typographers and type designers, to keep records of their own projects as well as work produced by others.[15] These ephemera-like collections contain things not found in conventional archives. They are non-textual artefacts, carriers of information and have the potential to fill some lacunae. This calls for a reinterpretation of what should be considered as archival source material in a study of typographic research. If these things were not recognized in a study such as this one, they might otherwise remain unconnected from a larger body of knowledge. Examples of such materials are found throughout chapters 4 and 5 (**fig. 2.4**): dia-positive presentation slides, trial drawings, proofs, and other artefacts of typeface manufacturing processes that have not yet been documented. These materials help re-shape narratives by cross-referencing them with conventional material such as correspondence, protocols, notes, unpublished essays etc. Consideration of these disparate sources informs the way relevant records are selected and interpreted in this thesis. The discovery of a manual is evidence that something had been developed, but reveals little about how it actually worked and is certainly no proof that is was ever in use. All of these insights carefully influenced the research questions.

One of the key questions that arises in this thesis, resolves around the theme of *dematerialization*: how should research be conducted in such an environment? As an example of a new emerging digital technology, reproductions of early graphic interfaces of digital type design systems are frequent findings in collections. With very few exceptions these so-called 'screenshots' are not electronic images captured directly on a system, but photographs captured by analogue cameras, mounted in front of a monitor. With the emergence of computer-aided design in the early 1960s, screen captures evolved as a means to document the new phenomenon, in fact, Allen suggests, screen captures were essential in 'constructing new meaning for the computer'.[16] Even though advanced solutions could shield the camera from reflecting light (**fig. 2.5**), such reflections and lens distortions are typical characteristics of these screen captures. If none were present, one might interpret them as analogue mock-ups that merely imitate an interactive system. Such a case is made in 4.2.1. Therefore, when assessing screenshots of that period, we are not simply looking at a digital character, but at the representation of a digital letterform description, reproduced on a computer screen (**fig. 2.6**).

Compared to the challenges described above, the aspect of language is marginal, but an issue to consider in the assessment of historical records. Trilingualism is a key characteristic of the messy history of the ATypI, with most official documents printed in English, French and German, while selected

15 See Jens Müller, *Collecting graphic design: The archiving of the visual,* Düsseldorf: Optic Books, 2021.

16 Allen 2016, p. 638.

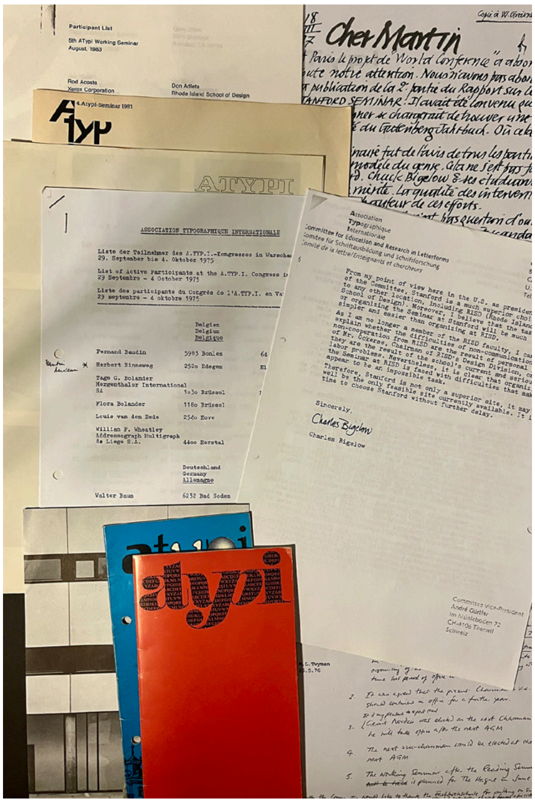


Fig. 2.7 Snapshot of some of the unsorted and 'messy' primary ATypI records at DTGC, May 2017.

Fig. 2.8 Richard Southall's papers are held in the special collections at DTGC, May 2022.

Fig. 2.9 The records of 'CSC 030' are comprised of twelve boxes and over 70 folders: manuscripts and typeset pages of the published/unpublished papers of the 1983 ATypI working seminar.

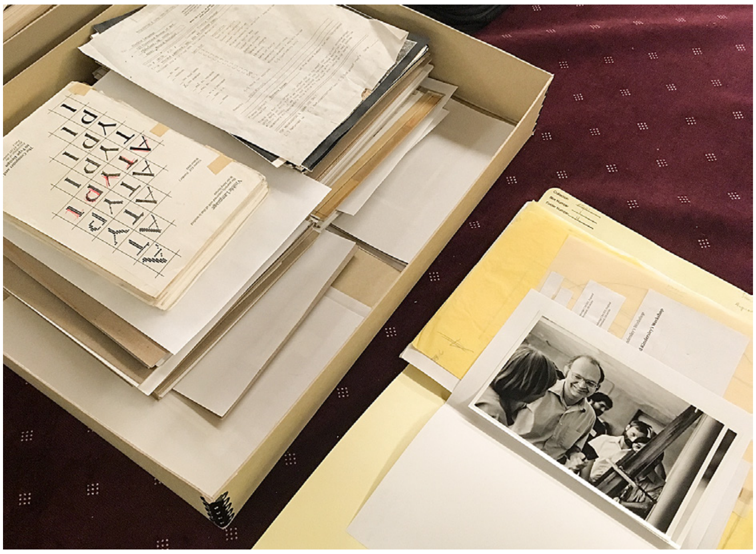


Fig. 2.10 The flat boxes contain drafts of the first (published) and second (mostly unpublished) proceedings of the working seminar. September 2017.

correspondence is available only in one of the languages. Even in some internal communication, the primary language seems to change with the presidency; in the late 1970s and early 1980s, during the 14-year tenure of Martin Fehle (associated with Haas, see below) many of the protocols and correspondence are in German, while most of the relevant correspondence between Charles Bigelow and the education committee leading up to the 1983 ATypI working seminar is in English.

The following overview lists the archival institutions where research has been conducted for this thesis:

The **Department of Typography & Graphic Communication** (DTGC) at the University of Reading holds several distinct collections of relevance to the research conducted here, including selected material of the ATypI that has been available at the Department since 2004.[17] Although the material of the ATypI collection is by no means complete (it lacks the first 15 years of the Association), it covers the presidencies of Tage Bolander (1973–1977) and Martin Fehle (1977–1992), whose years in office span the period discussed in this thesis.[18] The collection includes material all the way to 2004, but generally ends with the predominant use of electronic mail. The scattered nature of the collection and lack of cataloguing made it necessary to go through the entire messy collection, before discovering any relevant material (**fig. 2.7**). Eventually, the author created an inventory list of this collection, which had previously not been available, upon an informal request of DTGC.[19] Relevant material includes protocols and correspondence of the association's board and education committee, and the exchange between Bigelow and the Association leading up to the 1983 working seminar at Stanford.

In 2018, the DTGC added Richard Southall's remaining personal archive to its existing *Richard Southall Collection,* which became a valuable source for this research. Over thirty boxes and hundreds of presentation slides, reveal a well-sorted medley of notes, correspondence, manuals, reports etc. associated with type manufacturing of different technologies (**fig. 2.8**). Materials related to the Digital Typography Group and to Metafont seem incomplete in this collection, but also contain items that are 'missing' at Stanford. Therefore, the Southall collections at DTGC and SUA complement each other — having visited both it was possible to fill gaps of knowledge on either end, which turned out to be a decisive step in the analysis of Southall's studies on early digital type.

17 Many of the boxes contain material compiled by ATypI member Sharon Moncur (some boxes indicate 1997), shipped to member Cynthia Batty in 2003, who passed them on to DTGC at the end of Mark Batty's presidency in 2004. From a conversation with Gerry Leonidas, 9 May 2017.

18 The collection also covers the presidencies of Ernst-Erich Marhencke (1992–1995) and Mark Batty (1995–2004).

19 The inventory list was assembled from archival research in the collection between April and May 2017. It has served as a reference for John D. Berry's work on the 'ATypI History Project' in 2018.

Fig. 2.11 Entrance to Green Library, home to SUA, October 2018.

Fig. 2.12 Inside the archive: *Richard Southall papers* in folders above, *Donald Knuth papers* in boxes and even more folders below.

Extensive archival material related to the 1983 ATypI working seminar at Stanford is held by the **Melbert B. Cary Jr. Graphic Arts Collection** (CC) at Rochester Institute of Technology. After Charles Bigelow, the former organizer of the 1983 seminar, relocated from California to join the faculty at Rochester in 2006, his personal collection of the event found a new home at the Cary Collection (**fig. 2.9**). The *Papers of the 1983 ATypI working seminar* [CSC 030] includes manuscripts, typescripts and galley proofs of typeset text of twelve published and nine unpublished talks, alongside negatives and photographs of the original presentation slides (**fig. 2.10**). Other related material includes correspondence between the authors and Bigelow's editorial team, mock-ups, notes. Since its inauguration in 1969, the Cary Collection has assembled a substantial inventory in the history in type and typography, including a distinct collection of items by Gudrun Zapf von Hesse and Hermann Zapf, who taught at Rochester from 1977 to 1987.

Located in the impressive Cecil H. Green Libary in Palo Alto/CA (**fig. 2.11**), the **Stanford University Archives** (SUA), Department of Special Collections house hundreds of voluminous collections, including the extensive *Donald E. Knuth papers* [SC 0097]. Over the course of two visits in 2018 for only a few days each, the author reviewed the relevant documents of the development of Metafont, records of the Digital Typography programme that Knuth co-taught with Bigelow and Southall, as well as a selection of Knuth's international correspondence and his own records of competing digital type design systems. In contrast to some of the collections mentioned above, Knuth's folders follow an impeccable structure, which eased the handling of the extensive amount of records (**fig. 2.12**).

The *Richard Southall papers* [SC 1002] are comprised of 15 folders that include Southall's correspondence with Knuth, notes on his teaching at Stanford, revisions of typefaces designed by Knuth as well as sketches and proofs of his own Metafont designs. Most importantly, the collection contains several notes and drafted reviews of Metafont that Southall turned into different versions of a report in the mid-1980s (see 5.1). As mentioned above, Southall's later reflections of Metafont are available at DTGC, therefore the two collections complement each other.

In 2016, the **Letterform Archive** (LA) in San Francisco/CA received a donation of archival material from Emigre, a publisher and digital type foundry co-founded by Rudy VanderLans and Zuzana Licko in Berkley/CA, in 1984. The material includes the original drawings and trials of Licko's typefaces, which were reviewed during a visit to the LA in 2018. The LA was formed in 2015 as a non-profit insitution and, in 2018, had not yet acquired collections with records of digital type manufacturing *before* 1984, which is once again proof that many materials of this period have not yet been made publicly available and remain difficult to access.

Fig. 2.13 Tour of the Museum of Printing by Frank Romano. Photograph by Norman Posselt, 6 September 2017.

Fig. 2.14 URW publications and type specimens, inherited and neatly arranged by the author, October 2020.

The **Museum of Printing** (MoP) in Haverhill, Andover/MA (USA) is home to an impressive hardware collection from printing presses to the first office printers. Hopes to rediscover the remains of Bitsream's company collection during a visit to MoP in September 2017 could not be fulfilled, it was however useful to witness some of the hardware of the period investigated here, such as a Hell drum scanner, different generations of cathode ray tubes and carriers of digital fonts, many items of which are rarely seen anywhere else (**fig. 2.13**). This provided some insight into the dimensions and material that these devices had.

URW Type Foundry (URW) had just been acquired and renamed (from previously URW++),[20] when a visit to its Hamburg office was possible in the summer of 2019, in hopes to review any remaining original records of URW. At that time, only a few remaining traces of a company 'archive' remained, yet a few surviving items include lecture slides, a folder that contained some Ikarus proofs, and type specimens. As managing director Peter Rosenfeld explained, material got lost after several office moves and due to the firm's history. After Monotype acquired URW Type Foundry in May 2020, Rosenfeld agreed to handing over the remaining records along with more rediscovered items and a full stack of specimens, company brochures and Peter Karow's publications to the present author, in October 2020 (**fig. 2.14**).[21] The material includes digitization hardware from Aristo along with unused software licenses, which shall be put to use in the future. Acquisitions like these have encouraged the author's personal collection of 'digital incunabula'.

20 Global Graphics acquired URW++ in 2018. URW Type Foundry and some of its former staff are connected to the original URW company, see 4.2.4.

21 This was also made possible by former URW employee and DTGC graduate Felix Kett.

2.3. Interviews as a collection of oral history and contribution to the field

Research on a time period of recent history offers the opportunity to speak to those who witnessed events, processes and transitions first-hand. Their experience of this transition, having worked in a rapidly changing discipline, presents valuable insights that cannot be found anywhere else. This engagement offers the possibility to document voices of the early digital era and to contribute new records to an underrepresented subject and to the oral history of the discipline of type and typography as a whole. Bearing in mind the challenges described in the previous section, great significance is attached to interviews with some key figures as a means to gather information from primary sources that would otherwise not be available and could therefore not be documented or considered at all. While interviews with type designers from the second half of the 1980s have been documented, this project is an opportunity to contribute to a collection of oral history on the issues of the previous decades that are investigated in this thesis.[22]

Oral history is a relatively young discipline in the field of research. The term itself is believed to have emerged with Joseph Gould's unpublished study undertaken in Greenwich Village during the 1940s, titled *An oral history of our time*.[23] Conditioned by the ability to record sound, a technology developed and perfected in the second half of the nineteenth century, it became sensible to investigate oral sources alongside written or printed evidence for scientific purposes around 1900. The first Oral History Association was formed in the United States in 1966, which adds to the list of associations emerging in new disciplines during that era (see 3.1). While some institutions favoured documentary evidence over what were deemed 'less "objective" sources',[24] Richie responds that oral history is as reliable or unreliable as any other source.[25] For this reason, as with other primary records, these oral records are assessed and cross-referenced with additional sources, when they are available.

Some of the aspects that were considered in selecting interview candidates for this research were their affiliations during the period investigated here, their experience with different digital type design systems and whether they have a history in type manufacturing of previous technologies. The following segments provide short biographical notes on the interviewees (in chronological order of the interviews) and

22 A collection of oral history is included in the Emigre collection at the Letterform Archive, San Francisco. It considers interviews conducted for the magazine of the same name from 1984 onwards.

23 Ritchie, 2014, p. 4 f.

24 Ibid., p. 3.

25 Ibid., p. 9.

states why they were considered (four of the interviews are discussed in detail in the following subsection 2.3.1):

Sumner Stone (*1945) studied sociology at Reed College, Portland/OR, and began his career in lettering at Hallmark Cards in the late 1960s. After receiving an MA in mathematics from Sonoma State University in 1977, Stone joined Autologic two years later, where he supervised the development of typefaces by employing the Ikarus type design system. In 1983, Stone became director of typography and design at Camex in Boston, who had co-developed the LIP system with Bitstream. When Stone joined Adobe only one year later as type director, he oversaw the development of tools and began building a library of typefaces, later he initiated the development of Multiple Masters. His typeface family 'Stone' was released with ITC in 1987 and later by Adobe. Stone was interviewed by the author during the Kerning conference at the Cinema Teatro Sarti, Faenza (Italy) on 3 June 2016.

Charles Bigelow, 8 September 2017, see 2.3.1.

Matthew Carter (*1937) is one of very few type designers who experienced all the major technological transitions in type manufacturing of the twentieth century, from hot-metal to film and digital. Carter learned punch-cutting as an intern at the Joh. Enschedé in Haarlem, before he began his career at Crosfield Electronics in the UK in the early 1960s. In 1965 he joined Mergenthaler Linotype in New York, where he designed typefaces for photocomposition in a division supervised by Mike Parker. During this period, Carter designed most of his well-known typefaces including Snell Roundhand (1965), and later Bell Centennial and ITC Galliard (both 1978). In 1981, Carter, Parker and two other partners co-counded Bitstream, probably the first 'digital type foundry', where they developed the digital type design system Camex LIP. Carter was interviewed by the author at Université du Québec à Montréal, 13 September 2017, during the ATypI conference.

Donald E. Knuth, 22 October 2018, see 2.3.1.

Gerard Unger, 12 November 2018, see 2.3.1.

Petr van Blokland, 3 May 2019, see 2.3.1.

Peter Karow (*1940) studied physics in Hamburg before joining two fellow students who had founded URW, an early software company dedicated to application for business administration, in 1972. Under Karow's lead, the firm developed the digital type design system Ikarus, which became an industry standard in less than a decade. Since presenting Ikarus at the 1975 ATypI congress in Warsaw, Karow became a frequent visitor of the Association's conference formats and maintained a close relationship with many of its members, including Matthew Carter, Kris Holmes and Hermann Zapf. In the early 1990s, Karow made significant contributions to text justification, optical sizing, and collaborated with Adobe on

some of these endeavours. When Karow was interviewed at his home near Hamburg, 20 May 2019, he had just disposed of his remaining private collection of URW material.

Hopes to include a more diverse range of voices could not be fulfilled due to a range of circumstances. Some candidates considered for interviews had moved into different career paths, where difficult to track, could not be or wished not to be interviewed at all, while referring to other colleagues. As the research progressed, its focus shifted and research questions were refined, some aspects that were investigated perviously could not be sustained in the final thesis. An emphasis on the changes and reform to type design education during the period of early digital technologies inlcuded interviews that were ultimately not considered, but will be extremely valuable for future research in this direction.[26] Other interviews that go beyond the scope of what is presented here could unfortunately not be considered at this point.[27]

26 This research focus includes interviews with Christopher Burke at DTGC, 11 May 2017, and with Bruno Maag in Antwerp, 14 September 2018.

27 These include in chronological order: Mark Simonson in Faenza (Italy), 3 June 2016; Frank Romano at the Museum of Printing, Andover/MA (USA), 6 September 2017; David Lemon at The Cooper Union, New York City, 16 June 2018 and Albert-Jan Pool in Berlin, 12 June 2019.

2.3.1. Interview methods

In preparation of the conducted interviews, three key aspects of oral history were identified, each of which pose certain challenges to consider: *narrative, subjectivity* and *memory,* as outlined by Abrams.[28] As a precondition of the interview, it is the researcher who seeks a *narrative* from the respondent, also referred to as the interviewee or the narrator. This narrative does not only depend on the narrator's memories and on the ability to articulate them, but may also be shaped by the circumstances of the interview. The intentions of the researcher, the questions asked, the environment selected for the interview as well as the overall atmosphere, the tone in the language and the interactions between both parties become a crucial part of this context with no hope for an objective narrative. It is important to acknowledge the biases involved on both sides; the narrative is not only shaped by the *subjectivity* of the narrator, but just as much by the subjectivity that the interviewer brings to the table, a constellation described as 'inter-subjectivity' by Abrams.[29]

The researcher's own subjectivity is shaped by the personal background and by the knowledge available at the time of the interview. The author's understanding of events is also influenced by the inconsistency of resources, their availability, language barriers, among other factors. Researchers with a different background and education may have chosen other sources, made alternative interpretations and asked different questions in the process.

An interview may also be influenced by a narrative that does not accurately respond to the questions, because certain stories have been told over and over. According to Abrams, it is important to maintain an awareness that narrators draw upon a 'range of ideas' in order to respond to the subject, that is not a 'static entity', but something that changes over time, and as it develops, considers variables such as the context of the interview.[30] Some of the designers that have been interviewed for this thesis are experienced conference speakers who have talked about their work many times. As any oral history interview becomes a site of performance to some degree, it is a particular challenge to avoid autobiographical storytelling.

Ritchie suggests that oral history is 'limited by the fallibility of human memory'.[31] As with any source that is consulted and requires critical analysis and assessment, incorrect dates, false account of people involved, contradictions, misrepresentation of achievements, unintentionally false or fragmented *memory* are issues to consider when conducting interviews. In order to anticipate such issues, a number of interviews were conducted amidst a personal collection or

28 See Abrams 2010.

29 Abrams 2010, p. 58.

30 Ibid., p. 56.

31 Ritchie 2014, p. 14.

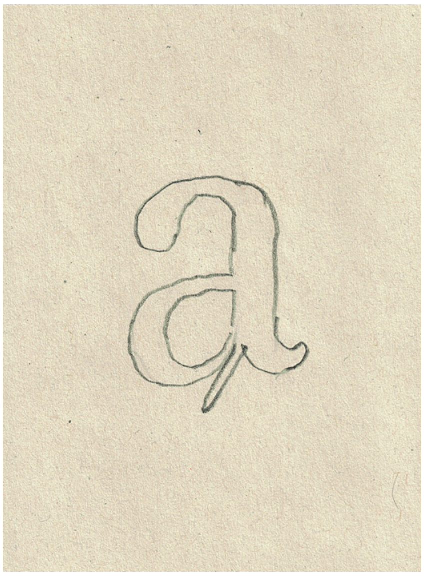


Fig. 2.15 Drawing by Gerard Unger as a visual aid during an informal conversation at DTGC, 27 January 2016 [FU].

Fig. 2.16 Interview with Charles Bigelow at the Melbert B. Cary Jr. Graphics Arts Collection at RIT, while also going through the *Papers of the 1983 ATypI working seminar*. Photograph by Norman Posselt, 8 September 2017.

archival material that relates to the interviewee — as close to the records as possible. This method has provided an opportunity to confront interview candidates with the actual evidence and to utilize specific material to recover memories in a conversation. This method of cross-referencing primary sources with the response of the narrator in real time has also been benefitial for the records, some of which are not easily identified as details in a process, not previously documented elsewhere, but that could be uncovered during the interview. However, it must be acknowledged that memory also depends on the questions being asked, on the preparations made and even more so on the environment which is selected for the interview to take place.

One of several informal conversations with Gerard Unger at DTGC, during which he used pencil and paper to illustrate an anecdote (**fig. 2.15**),[32] had sparked the idea that even formal interviews should be more interactive, allow the narrator to make sketches, use visual references to make a point, involve others if necessary. Given the dematerialized nature of the subject, it has proven to be necessary to utilize tangible artefacts in order to discuss numerical description of 'visible language' in visual references, especially when the interview shifts to details such as serifs, bows, transitions into stems and pixel contours.

The following provides short biographical notes of the candiates of four interviews conducted in the method described above and mentions where they took place:

Charles Bigelow (*1945) studied anthropology at Reed College, Portland/OR, and typography for one semester with Jack Stauffacher at the San Francisco Art Institute, before co-founding a type design studio with Kris Holmes. After teaching at Rhode Island School of Design for three years, Bigelow received the prestigious MacArthur Fellowship in 1982 and was appointed professor at Stanford University the same year, where he co-established the Digital Typography programme with Donald Knuth. Bigelow was an active member of the ATypI, and after chairing its Education Committee, became responsible for organising the 1983 ATypI working seminar at Stanford. With Holmes, Bigelow designed the typefaces Lucida (1985) and Wingdings (1990) as well as a series of TrueType fonts for Apple. In 2006 Bigelow received the Melbert B. Cary Distinguished Professorship at RIT, where he was interviewed by the author on 8 September 2017 amidst the unpublished papers and archived material of the 1983 working seminar (**fig. 2.16**).

32 Unger recalled a live demonstration of Ikarus by Peter Karow to a small group of attendees during which an anchor point slipped off the coordinates of a lowercase letter 'a', followed by an awkward silence among the audience (**fig. 2.15**). Unger tried to explain that technology was not as reliable at the time and that these kind of 'accidents' frequently occured during demonstrations — his illustration made the scene very tangible.

Fig. 2.17 Interview with Petr van Blokland at his home in Delft, with some of his experimental work laid out on the floor, from an internship completed at URW in Hamburg in 1976. Photograph by Norman Posselt, 16 September 2018.

Fig. 2.18 Interview with Donald Knuth in Stanford Libraries' Special Collections and University Archives exhibits prep room at the Cecil H. Green Library of Stanford University made it possible to discuss specific findings from the collections related to Metafont and the Digital Typography programme (Knuth wore the 1983 ATypI working seminar t-shirt for the interview). Photograph by Elizabeth Fischbach, 22 October 2018.

Fig. 2.19 During the interview with Knuth it was possible to discuss the significance and difference between 'smoke mode' and 'proof mode' in assessing trial letters in Metafont at the example of original visual reference [SUA, SC 1002, box 1, folder 5], photographed by the author.

Petr van Blokland (*1956) studied typography with Gerrit Noordzij at the Royal Academy of Visual Arts in The Hague. After graduating in 1979, he co-founded a design studio with Claudia Mens. As a type designer, van Blokland was intrigued by the constraints of digital technology, which is particularly visible in his early typefaces such as VijfZeven (1978, see 4.1.1) or Proforma (1984, see 5.2.1). In 1988 he was awarded the Prix Charles Peignot from the ATypI. Since completing an internship at URW in 1976, van Blokland became invested in devising his own digital type design tools. Eventually he developed a Macintosh-compatible version of Ikarus, which was released in 1989. Van Blokland was also a co-organizer of the TypeLab events within the ATypI and has been an active member of the Association since. After meeting him at the 2018 ATypI conference in Antwerp, the author explored van Blokland's private collection and interviewed him at his home in Delft 16 September 2018 (**fig. 2.17**), and after gathering enough evidence, interviewed him again on 3 May 2019.

Donald E. Knuth (*1938) studied computer science at Case Institute of Technology before receiving a PhD in mathematics from CalTech in 1963. In 1969 Knuth was appointed professor at Stanford University where he focused on the analysis of algorithms, and in 1974 was awarded the prestigious ACM Turing Award. As the creator of the computer-based systems Tex and Metafont and as co-organiser of the Digital Typography programme at Stanford, Knuth drew the attention of the type community in the early 1980s and engaged with key figures such Carter, Unger and Zapf. An interviewed with Knuth at the Stanford University Archives on 22 October 2018 (**fig. 2.18**) allowed the author to raise questions about specific archival findings and aspects of Metafont that would have been more difficult to discuss without visual reference (**fig. 2.19**), and to confront Knuth with documents that are available nowhere else but in this collection.

Gerard Unger (1942–2018) studied at the Gerrit Rietveld Academie in Amsterdam. After graduating in 1967, he worked at Total Design and at Enschedé in Haarlem, before establishing himself as an independent typeface designer in 1975. During the following decade and a half, Unger was one of the few designers who utilized several different digital type design systems to realize his work, including Digiset, Ikarus and Camex LIP as well as Metafont at an early experimental stage. This experience made Unger an ideal interview candidate for this research; as frequent visiting professor at DTGC, Unger and the author met on several occasions, often exploring the department's special collections together, in addition to a formal interview on 12 November 2018. In anticipation of these conversations, Unger prepared and shared material from his private collection in Bussum, Netherlands. Other conversations with Unger took place in Berlin (December 2015) and in Antwerp (September 2018) in addition to frequent correspondence.

It is important to note that in each interview there was another person present during the encounter — an undeliberate, but often inevitable decision: typically an archivist, a photographer or a host. It was also an unconscious reminder that the responses in the interview would not remain between the author and the narrator, but that they could be considered and recorded within the bounds of the thesis and add to the overall contribution to knowledge. Only in one case, during the interview with Peter Karow, another interviewer was present.[33]

Some technical aspects to consider: in preparation of a proposed series of interviews, the project underwent ethics procedure of DTGC.[34] While the author took several written notes during the interviews, recorded audio files were later transcribed offline with Descript, an audio-to-text transcription application and were then manually edited to a degree that omits expletives in speech.[35] The interview with Karow is the only interview conducted in German; it was transcribed in the original language, only the excerpts included in this thesis are translated.

33 After some attempts to reach out to Karow, arrangements were made through Hamburg-based type designer Henning Skibbe who joined the interview with his own set of questions.

34 The series of interviews was subject to ethical review according to the procedures specified by the University Research Ethics Committee.

35 Descript was selected due to its underlying automated speech recognition that exhibits a word error rate of 16%, one of the best values available in 2018. Edits were made manually.

3. Environments of discourse as a catalyst of change

Spaces and formats of spoken and written debate are essential environments of a discipline that claims interdisciplinary relevance and seeks to reflect on its transitions, its changes and its opportunities in a discourse of diverse opinions, encouraged by a linguistic framework.[1] Prerequisites necessary to establish and cultivate such environments are often found in the formation of associations that negotiate the codes and modes of discourse, that also offer spaces for speech and debate and establish publication formats, as well as in the reformation of academic programmes in accordance with the rapid expansion of the field. The following sections explore the transitional phase of early digital type design not through the study of technical manuals or company reports, but by identifying particular environments of discourse that enabled a change and new opportunities in new technologies at the example of associations and their activities, of reform in typography education and of an emerging landscape of typography-related journals.

Such investigations hold the risk of following an established canon of visual communication and its biases. In the introduction to a much-discussed paper in this thesis, *A survey of type design techniques before 1978,* Richard Southall admits to uncritically accepting a 'canonical history' in relying on sources because they were easily available to him.[2] He ascribes the term to Robin Kinross who critically remarks whether there are levels of cultural value, a concern expressed through the discourse in a '"canon" of products' described as 'a restricted set of material, to which discussions, reproduction and teaching is confined'.[3] In acknowledging possible biases of this canon, the investigation in this chapter is not primarily concerned with the environments of well-established (and already well-researched) institutions, but instead seeks to map the emergence of a discipline through new communities. As Kinross suggests 'each thing has to be thought out freshly, for itself, in its context',[4] the discourse in early digital type design is explored through new environments, which evolved in response to these new communities.

1 Michelle Foucault established 'discourse' as a sequence of related written and spoken articulations within a linguistic construct and applies what he identifies as 'discursive formation' to analyse systems of knowledge and thoughts. Some of these ideas are expressed in *L'Archéologie du savoir* (The archaeology of knowledge), 1969. See M. Foucault, *Archäologie des Wissens,* Frankfurt/Main: Suhrkamp, 1981, pp. 31–112.

2 Southall refers to sources close to the Monotype Corp. See Southall 1997, p. 31.

3 Kinross 2011, p. 363. Kinross attributes the term to Martha Scotford, who suggests 'some latent "canon" in what is reproduced'. See Martha Scotford, 'Is there a canon of graphic design history?', in *AIGA Journal of Graphic Design,* vol. 9, no. 2, 1991, pp. 3–5, 13.

4 Kinross 2011, p. 364.

3.1. Establishing associations

During the late 1950s and the 1960s professions related to visual communication, especially in the discipline of typography, changed drastically. The transition into a period of proprietary phototype technologies challenged previously accepted standards in the industry and prompted the formation of associations that tried to maintain or adjust those standards, while also considering the establishment of new ones in collaborative efforts. To achieve those goals, associations put in place codes of conduct, structures of specialised working groups and committees that organized conference formats to reflect developments in an international setting.

In this period of transition, existing associations sought new orientation and considered renaming to reflect the changing industry. Some of these associations have roots in the first half of the twentieth century, such as the British Typographers Guild, founded in 1920 and then renamed Society of Typographic Designers (STD)[5] in 1953 or the British Society of Industrial Artists and Designers (SIAD), which was established in 1930 and then omitted the 'British' name element in 1963.[6] The German trade association *Bund der Deutschen Gebrauchsgraphiker* (BDG), established in 1919, switched the terminology from 'commercial artist' to *Grafik-Designer* in its name in 1968.[7] 'Commercial artist or graphic designer?' was one of the questions raised during the first congress organized by the International Council of Graphic Design Associations (ICOGRADA),[8] formed in 1963 as a network of associations in a much broader context. All of the associations mentioned above were concerned with issues that mattered for practitioners in the graphic industry, much less so for professions involved in the design and manufacturing of typefaces. A unique role is therefore assigned to the Association Typographique Internationale (ATypI) in this thesis; established in 1957 in an international setting from the start, with a clear mission to oppose unauthorised copying of typefaces, while expanding its activities to a variety of typographic issues, the ATypI became engaged in environments of research and education and was able to build a sustainable presence in the academic landscape. This is explored further in 3.2 as well as in 3.4 and its sub-sections.

The *Association Typographique Internationale* (ATypI) was formed in 1957 by Charles Peignot during the advent of commercial phototypesetting as a reaction to the challenges that the new technology posed to typographic standards and to intellectual property rights of type manufacturers at the time. Peignot, the Association's first president (1957–1968), was also head of Deberny & Peignot, one of the

5 In the 1990s the society added 'international' to its name and is since known as ISTD.

6 Reinvented itself in the 1980s as the Chartered Society of Designers (CSD).

7 The name was changed again in the 2000s to *Berufsverband Kommunikationsdesign,* but the associations continues to use the abbreviation 'BDG'.

8 Known today as the International Council of Design.

most successful type foundries in Europe. He became an advocate of the new technology, but was equally concerned with its implications to the industry, e.g. like many of his competitors, he was confronted with the adaptation of a large existing library of typefaces to a radically different technology. One of the Association's founding members and its second president, John Dreyfus (1968–1973), therefore describes the founding of ATypI as a result of Peignot's ability to recognise a 'turning point in type design' during the 1950s, mainly in observing that 'the art of typography was now rapidly passing into the hands of entrepreneurs, electronic engineers, lens makers and computer experts, who had a totally inadequate understanding of type design'.[9] Peignot not only obtained the rights to distribute phototypesetters of the French manufacturer Lumitype (known as Photon outside of France), but secured the licence to develop proprietary fonts with Deberny & Peignot.[10]

Correspondence between Dreyfus and Peignot suggests that the ATypI may have also been created as a 'European counterpart' to another association: the National Board on Printing Type Faces, founded earlier in the United States, where type manufacturers where not as concerned regarding intellectual property rights. Although the ATypI was initially centred in Western Europe, it was soon also represented by country delegates in Canada and the US.[11] In the early years of ATypI, members were typically representatives of the industry, board members, agents and consultants of type manufacturers. Despite their competition and in the light of mutual interests, Dreyfus assumed 'typefounders [were] surprisingly willing to co-operate with each other',[12] but in later years, as the change of the type industry favoured independent careers, freelance type designers such as Gerard Unger, Charles Bigelow and Kris Holmes joined the Association with no specific affiliation.

9 Dreyfus 1985, p. 11.

10 Batty 2002, p. 8.

11 See *Progress report of the organization of A.Typ.I-U.S.A.,* Aaron Burns, July 1960 [SBL, ATypI files, box 3, vol. 7].

12 In a letter by Dreyfus to Charles Peignot, 29 June 1955 [SBL, ATypI files, box 3, vol. 8].

3.2. Typographic education

As new technologies swept into the type industry and professional associations were formed to debate related challenges, the developments described in the previous section coincided with concerns over what this meant for design education. Academic institutions are undoubtfully environments of discourse, they offer a space for experimentation and research with the aim to reflect and generate new knowledge. Especially in the UK, dissatisfaction with the state of graphic design education grew during the 1960s, in particular within the field of typography, and sparked efforts in forming specialist working groups that would review and eventually reform curricula.[13] Disciplines that had previously only been offered as integrated courses in fine arts departments were gradually transformed into independent programmes and into departments that offered degrees on different levels of education. This section sheds light on these developments at the example of academic institutions where the ATypI hosted so-called working seminars just a few years later to explore and discuss the state of teaching letterforms (see 3.4.1). In adding to the overall grammatology, attention is paid to the name change of design programmes during this era.

One of the first design schools formed in Western Europe after World War II was the Hochschule für Gestaltung Ulm in Germany, co-founded by Otl Aicher, Max Bill and Inge Scholl in 1953 with the aim to bring societal change to a post-war community through higher design education. While Bill, a former Bauhaus student, carried artistic influences into the school, Aicher claims to have established the term 'visuelle Kommunikation' (visual communication) as a means to find an umbrella term for a new department dedicated to 'advertising, propaganda, language, persuasion and publishing'.[14] Eventually, Aicher and fellow design theorist Tomás Maldonado broke with Bill's artistic approach to push the 'scientification of design', which involved the rejection of ideas of *one* genius and of master classes, while propagating design as a team effort and training in scientific disciplines.[15] It has also been suggested that Aicher and Maldonado adopted the English word 'designer' in favour of 'Gestalter' as a verbal expression of this transition.[16] This is proof of an early influence of English in the specialist vocabulary of another language.[17] Since

13 Twyman 1969, p. 91.

14 Translated by the author from the original German: 'Werbung, Propaganda, Sprache, Überredung, Publizistik'. According to Aicher, when local politicians visited the school, they asked whether the term 'visual communication' was related to 'communism' or 'communion'. Otl Aicher, *Analog und digital,* Berlin: Ernst & Sohn, 1992, p. 34.

15 Müller 2014, p. 37 f.

16 Ibid., p. 38.

17 It is also worth mentioning that Ulm was located in the American occupation zone, where influences of American culture and English language in every-day life were not unusual.

the Ulm school was already closed in 1968 for financial and political reasons, many of its approaches were later adopted and further developed by other programmes.

Meanwhile in the UK, dissatisfaction with the state of graphic design education was repeatedly expressed by university teachers and design employers over a quality decline in the work of students due to 'an immature approach to typography', a much-repeated phrase in various reports.[18] While one source describes this dissatisfaction as a 'feeling',[19] another much more substantial explanation can be found in the arrival of computers on university campuses all across the country and in a lack of concepts how to best integrate new technologies in existing design programmes. In order to address these challenges and problems in graphic design education and to contribute to its improvement, the associations SIAD and STD established the Working Party on Typographic Teaching (WPTT). One of its central activities was the organization of a series of national one-day conferences. During its first edition held in London in 1967, Ernest Hoch, an educator himself and a member of SIAD, STD, ATypI and ICOGRADA, explained to the point made above: 'disciplines relating to design in the context of organisation, methods, management, research and technology are usually seen as unwelcome intruders in graphic design courses'.[20] In a published report of the third WPTT conference, held at Stafford in 1968, it was generally acknowledged that many university teachers were 'largely ignorant of technical matters and are not in touch with recent developments'.[21] Members of the WPTT will have been familiar with announcements to the 1969 ATypI annual congress in Prague dedicated to 'typographic opportunities in the computer age' or with its published proceedings (see 3.4) and realised their matter was urgent if design education was not to lose touch with the industry.

Profound change was only going to be possible with committed figures. Michael Twyman, who had been a faculty member of the University of Reading, UK, since 1959 was one of them. Before his tenure, typography at Reading was very much settled in a fine-printing environment in the tradition of private presses, a convergence to typography was only granted to students as part of a degree course in the university's Fine Arts programme.[22] Twyman's efforts were crucial in establishing a BA honours course in 'Typography and Graphic Communication' in 1968, which grew into its own department by 1974. The faculty's decision to omit the term 'graphic design' was to avoid misinterpretation; instead 'typography' was favoured as one specific area of graphic design through which design methods could

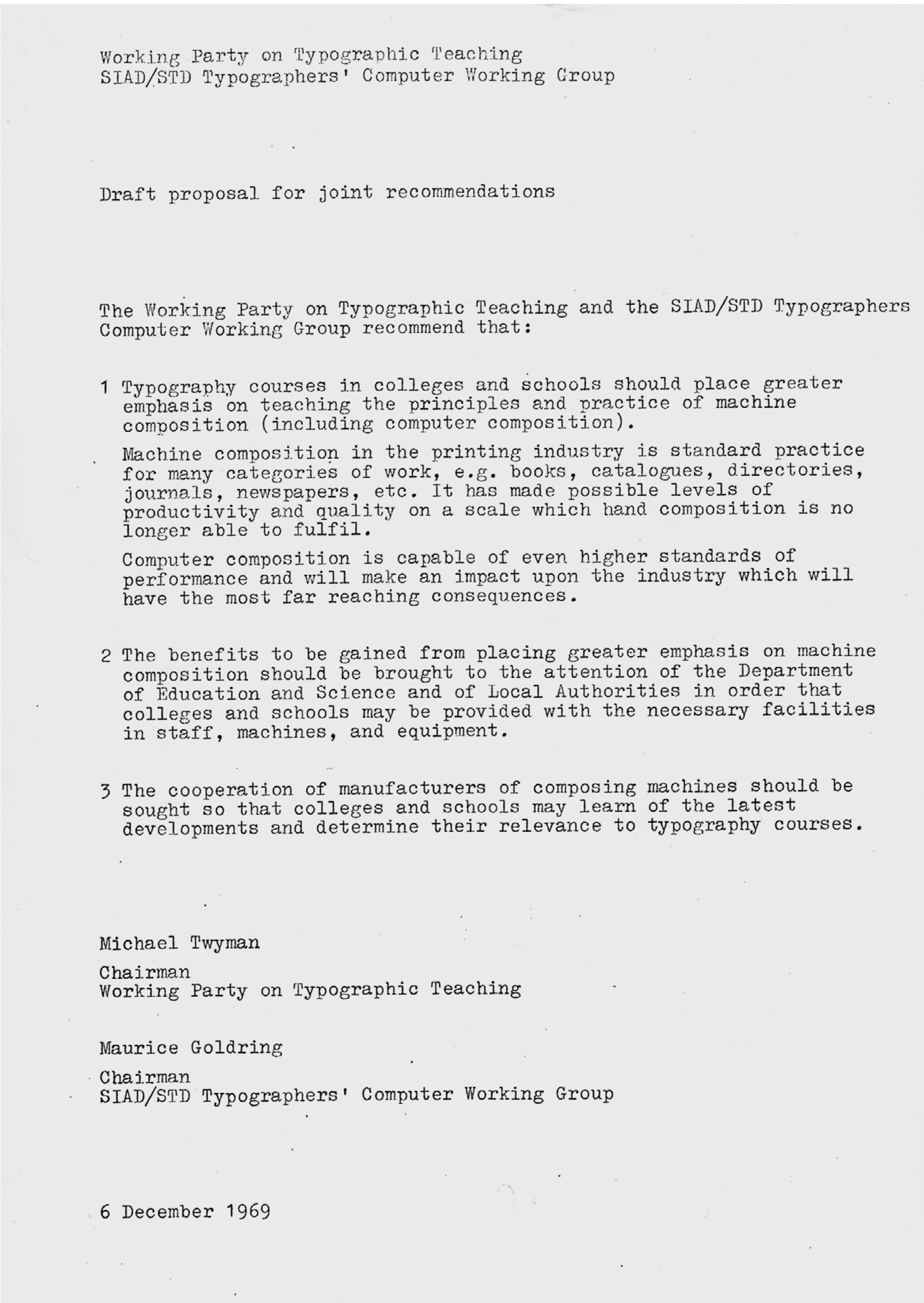
18 Twyman 1969, p. 91.

19 In the *Report and press release* of the first WPTT conference, undated (likely 1967) [DTGC, WPTT collection].

20 Ibid.

21 Twyman 1969, p. 99.

22 See Twyman 1970.



Working Party on Typographic Teaching
SIAD/STD Typographers' Computer Working Group

Draft proposal for joint recommendations

The Working Party on Typographic Teaching and the SIAD/STD Typographers Computer Working Group recommend that:

1 Typography courses in colleges and schools should place greater emphasis on teaching the principles and practice of machine composition (including computer composition).

Machine composition in the printing industry is standard practice for many categories of work, e.g. books, catalogues, directories, journals, newspapers, etc. It has made possible levels of productivity and quality on a scale which hand composition is no longer able to fulfil.

Computer composition is capable of even higher standards of performance and will make an impact upon the industry which will have the most far reaching consequences.

2 The benefits to be gained from placing greater emphasis on machine composition should be brought to the attention of the Department of Education and Science and of Local Authorities in order that colleges and schools may be provided with the necessary facilities in staff, machines, and equipment.

3 The cooperation of manufacturers of composing machines should be sought so that colleges and schools may learn of the latest developments and determine their relevance to typography courses.

Michael Twyman

Chairman
Working Party on Typographic Teaching

Maurice Goldring

Chairman
SIAD/STD Typographers' Computer Working Group

6 December 1969

Fig. 3.1 Draft proposal by Michael Twyman and Maurice Goldring, 6 Dec. 1969. Reproduced by the author [DTGC, WPTT collection].

be effectively taught.[23] In late 1969, Twyman co-published a 'joint recommendation' with Maurice Goldring, chairman of the Typographers' Computer Working Group (TCWG, another committee formed by the SIAD and STD), in which they propose that universities should intensify teaching of computer composition:

> Machine composition in the printing industry is standard practice for many categories of work […]. Computer composition is capable of even higher standards of performance and will make an impact upon the industry which will have the most far reaching consequences.[24] (**Fig. 3.1**)

In 1970, Twyman gave a remarkable lecture that pointed the way ahead, titled *Typography as a university study,* in which he outlined the reform of education at Reading. In a statement about the integration of technology in the curriculum, he supports the introduction of hand-setting metal type, not for ideological reasons, but as an argument: grasping the principles of one facility would lead to a better understanding of another 'at the other end of the technological spectrum'.[25] Mandatory introductory classes to computers, programming and graphic display systems was provided by the neighbouring Applied Physical Science Department at Reading. After the formation of an independent Typography department was granted, postgraduate study was possible as individually directed research in order to pursue an MPhil or PhD by the mid-1970s.[26] During this time, Twyman continued to write and lecture about the developments of the Typography programme at Reading, especially in an international setting provided by the ATypI in exchange with colleagues from Mainz, The Hague and Basel.

In the course of reformation of design education in Switzerland, the Allgemeine Gewerbeschule Basel (AGS) was transformed into a *Kunstgewerbeschule* in the 1960s, therefore developing from a vocational school into a school of applied arts.[27] Through its lecturers Emil Ruder and Armin Hofmann, who were prominent proponents of the Swiss typography style, the school quickly gained an international reputation, continued by the young German typographer Wolfgang Weingart who joined the faculty in 1968. The prominence of the Swiss Style, particularly in the United States during the early 1970s, set in motion what can almost be described as a pilgrimage of American students who came to study in Hofmann's advanced programme for graphic design or to pursue a focus in typography with Ruder and

23 Ibid. Twyman's definition of the programme's name also included the design of letterforms, a discipline that was specialized in a graduate programme decades later.

24 Draft proposal for joint recommendation by Twyman and Goldring, 6 Dec. 1969 [DTGC, WPTT collection].

25 Twyman 1970.

26 M. Twyman, 'Summary of an introductory talk about the course at Reading', in the *Summary report of the second Working Seminar on the teaching of letterforms,* University of Reading, 1976, p. 5.

27 Since 1980 it is officially known as *Schule für Gestaltung Basel,* School of Design, often translated as College of Design.

later with Weingart.[28] Without initially offering formal training in type design in its curriculum, the Basel school brought forward a generation of students who went on to pursue careers in type design. Among them are foremost Erich Gschwind, André Gürtler and Christian Mengelt who formed the collective Team ’77, specialized on typeface systems while making use of the latest digital tools. Gürtler returned to the Basel school to teach identity and letterform design in 1965, Mengelt followed him in 1972. Their joint research focused on the history and on the design of text typefaces for newspapers, while Gürtler also developed a strong interest in the reform of design education. Many of his writings appeared in a series he initiated in *Typografische Monatsblätter* (see following section) in 1976: *Beiträge zur Ausbildung in Schrift* (contributions to education in letterforms).[29] Gürtler and Mengelt were both active members of the ATypI where they became the faces of the Basel school in the international discourse in typography education.

In contrast to existing programmes that were able to build on and maintain previous structures, a graduate programme in ‘Digital Typography’ was formed almost from scratch at Stanford University in 1982. Established as a joint effort between the Department of Computer Science and the Department of Art it was primarily shaped by two key figures: computer scientists Donald Knuth and Charles Bigelow. While Knuth provided the technological underpinnings, mainly in the digital type system Metafont and its related composing system Tex (for mathematical typesetting), Bigelow, who received a joint-professorship in both departments in 1982, contributed a curriculum for type design and for the history of letterforms. The degree that could be obtained through the programme was an MSc in association with Knuth, which suggests the courses may have been leaning towards one department versus the other. Although Stanford did have a history in an existing ‘Joint Program in Design’,[30] established between the departments of art and mechanical engineering as early as 1958, there seems to have been very little overlap and interaction during the conception of Digital Typography or in later activities.[31]

As the programme progressed, Richard Southall, who had previously taught at the University of Reading since 1974, was invited as a recurring guest and co-taught most of the courses with Knuth and Bigelow, adding a more systematic and conceptual approach in type design to the programme.[32] Course descriptions and student results, sighted in the Stanford University archives, reveal an experimental

28 See separate interviews by Louise Paradis with former students Lauralee Alben and Jim Farris on ‘TM RSI SGM 1960–90 research archive’, <http://www.tm-research-archive.ch/interviews/> (last visited 31 May 2022).

29 Paradis 2017, p. 231.

30 See McCarthy 2020.

31 McCarthy 2020, p. 557.

32 A course syllabus draft between Bigelow, Knuth and Southall breaks down the tasks for each faculty member, 23 Feb. 1984 [SUA, SC 0097, box 21, folder 10.4]. Southall is introduced in 4.2.2.

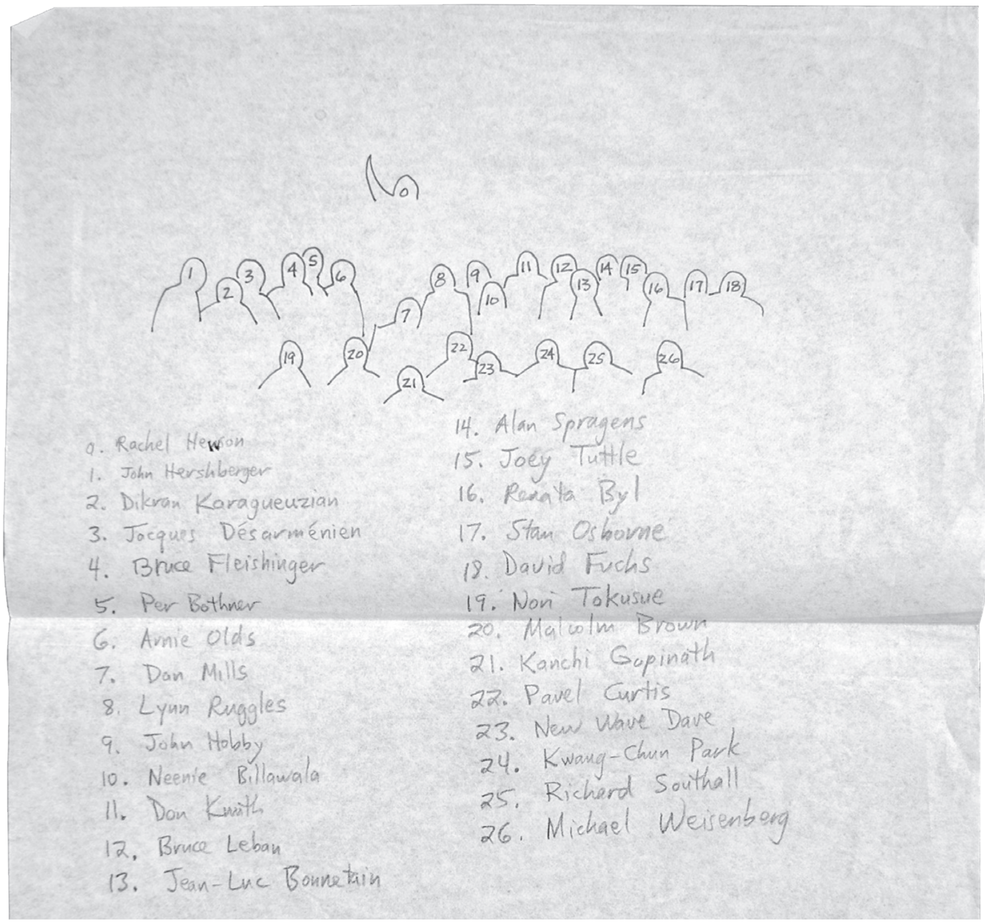


Fig. 3.2+3 The Digital Typography Group by during a 'Metafont picnic', Spring 1984. Photograph by Jill Knuth [SUA, SC 0097, box 21, folder 10.4].

approach to letterform design; in one instance, 25 class participants and Knuth each designed one letter to create an alphabet in order to focus on the 'manufacturing' aspects of Metafont.[33] A syllabus draft between Bigelow, Knuth and Southall confirms: 'We do not claim to be *teaching* type design, but *studying* it in the Metafont context.'[34]

Digital Typography was also a research programme: although there was room to explore other means of numerical letterform description, almost all seminar projects, research papers and theses were dedicated to the potential and improvement of Metafont. In its relatively short time of existence, the programme's small faculty and its students formed a close-knit community that referred to itself as the 'Digital Typography Group' (**figs. 3.2+3**), a name found in several publications.[35] The programme ended in 1988 and although this thesis does not further investigate type design education during this early digital period, the Digital Typography Group and its research activities must be regarded as an essential component of the development of Metafont, which is why it is subject to some closer examination in section 4.2.2.

In addition to a handful of MSc theses and several unpublished research papers, the Digital Typography programme encouraged doctoral dissertations related to Tex and Metafont, supervised by Knuth.[36] Previously and around the same time, the emergence of digital type and typography sparked MSc and PhD research at other academic institutions of comparable scale and profile that had established doctoral programmes and scientific guidelines.[37] One of the earliest graduate research studies on letterform outline description in the pursuit of generating fonts was delivered by Philippe Coueignoux at MIT's Department of Electrical Engineering and Computer Science in 1973,[38] which became the foundation for a doctoral thesis

33 See results of the seminar CS 279 'A course on Metafont programming' [SUA, SC 0097, box 21, folder 10.4].

34 Course syllabus draft for CS 279 'A course on Metafont programming', 23 Feb. 1984 [SUA, SC 0097, box 21, folder 10.4].

35 See introduction to Siegel 1985.

36 David Fuchs and Scott Kim were both members of the Digital Typography Group and made several contributions to Tex and Metafont, although they were not enrolled in the MSc programme. They had both begun their PhD programmes with Knuth in 1978 and graduated in 1986 and 1988 respectively.

37 Noteworthy dissertations in chronological order: Michael McPherson, *Electronic textsetting: the impact of revolutions in composition on typography and type design* (May 1979), MA dissertation co-supervised by Charles Bigelow at Rhode Island School of Design; Kathleen Carter, *Computer-aided type face design* (1986), PhD thesis supervised by Neil Wiseman at the University of Cambridge, UK; Debra A. Adams, *A dialogue of forms: letters and digital font design* (September 1986), MSc dissertation supervised by Muriel Cooper at the Department of Architecture, MIT.

38 See P. Coueignoux, *Compression of type faces by contour coding,* unpublished MSc thesis, Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Cambridge/MA, January 1973.

that followed in 1975 at the same department.[39] Although Coueignoux's achievements went largely unnoticed at the time of submission and remained uncommercialized, his post-doctoral teaching in France sparked follow-up research by two of his students,[40] while his own research caught the attention of Bigelow who invited him to talk at the 1983 ATypI working seminar at Stanford (see section 3.4.2).

Within a decade and a half Twyman's agenda of 'typography as a university study' became a reality, indicating the time span that is necessary for a discipline to reach a wider trend and to progress to reflection and research at the level of graduate programmes. As typography programmes developed an interest for emerging digital technologies, departments of engineering and computer science discovered possibilities in word processing and computing of letterforms, slowly forming intersections between the disciplines. Even though these developments do not yet reflect a larger commercial shift, but a small-scale pursuit by a select few academic institutions in the Western world, these spaces spark interaction between people sharing interests and experiences, gradually forming a new community.

39 See Coueignoux 1975.

40 Marc Hourdequin in 1978 and Marc Bloch in 1981. Bigelow 2020, p. 20.

3.3. Publication landscape

The previous two sections identify environments in which designers, type manufacturers, educators and scientists could reflect, debate and pass on knowledge. Such engagements need to be documented, written about and published; as Bigelow acknowledged, 'computer literacy and its problems can best be understood in the context of writing'.[41] As the discipline quickly expanded, its relevance grew, which demanded a diverse apparatus of publication formats to reflect those interests. Each format has its own audience and unfolds its own dynamic of debates in articles, follow-up pieces, comments and letters to the editor etc. that become an exchange of opinions forever documented on printed pages that eventually turn into a lasting record of primary sources.

This section reviews the discourse in early digital type design through representative publications (in chronological order of their founding) by showcasing relevant contributions and by identifying its readership, its editors and selected contributors, some of whom are recurring figures in this thesis. Attention is also paid to the visual layer of this discourse: how were issues of 'digital nature' illustrated, with special attention to cover stories, i.e. the face of a publication.

Most commercial arts journals from the first half of the twentieth century are typically rooted in graphic arts and trade associations. In the German-speaking countries *Gebrauchsgraphik* is an excellent example of a periodical that offered an overview of selected typeface releases, of new printing presses and composing room equipment as well as paper samples and specimens of printing techniques, leaving room for reports, reviews, designer features, and essays that sparked follow-up articles in consecutive issues. Annuals such as *Klimsch Jahrbuch* offered a medley of all of these issues for a full year and although they too includ significant essays by leading figures of the type industry, those contributions naturally became pieces isolated from debate. While *Klimsch* was discontinued after 1943, *The Penrose Annual,* a slightly older English-language equivalent remained in print until 1982, just enough to cover the transitional period of overlapping technologies in the last decade and a half of its existence. Like *Klimsch, Penros*e was made 'by printers for printers', though it tied 'disparate areas of the trade'.[42] However, a look at some sample volumes from the early seventies shows no particular interest in type-related issues with regard to digital technologies. Single articles document the change of the industry and try to shed light on technological developments, but they are very

41 Charles Bigelow, 'Introduction' in *Visible Language,* vol. 19, no. 1, Cleveland/OH, 1985, p. 5.
42 Hare 2006, p. 58.

technical and are typically focused on printing.[43] Overall, the *Penrose* annuals offer little contribution in capturing the larger discourse investigated here.

Typografische Monatsblätter (TM) exemplifies another trade journal that has cultivated a symbiosis between the printing trades and a community of typographic designers since its establishment in the 1930s, a synergy that is also expressed in the different names of the journal in its two primary languages: emphasizing typography in German, while focusing on printing in French: *Revue suisse de l'imprimerie* (RSI). Since 1952 and for almost three decades its development and direction laid in the hands of editor Rudolf Hostettler in St. Gallen who carried it to international prominence during the 1970s. This recognition is attributed to a close connection to the Schule für Gestaltung Basel and its leading figures, particularly with Emil Ruder, later with Wolfgang Weingart, both of whom maintained a lasting influence on the content of the journal as well as on its typographic design which reflected the characteristics attributed to the much-celebrated Swiss Typography.[44] Despite its international appeal, contributions by recurring figures and for instance the predominant use of Univers in comparison to the complete absence of Helvetica, can also be interpreted as indications of regional ideologies and introspective positions of a relatively closed community. E.g., after the ATypI hosted one of its working seminars in Basel (see 3.4.1), TM reported on the event in full detail, but did not similarly cover the editions held at the universities in Reading, in The Hague and in Mainz.

A 2017 published synopsis of TM's decisive years, identified between 1960 and 1990 and therefore concurrent with the years of technological transition, shows little contribution to the discourse in early digital type before the mid-1980s.[45] A handful of articles on digital type systems are exceptions, for example Veronika Elsner's introduction to Ikarus.[46] These pieces were provided by the systems' manufacturers and offer little critical review. The focus began to slightly change with the contributions of Max Caflisch under the new editor Jean-Pierre Graber who had taken over in 1982. Caflisch was a type designer, a typographer and book designer, head of the graphics department at Schule für Gestaltung Zürich, and had been a frequent writer for TM since the 1950s. As a consultant of digital type manufacturer Hell since 1972, Caflisch was familiar with company's translation of

43 One noteworthy article describes the change of the industry and simply acknowledges the need for computers, yet shows little reflection of particular issues or challenges, see D. L. Cooper, C. D. Nield, 'Printing and computers: the changing scene', in *The Penrose Annual,* vol. 64, London: Lund Humphries, 1971, pp. 211–216.

44 Paradis 2017, p. 83.

45 Ibid., p. 223 f.

46 See Elsner 1980, pp. 69–77. The inclusion of this article must probably be regarded in connection to André Gürtler and Christian Mengelt and their design of Haas Unica as Team'77. The project involved a digitization process in collaboration with the Stempel type foundry and URW executed in early 1981.

Fig. 3.4 Special reprint of Max Caflisch's typeface review of Gudrun Zapf von Hesse's first digital typeface Carmina released by Bitstream in 1986, in *Typografische Monatsblätter,* no. 6, 1988. Photographed by the author [FU].

Fig. 3.5 First cover of TM designed using digital software, by American student Mara Jerman at Schule für Gestaltung Basel, reproduced from Paradis 2017, p. 222.

letterform drawings into digital formats and with their numerical storage for composition. In 1985 he began reviewing a series of typefaces by Gerard Unger and Hermann Zapf that had been released with Hell.[47] Since Caflisch had advised these designs as a consultant, his reviews were of course written favourably, nevertheless they offer a detailed analysis of legibility issues, while acknowledging the technological circumstances behind them. Caflisch continued the series with reviews of typefaces by Gudrun Zapf von Hesse (**fig. 3.4**), by Matthew Carter and again by Unger that had been released with the digital typeface manufacturer Bitstream.[48] With the exception of one review, all of the typefaces were featured on the respective TM covers, bringing special attention to this new direction. After years of influence by Ruder and Weingart, the authors of the 2017 publication describe this change as 'refreshing' and as a an 'interesting and legitimate new direction'.[49] Above all it seemed necessary; for decades TM had shared a national discourse with an international audience and it was time to catch up on topics that concerned a rapidly growing international community during a period of transition and change. The new direction in TM was underlined by a guest contribution on design fundamentals for typefaces on screen by Charles Bigelow,[50] followed by an article on digital type for high and low resolutions from the undergraduate thesis of Bruno Maag.[51] This was accompanied by a cover design dedicated to low-resolution digital type (**fig. 3.5**) and another with an abstraction of anchor points that form the outline description of a letter (TM, no. 2, 1989).

Until the 1960s, most of the journals dedicated to typographic issues arose from trade periodicals. Even when they encouraged scholarly writing occasionally, these contributions typically did not follow academic standards. This void was filled with *The Journal of Typographic Research* (JTR), launched by editor and publisher Merald E. Wrolstad of The Cleveland Museum of Art for all aspects of 'visible language' in 1967, following his conviction that scholarly work was the foundation to the development of a discipline (**fig. 3.6**).[52] The journal was primarily aimed at an English-speaking readership, but also included abstracts of all articles in French and German. Within the first two years of publishing, the JTR shed light on various aspects of the earliest period of digital type found almost nowhere else in this depth,

47 Unger's Flora in TM no. 2, 1985, Hollander in TM no. 2, 1987, and Swift in TM no. 4, 1987, as well as Zapf's Aurelia in TM no. 3, 1988.

48 Zapf von Hesse's Carmina in TM no. 6, 1988, Unger's Amerigo in TM, no. 3, 1989 and Carter's Charter in TM no. 4, 1989.

49 Paradis 2017, p. 232.

50 See Charles Bigelow, 'Grundlagen für Bildschirmschriften', in *Typografische Monatsblätter,* vol. 106, no. 1, 1987, pp. 21–30.

51 See Bruno Maag, 'Typeface design on the Apple Macintosh', in *Typografische Monatsblätter,* vol. 108, no. 2, 1989, pp. 21–30.

52 See 'publication history', <http://visiblelanguage.herokuapp.com/#about> (last visited 12 May 2022).

Fig. 3.6 For the first four years, all issues of the *Journal of Typographic Research* featured a cover design by typographer Jack W. Stauffacher, printed letterpress from metal types, probably in November 1966. Only the first issue is bound with a jacket, showcasing the full design: a character set of Univers, printed on top of each other four times in the nature of a proof for which the position of type is registered on press. The extremely tight letter-spacing in the final result, reflects an effect associated with phototype-setting. The original print from the series *Shifting and inking* is part of the SF MoMA collection since 2007. Photographed by the author [DTGC].

including 'Typographical effects by cathode ray tube typesetting systems' in the very first issue,[53] followed by articles on 'Three fonts of computer-drawn letters'[54] as well as on another 'Approach to computer-assisted letter design', all of which document this interest.[55] As the journal was quickly established as a critical organ that documented, compared and confronted different opinions, and became an environment of fierce debates, it was renamed *Visible Language* (VL) in 1971, in an attempt to expand its primary purpose and to unite the 'scattered' research effort by 'improving the exchange of information among the individuals currently engaged in research on visible language problems'.[56] In 1982, an article by Donald Knuth on 'The concept of a Meta-font' outlines his approach of parametric type design (the article was typeset entirely from alphabets designed with his system), was met with a highly analytical and in-depth critique by Douglas Hofstadter,[57] only to be followed by twenty letters-to-the-editor on seventeen pages by an impeccable international medley of distinguished typographers, type designers and fellow type system developers.[58] Knuth was given the opportunity to defend himself in a final response of the same issue:

> As I was reading the diverse reactions, I often found myself siding more with the people who were sharply critical of my research than with those who acclaimed it. Critical comments are extremely helpful for shaping the next phases of the work that people like me are doing, as we search for the proper ways to utilize the new printing technologies.[59]

Selected comments and Knuth's response are reviewed in more detail in 4.2.2. These interactions are proof of a lively discourse, participated by an active community of readers who also became contributors, not only from researchers and scientists, but also from practitioners. In 1982, after fifteen years of publishing, the journal had touched upon issues of readability and legibility, communication theory, character recognition, concrete poetry, Japanese calligraphy, linguistics and many more topics. Early on Wrolstad expected contributions from practitioners in addition to researchers, yet in the light of an absent coherent methodology, he acknowledged that it was necessary to unite the sides by finding a common terminology and by establishing a general style guide for submitted papers:[60]

53 See Holland 1967.
54 See Matthews 1967.
55 See Mergler 1968.
56 Merald Wrolstad (ed.), 'Editorial', in *Visible Language,* vol. 5, no. 1, Cleveland/OH, Winter 1971, p. 7.
57 See Hofstadter 1982.
58 See Wrolstad 1982.
59 Ibid., p. 358.
60 Merald Wrolstad, 'A preface note to the first number', in *The Journal of Typographic Research,* vol. 1, no. 1, Cleveland/OH, Jan. 1967, p. 4.

> Certainly there has been little enough contact between those who actually work with letterforms and those who are interested in studying the effects and history of these letterforms. Both groups will benefit from cross-fertilization of ideas, but for communication to take place, graphic designers must be willing to familiarize themselves with a few basic procedures for writing research reports.[61]

Since its establishment, the JTR maintained a close relationship with the ATypI. Shortly after the first issue was published, this convergence between Wrolstad, who aspired to become a member of the Association, and the ATypI board began with negotiations of a possible French edition of the journal under the auspices of Peignot, which however, quickly evolved into the idea of a 'co-publishing venture': a supplement of the Association's 1967 congress proceedings.[62] Dreyfus, who was vice president of ATypI and at the same time a member of JTR's editorial board, became a strong supporter of these endeavours. In a written endorsement to the parties involved, he emphasised that 'if Dr Wrolstad places his columns at the disposal of the A.Typ.I. news of its activities will reach 1700 or more subscribers'.[63] As the Association's activities were expanding into areas beyond typeface protection, Dreyfus identified this collaboration as an opportunity to increase their attention. Eventually, the idea of a supplement edition did not come to fruition due to unsolved funding on both ends, elegantly and diplomatically concluded by Dreyfus:

> We seem to share many fundamental things in common — notably a real devotion to the typographic arts, and the lack of funds adequate for our ambition. [...] As I see it, the activities of the A.Typ.I. include the bringing together of interested and competent persons [...] and the outcome of these activities may well continue to result in written or spoken papers which the Editor of the Journal of Typographic Research will wish to print.[64]

Dreyfus, who was elected ATypI president at the 1967 congress in Paris, and Wrolstad ultimately agreed that single congress presentations as well as committee reports would occasionally be included in JTR.[65] This process shows the willingness to reach out within the network of a rapidly growing community, to create business

61 M. Wrolstad, 'Author's guide to the Journal of Typographic Research', in *The Journal of Typographic Research,* vol. 2, no. 1, Cleveland/OH, Jan. 1968, p. 99.

62 Correspondence between M. Wrolstad and ATypI board members [SBL, ATypI files, box 4, vol. 9].

63 Quoted from *Memorandum by John Dreyfus concerning Dr Wrolstad's proposal for an affiliation between A.Typ.I. and The Journal of Typographic Research* [SBL, ATypI files, box 4, vol. 9].

64 In letter by Dreyfus to M. Wrolstad, 5 Jan 1968 [SBL, ATypI files, box 4, vol. 9].

65 A summary of the inaugural meeting of the ATypI Legibility Research Committee (held subsequently to the 1967 congress) was published in *The Journal of Typographic Research,* vol. 2, no. 3, 1968, pp. 271–276. Hermann Zapf's illustrated presentation on 'The changes in letterforms due to technical developments' was included in the following issue (pp. 351–368).

Fig. 3.7 Gerard Unger's richly illustrated article about the design process of his typeface Demos, released with Hell in 1976, in *Visible Language,* vol. 13, no. 2, pp. 136/137. Photographed by the author [FU].

affiliations and build long-lasting relationships. The initial idea to produce a supplement issue of congress proceedings was revisited for ATypI's 1983 working seminar, yet the issue of funding caught up with those endeavours (see 3.4.2).

Gerard Unger's brief but precise summary of his design of Demos for the digital type manufacturer Hell, published in *Visible Language* in 1979, marks the recognition of a design process case study considered alongside other scholarly material in a research journal. Although concepts of digital type had been covered earlier in *Visible Language,* Demos was the first type for commercial use that was discussed. Unger's shared experience of matching 'his own desire for aesthetic as well as perceptual quality with the necessary restrictions of technology' shows a high degree of reflection, illustrated in prominent letters that make all the mentioned obstacles comprehensible (**fig. 3.7**).[66]

Apart from *Visible Language,* no other scholarly journal of visual communication and related disciplines was equally concerned with early digital type and its implications for composing systems. Although the prestigious *Journal of the Printing Historical Society* naturally did not include articles on contemporary digital technology,[67] the society's *Bulletin,* a twenty-page leaflet distributed to PHS members, occasionally discussed digital typeface revivals and reviewed the relationship of maintaining and improving historical models through new tools.[68] *Icographic* was launched in 1971 to 'reveal the ideas in the technical aspect of design and to become an essential information source in the area of visual communication' as the quarterly review of ICOGRADA.[69] As a result, *Icographic* generally did not cover the transition in digital type design technologies, with the exception of very few isolated pieces including an article by Hermann Zapf about the work environment shift for type designers in one of the early issues.[70]

The transitional period also saw the launch of well-designed magazine-like typography journals. *Baseline* serves as an example of a magazine issued by a type

66 Unger 1979, p. 134.

67 A backlist of all issues since 1965 is available at <https://printinghistoricalsociety.org.uk/publications/index.html#294> (last visited 21 June 2022). The list also reveals a period of irregular publishing with only four numbers issued between 1983 and 1992.

68 In the case of Christopher Burke's review of Adobe Jenson, a vector outline description of a letter was used as the issue's cover illustration. See *Printing Historical Society bulletin,* no. 42, London, Winter 1996/97, pp. 16–17. The same issue also includes Gerard Unger's review of a book on Bram de Does' Trinité, a typeface re-released in different digital formats (see 3.2.2.). The *Bulletin* was typeset in contemporary digital typefaces by Burke: FF Celeste and Pragma.

69 Introductory words by editor John Hallas, in *Icographic,* vol. 1, no. 1, London: ICOGRADA, 1971, p. 1.

70 Zapf 1972, p. 20.

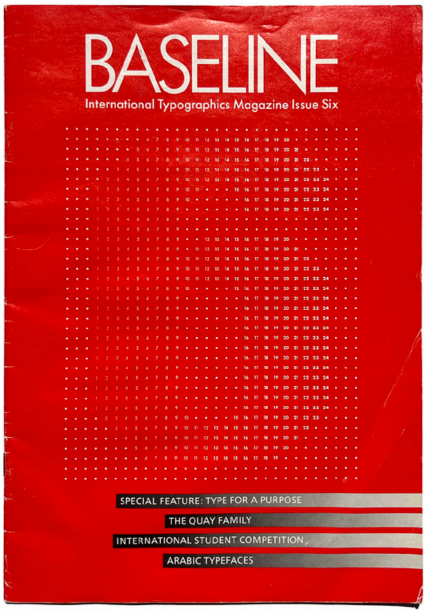
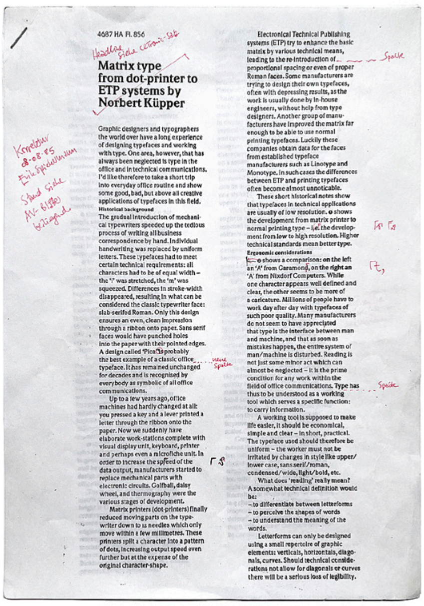


Fig. 3.8+9 Cover and inside page of *Baseline* no. 6 (1985), co-designed by guest editor Erik Spiekermann and H. W. Holzwarth of MetaDesign, Berlin. Photographed by the author [ES].



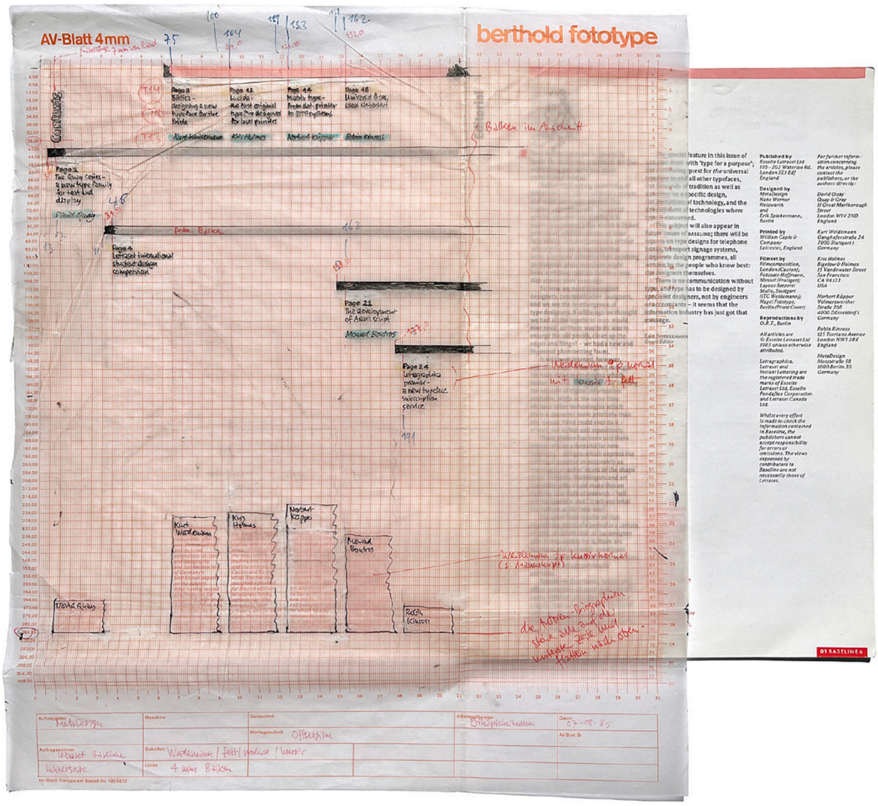


Fig. 3.10 Edited and corrected laser-printed proof of a submitted article, typeset in PageMaker for better control of line breaks before composition on a Berthold ADS machine. **Fig. 3.11** The editor supplied 'copyprep' (typesetting instructions) on Berthold AV (Arbeitsvorbereitung, transl. work preparation) graph paper for film-makeup, superimposed on the final double spread for comparison here. The fonts in use were digital, but production is photocomposition. Photographed by the author [ES].

manufacturer.[71] First published in 1979, it was issued as the official organ of Letraset, a British manufacturer of dry-transfer lettering that did not have a history in metal type production, co-published with Typographic Systems International (TSI), Letraset's distributor. From the start, *Baseline*'s appearance underlined its position of a magazine by designers for designers. In September 1980, TSI and Letraset acquired a license for an Ikarus system and began using URW's services to prepare digital outline data of a growing collection of typefaces. The following year, a piece about Ikarus was placed in *Baseline,* an almost identical, just slightly shorter version of the Ikarus article that had been previously published in TM.[72]

Baseline editor-in-chief Mike Daines placed the editorial responsibility and the design in the hands of German type designer Erik Spiekermann for issues 6 (1985, **figs. 3.8+9**) and 7 (1986). As Spiekermann recalls, *Baseline* was until then London-centric and rather modest by design, but he was given a free hand in making changes.[73] Both issues were dedicated to designing type and preparing digital fonts, with an emphasis on type for telephone directories and laser-printing.[74] In an attempt to promote the different kinds of composing systems for which Letraset and TSI could supply digital fonts, issue 6 is typeset in five different typefaces, a design ambition that could only be realised by involving four different phototypesetting studios in the UK and Germany, because specific fonts were only available on proprietary systems (**fig. 3.10**).[75] The laborious production of both issues reflects the transitional period they were published in: Spiekermann, who knew each studio from previous collaborations, drew up the analogue copy preparation on Berthold AV graph paper himself (**fig. 3.11**). The convergence of writing, editing, designing and maintaining control of composition instructions from within the same studio desk somewhat anticipates the 'desktop publishing' era, a remarkable change in the publication landscape. By just a few years, *Baseline* predates a series of popular design publications launched after the introduction of PostScript, including *Émigré*

71 Similarly, the International Typeface Corporation (ITC) a phototype distributor in New York City had published the well-known typography magazine *Upper and lower case* (U&lc) since 1973, dedicated to promoting change in technology. ITC was acquired by Letraset in 1986 and later *U&lc* ceased print publication in 1999.

72 See Daines 1981 in comparison to Elsner 1980.

73 Erik Spiekermann in correspondence with the author, 10 June 2022.

74 See for example Kris Holmes, 'Lucida: the first original typeface designed designed for laser printers', in *Baseline,* no. 6, 1986, pp. 12 f.; Matthew Carter, 'Bell Centennial' or Spiekermann's own article 'Post mortem. Or how I once designed a typeface for Europe's biggest company', both in *Baseline,* no. 7, 1986, pp. 6–8 and 9–13.

75 The issue was typeset in Caxton by Filmcomposition (London, UK) on a Berthold ADS, in a then unreleased condensed font of Frutiger by Fotosatz Hoffmann (Messel, Germany) on a Linotronic 300, in ITC Weidemann by Layout-Setzerei Stulle (Stuttgart, Germany) on a Berthold ADS, and in Futura by Nagel Fototype (Berlin, Germany). See *Baseline,* no. 6, London: Esselte Letraset, 1985, p. 1 and back cover.


Max Kisman: schets affiche / sketch for poster, 1985, 60 × 42 cm

Bogen / curves Swift

Binnenvorm / counter Swift

Tussenvorm / intercharacter space Swift

Turning to art, here it is more difficult, if not impossible, to discover Dutch characteristics in the same way that they can be found in typefaces. Nor, of course, is that the point. Nor, again, is it my intention to give a complete rundown of recent developments in the arts. These examples have been chosen because they contain elements that lend themselves for use in my own type designs: contrast, tension and openness. And these elements come close to Dutch characteristics like those mentioned by Erik Spiekermann and Helen Howard, such as clarity, contrast and variety.

In my own work, tension and contrast can be found in *Swift*, for example. The wide curves of this type are sharpened as they approach the stems. The broadly built, wing-like serifs contrast with the basic perpendicular shapes and join the stems all of a sudden. Openness and tension are found in the interplay between the roomy counters and the spaces between the letters, which have been treated as autonomous forms and function as a binding medium joining the letters together. In *Amerigo*, designed for laser printers and desk-top publishing, other details arouse similar tensions and contrasts. By the use of thinner horizontals the counters are even larger than in *Swift*. The curves barely touch the stems at top left and bottom right, so that on the inside they almost form a right angle. When used at coarse resolutions the insides of these horizontal curves become completely flat, though they are preserved at higher resolutions and in the larger sizes. The triangular, serif-like terminals are so robust that they suffer little from reproduction at low resolutions. In *Oranda*, also a design for DTP, the same flat curves recur that I used in *Amerigo*, though here they are incorporated into a far sturdier type with little contrast between thick and thin strokes. Whatever the user may inflict on these letters, his text will appear bright and alive on paper.

Dutch landscape with letters
44

Puntenopstelling bij 300 lijnen per inch / bitmap at 300 lines per inch

Afdruk op papier bij 300 lijnen per inch / print on paper at 300 lines per inch

Gerard Unger: Bitstream Amerigo, analoge lettervorm / analogous letter form

Gerard Unger: Bitstream Amerigo vet / bold, 1986

Bij de voorbeelden uit de beeldende kunst is het moeilijker, zo niet onmogelijk, om Hollandse karakteristieken te ontdekken, zoals bij lettervormen. Daar is het ook niet om te doen. Evenmin is het de bedoeling een compleet overzicht te geven van de recente ontwikkelingen in de beeldende kunst. Deze voorbeelden zijn gekozen omdat er elementen aan te ontlenen zijn, die de ontwikkeling van mijn lettervormen bepalen: contrast, spanning en openheid. En deze elementen komen dicht in de buurt van Hollandse eigenschappen die Erik Spiekermann en Helen Howard noemden zoals helderheid, contrast en afwisseling.

In mijn eigen werk zijn spanning en contrast onder meer in de *Swift* terug te vinden. De ruime bogen van dit type zijn verscherpt bij nadering van stokken. De breedgebouwde, vlerkachtige schreven contrasteren met de staande grondvormen en gaan plotseling in de stokken over. Openheid en spanning zijn te vinden in het samenspel tussen de ruime binnenvormen en de vormen tussen de letters, die als zelfstandige vormen zijn behandeld en als bindmiddel tussen de letters fungeren. In de *Amerigo*, ontworpen voor laserprinters voor desk-top publishing, roepen andere details soortgelijke spanningen en contrasten op. Door dunnere horizontale delen zijn de binnenvormen nog groter dan bij de *Swift*. Bogen raken linksboven en rechtsonder nauwelijks de stokken en vormen daarmee aan de binnenzijde bijna een rechte hoek. Bij toepassing in grove rasters worden de binnenzijdes van deze horizontale bogen helemaal vlak, terwijl in fijnere technieken en in de grote corpsen de lichte buigingen behouden blijven. De driehoekige, schreefachtige uiteinden zijn zo sterk, dat ze bij reproductie in grove rasters weinig te lijden hebben. In de *Oranda*, eveneens voor desk-top publishing ontworpen, zijn dezelfde vlakke bogen als bij de *Amerigo* te zien, maar dan verwerkt in een veel steviger type met een gering verschil tussen dik en dun. Wat er ook met deze letters gebeurd, tekst verschijnt helder en levendig op papier.

Hollands landschap met letters
45

Fig. 3.12 Specimens of Gerard Unger's typefaces Swift (left page, highlighting the counter forms) and Bitstream Amerigo (right, comparing the effects of enlarged characters at 300 dots per inch on screen and in print) side-by-side with graphic design work by Unger's contemporary Max Kisman. *Gravisie* 14 (1989), pp. 44/45. Photographed by the author [FU].

(1984), *Page* (1986) and *Eye* (1990).[76] The first issues of *Page* and *Eye* were produced on Macintosh computers by teams characterised by intersections of editorial and design tasks. Although these magazines did not tend to publish scholarly work as *Visible Language* did, *Eye* in particular featured pieces on historical research 'for the light in can shed on the present' adapted into a narrative style for a wider readership.[77]

Gravisie was not a traditional magazine although it shared some attributes, mostly the format, binding and the overall visual appearance of a periodical-like publication. Although its editorial structure varies and it did not follow a strict publishing rhythm, *Gravisie* was typically issued annually on the occasion of the Gravisie Prize awarded to a single person, a company or a product in the Netherlands. Each issue is different, comprised either of just one essay or of an anthology of contributions, but was fully dedicated to an overarching topic. After the first issue in 1979, honouring Dutch graphic designer and legibility researcher Gerrit Willem Ovink,[78] Gravisie was dedicated to graphic design, typography and type, and to its technological aspects, which became particularly evident in the anthology issue that critically asked 'Do new typesetting technologies affect typography?'.[79] In 1984 the Gravisie Prize was awarded to the developers of Aesthedes, a numerically controlled device that could cut friskets, similar to the devices produced by Aristo (see 4.2.4) — oddly the issue looks a bit like a commercial company brochure. It was also common to bestow the recipients with the issue's editorial decisions and even with its design, as was the case for the issue dedicated to Gerard Unger in 1989. Unger, who had been under consideration for the prize following the release of his much-appraised typeface Swift, was eventually awarded for his achievements in 'two decades of technological development'.[80] For the commemorative issue, Unger suggested to publish two lectures that he and Max Caflisch had delivered during an event in 1987, dedicated to type design in the Netherlands.[81] Within the *Gravisie* series this became a remarkable issue with presentations of Unger's own typefaces

76 Former *Page* editor Jürgen Siebert remembers that the editorial team would review a specific software one day, only to apply it in the making of the following issue, see J. Siebert, 'Blick zurück nach vorn', in *Page,* vol. 30, no. 11, Hamburg, 2016, p. 114. In the tradition of the ATypI, but unintentionally so, *Eye* was published in full in English, French and German for the first couple of issues. All of the issues shared review section on the latest digital tools.

77 Rick Poynor, 'Why Eye', loose editorial leaflet enclosed in *Eye,* vol. 1, no. 1, London, 1990.

78 See G. W. Ovink, 'Kastanjes uit het vuur. Inventie en innovatie in de grafische technieken', in *Gravisie,* no. 1, Utrecht, July 1979. Ovink also received the Gutenberg Prize from the city of Mainz in 1983.

79 C. Jongens (ed.), 'Hebben nieuwe zettechnieken invloed op typografie?', in *Gravisie,* no. 6, Utrecht, April 1982.

80 P. Groenendaal, 'By way of explanation' (foreword), in *Gravisie,* no. 14, Utrecht, March 1989, p. 5.

81 Unger and Caflisch had held their talks during an event of Forum Typografie in Stuttgart on 12 November 1987.

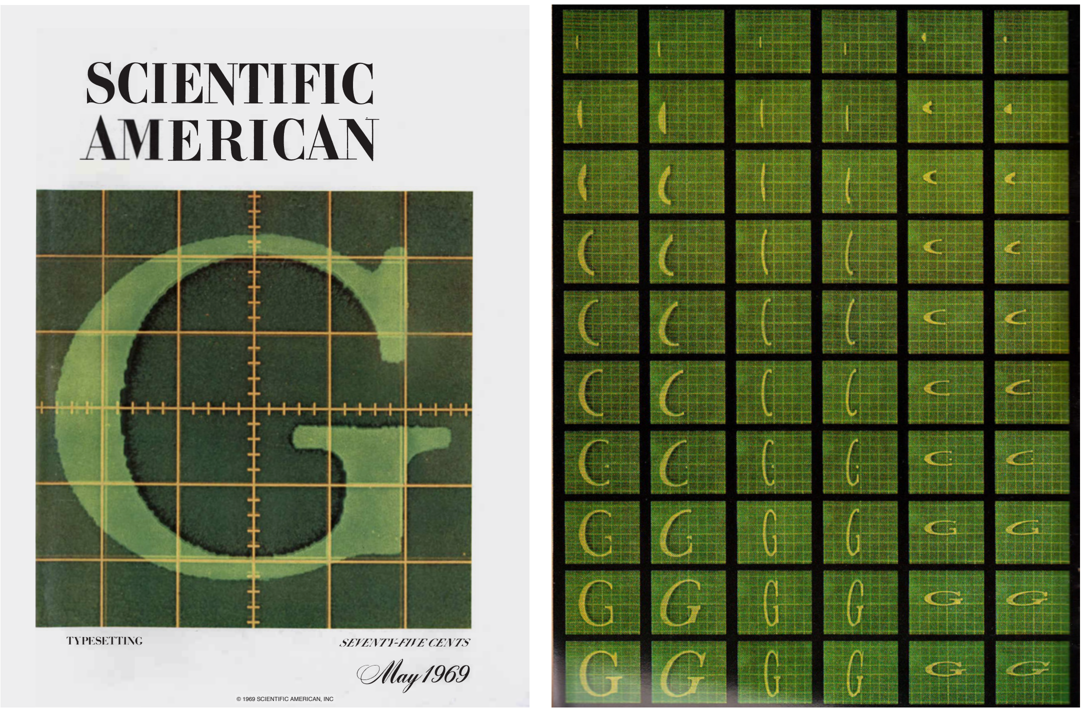
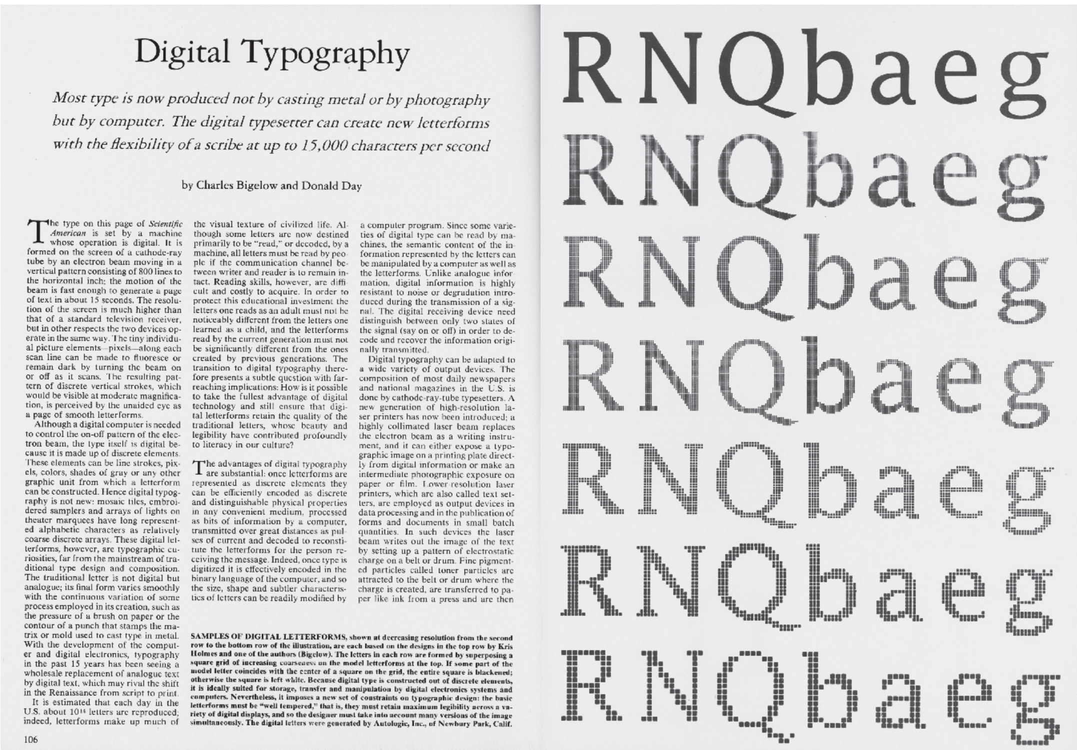


Fig. 3.13 Cover and first page of Gerard O. Walter's article on 'Typesetting', in *Scientifc American*, vol. 220, no. 5, 1969. The illustrations show electron beams of modified letterforms on a cathode ray tube of a RCA Videocomp machine. Reproduced from the digitized issue, www.scientificamerican.com/store/archive.



Digital Typography

Most type is now produced not by casting metal or by photography but by computer. The digital typesetter can create new letterforms with the flexibility of a scribe at up to 15,000 characters per second

by Charles Bigelow and Donald Day

The type on this page of *Scientific American* is set by a machine whose operation is digital. It is formed on the screen of a cathode-ray tube by an electron beam moving in a vertical pattern consisting of 800 lines to the horizontal inch; the motion of the beam is fast enough to generate a page of text in about 15 seconds. The resolution of the screen is much higher than that of a standard television receiver, but in other respects the two devices operate in the same way. The tiny individual picture elements—pixels—along each scan line can be made to fluoresce or remain dark by turning the beam on or off as it scans. The resulting pattern of discrete vertical strokes, which would be visible at moderate magnification, is perceived by the unaided eye as a page of smooth letterforms.

Although a digital computer is needed to control the on-off pattern of the electron beam, the type itself is digital because it is made up of discrete elements. These elements can be line strokes, pixels, colors, shades of gray or any other graphic unit from which a letterform can be constructed. Hence digital typography is not new: mosaic tiles, embroidered samplers and arrays of lights on theater marquees have long represented alphabetic characters as relatively coarse discrete arrays. These digital letterforms, however, are typographic curiosities, far from the mainstream of traditional type design and composition. The traditional letter is not digital but analogue; its final form varies smoothly with the continuous variation of some process employed in its creation, such as the pressure of a brush on paper or the contour of a punch that stamps the matrix or mold used to cast type in metal. With the development of the computer and digital electronics, typography in the past 15 years has been seeing a wholesale replacement of analogue text by digital text, which may rival the shift in the Renaissance from script to print.

It is estimated that each day in the U.S. about 10^{14} letters are reproduced; indeed, letterforms make up much of the visual texture of civilized life. Although some letters are now destined primarily to be "read," or decoded, by a machine, all letters must be read by people if the communication channel between writer and reader is to remain intact. Reading skills, however, are difficult and costly to acquire. In order to protect this educational investment the letters one reads as an adult must not be noticeably different from the letters one learned as a child, and the letterforms read by the current generation must not be significantly different from the ones created by previous generations. The transition to digital typography therefore presents a subtle question with far-reaching implications: How is it possible to take the fullest advantage of digital technology and still ensure that digital letterforms retain the quality of the traditional letters, whose beauty and legibility have contributed profoundly to literacy in our culture?

The advantages of digital typography are substantial: once letterforms are represented as discrete elements they can be efficiently encoded as discrete and distinguishable physical properties in any convenient medium, processed as bits of information by a computer, transmitted over great distances as pulses of current and decoded to reconstitute the letterforms for the person receiving the message. Indeed, once type is digitized it is effectively encoded in the binary language of the computer, and so the size, shape and subtler characteristics of letters can be readily modified by a computer program. Since some varieties of digital type can be read by machines, the semantic content of the information represented by the letters can be manipulated by a computer as well as the letterforms. Unlike analogue information, digital information is highly resistant to noise or degradation introduced during the transmission of a signal. The digital receiving device need distinguish between only two states of the signal (say on or off) in order to decode and recover the information originally transmitted.

Digital typography can be adapted to a wide variety of output devices. The composition of most daily newspapers and national magazines in the U.S. is done by cathode-ray-tube typesetters. A new generation of high-resolution laser printers has now been introduced; a highly collimated laser beam replaces the electron beam as a writing instrument, and it can either expose a typographic image on a printing plate directly from digital information or make an intermediate photographic exposure on paper or film. Lower-resolution laser printers, which are also called text setters, are employed as output devices in data processing and in the publication of forms and documents in small batch quantities. In such devices the laser beam writes out the image of the text by setting up a pattern of electrostatic charge on a belt or drum. Fine pigmented particles called toner particles are attracted to the belt or drum where the charge is created, are transferred to paper like ink from a press and are then

SAMPLES OF DIGITAL LETTERFORMS, shown at decreasing resolution from the second row to the bottom row of the illustration, are each based on the designs in the top row by Kris Holmes and one of the authors (Bigelow). The letters in each row are formed by superposing a square grid of increasing coarseness on the model letterforms at the top. If some part of the model letter coincides with the center of a square on the grid, the entire square is blackened; otherwise the square is left white. Because digital type is constructed out of discrete elements, it is ideally suited for storage, transfer and manipulation by digital electronics systems and computers. Nevertheless, it imposes a new set of constraints on typographic design: the basic letterforms must be "well tempered," that is, they must retain maximum legibility across a variety of digital displays, and so the designer must take into account many versions of the image simultaneously. The digital letters were generated by Autologic, Inc., of Newbury Park, Calif.

106

Fig. 3.14 Opening spread of Charles Bigelow's article 'Digital typography', in *Scientifc American*, vol. 249, no. 2, 1983, p. 106 f. Reproduced from the digitized issue, www.scientificamerican.com/store/archive.

contextualized in a broader historic understanding of Dutch type and in the light of technological transitions (**fig. 3.12**).[82]

In addition to these typography-specific journals, interdisciplinary relevance of a research field is demonstrated in the attention given to it in popular science literature. The most prominent example of this kind of recognition is found in Gerard O. Walter's cover story on electronic typesetting, published in *Scientific American* in 1969.[83] Bigelow still recalls the iconic 'big green "G" on the cover' and cites the article as an eye-opener on the subject (**fig. 3.13**).[84] Over a decade later, Bigelow's own article on 'Digital typography', co-written with Donald Day and published in *Scientific American* in 1983, confirmed the trend of and interest in the topic and became one of the most credited and cited papers on the issues of early digital type (**fig. 3.14**).[85] In anticipation of a broader readership, Bigelow and Day introduced a new set of vocabularies such as 'glyptal letters' and 'sculptural processes' to offer abstractions for some of the new dematerialized aspects of type, instead of using a technology-heavy jargon.[86] As Bigelow recalls, 'they were made-up words to describe new phenomena', which were met with much criticism from the type community, namely by Walter Tracy who reacted in a written complaint.[87] Language evolved as people grappled and negotiated with a new set of terminology for things that had not yet been named.[88] Bigelow continues to use poetic terminology to describe technical aspects.[89]

One publication that stands out as a valuable source in documenting digital innovation in text composition, word processing, publishing, and type manufacturing is *The Seybold Report*. Launched in 1971 by John Seybold and his son Jonathan, the *Report* gave the most extensive insights into the technical details of computing and its devices used for text composition during the early digital period and helped identify distinctions between the growing separation of composition systems in

82 See Caflisch 1989 and Unger 1989. Unger's article was co-written with his wife Marjan Unger.

83 See Walter 1969.

84 Charles Bigelow in an interview with the author, 8 September 2017 [audio file 01, 05:00]. This issue of *Scientific American* has also been mentioned by Gerard Unger as the first source on digital typesetting available to him, in correspondence with the author, 16 December 2015.

85 See Bigelow 1983 I.

86 Ibid., p. 108 f.

87 Charles Bigelow in an interview with the author, 8 September 2017 [audio file 03, 06:00].

88 Ibid. In the interview, Bigelow also remarks that while 'glyptal' had not been accepted at the time, 'Glyphs' was chosen as the name of a digital font editing software in 2011, see <www.glyphsapp.com> (last visited 8 Aug. 2022).

89 Bigelow uses the term 'mosaic' to describe digital bitmap-based fonts, see Bigelow 2020, p. 8 f.

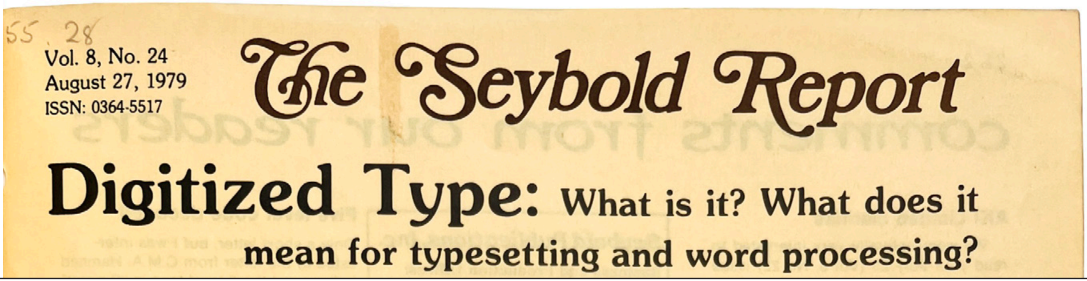
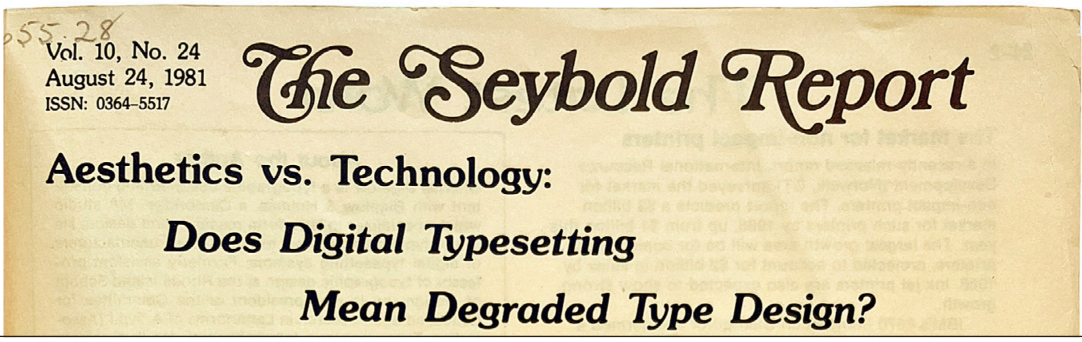


Fig. 3.15 One of the first title headlines that raises awareness of digital type in the *Seybold Report,* vol. 8, no. 24, 1979. Photographed by the author [DTGC].



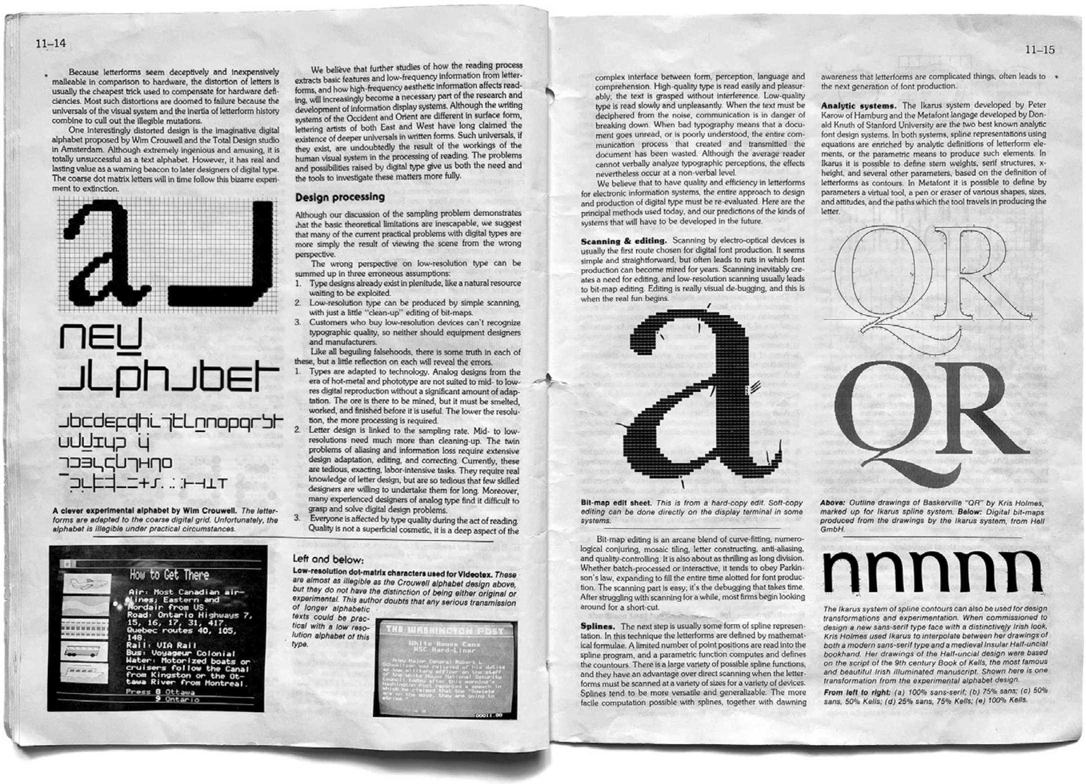


Fig. 3.16+17 'Aesthetics vs. technology' was Charles Bigelow's two-piece article in separate issues of the *Seybold Report,* that brought a lot of attention to the advantages and challenges of digital type. Cover of part 1 above, double-spread of part 2 below. Photographed by the author [DTGC].

publishing and word processing, i.e. text editing in office environments.[90] It is noteworthy that *Seybold* reported extensively on the development of type composition systems (for seven volumes) before dedicating more attention to the digital description of letterforms used on those systems. This pattern of interest is a recurring theme discussed in chapter 4. In the summer of 1979 the *Seybold Report* dedicated an entire issue to explain methods of digitally encoded letters: 'Digital type: What is it? What does it mean for typesetting and word processing?' (**fig. 3.15**).[91] Jonathan Seybold himself compiled a 17-page report on the particularities and challenges of digitally stored letterforms and on their manufacturing, including descriptions of Ikarus, listing American companies already using it, and of Metafont at a conceptual stage, not yet an application.[92] After providing a basic understanding to their readers, the Seybolds held talks with Bigelow about an extensive two-piece essay with the overarching theme 'Aesthetics vs. technology: does digital typesetting mean degraded type design?' (**figs. 3.16+17**). Both papers are further discussed in 3.4.2.

The period of technological transition is also a transitional period of publications, some of which underwent change, while new ones emerged, and yet there was no native environment for this discourse on digital issues in print titles. *Visible Language* stands out as a publication that offers a platform where typography researchers and computer scientists share ideas, and invites design practitioners to participate in those discussions. In building a relationship with the ATypI it seeks to become a part of an emerging community that is thoroughly explored in the following section.

90 Eventually the Seybolds launched a second journal in 1977, the *Seybold Report on Word Processing*. To emphasize this distinction even further, both journals were renamed in 1982: the original report became *The Seybold Report on Publishing System,* the younger edition was renamed *The Seybold Report on Office Systems,* thus shifting from a focus on technologies to an emphasis on the environments they were used in. See the announcement in *The Seybold Report on Word Processing,* vol. 4, no. 12, 1981, p. 1.

91 Seybold 1979, p. 1.

92 Ibid., pp. 15 f.

3.4. The ATypI working seminar at Stanford as a highpoint of discourse

The first half of this chapter has outlined the significance ascribed to the various environments that nurtured grounds for a discourse in digital type design technologies and identifies the Association Typographique Internationale as a part of that quickly expanding network. The following sections uncover in more detail why the ATypI serves as a key example of these environments in the case of some of its selected activities and platforms. Critical reflection and heated debates were at the essence of the Association, rooted in its conferences, particularly in the 'working seminar' format that was organised in conjunction with academic institutions. The structure of these formats will be investigated here, more specifically at the example of the 1983 event at Stanford University. A series of issues debated there unveil relevant research questions that serve as a framework for investigating the transitional phases in early digital type design in the following chapters of this thesis. In order to understand the significance of the Stanford working seminar, it is necessary to first take a closer look at the Association's interest in the technological transition and at its convergence towards education and research during a period of rapid change.

Since its inaugural meeting in Lausanne in 1957, the ATypI organised annual conferences (referred to as 'congresses' in the Association's early years) for its members, general assemblies for its Board of Directors and held regular meetings for the committees that were gradually formed within the Association: the Committee of Type Manufacturers and the Committee of Type Designers and Typographers represented the common interests of most of its members in addition to other working groups.[93] The congress programmes offered presentations by distinguished speakers,[94] followed by open discussion sessions, and also offered ten-minute 'interventions' for shorter announcements.[95] During its first decade all of the Associations' annual congresses were held in Western Europe, three of them in Paris, the home of Deberny & Peignot. A key characteristic of the Association was the trilingualism of English, French and German in all printed announcements, statutes, some publications as well as internal reports and correspondence between

93 Four so-called 'special committees' were formed within the ATypI: 'Committee to study the creation of type faces', 'Committee concerned with creative work in Typography', 'Legal committee', 'General Activities committee'. See Berry 2019.

94 The Association was represented almost exclusively by men at the time, certainly on the board. Until the mid-1970s, congresses offered a separate 'ladies' programme' for spouse, see the 1973 ATypI congress announcement [DTGC, ATypI collection]. This culture began to change only slowly thereafter.

95 J. Dreyfus offered M. Wrolstad to announce the recent launch of *The Journal of Typographic Research* during an intervention at the 1967 ATypI in Paris, in a letter by Dreyfus to Wrolstad, 12 July 1967 [SBL, ATypI files, box 4, vol. 9].

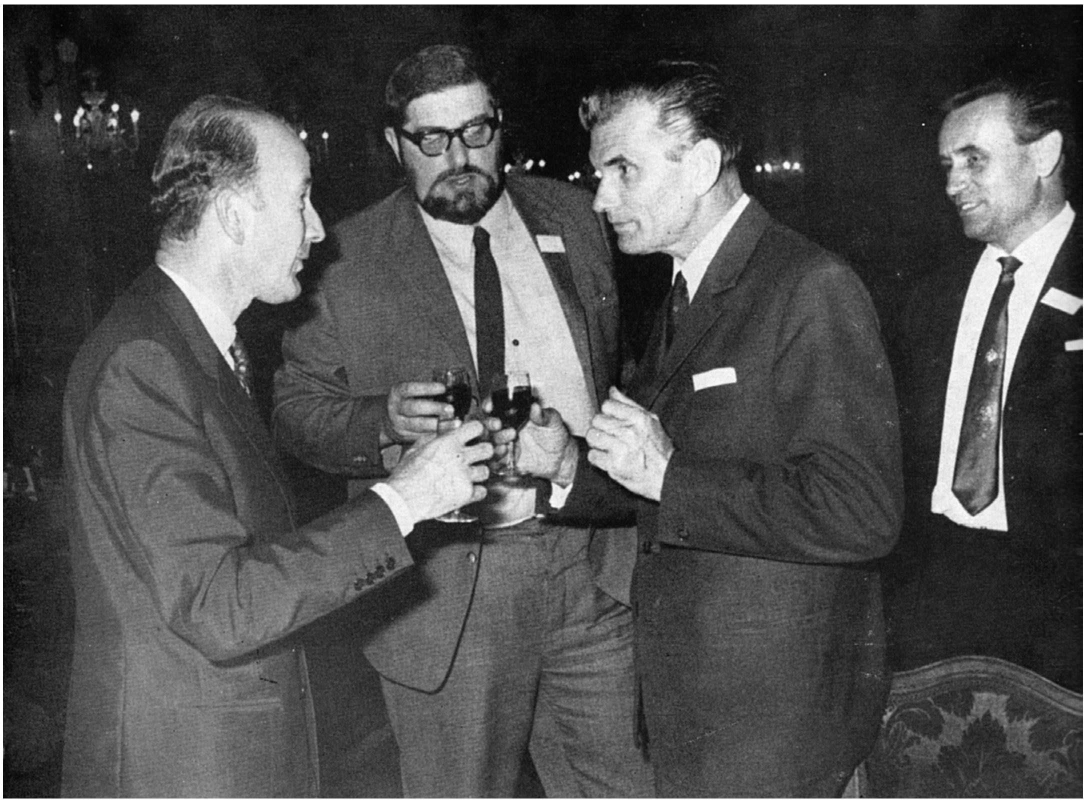


Fig. 3.18 FLTR: ATypI president John Dreyfus, congress manager Václav Modroch, chairman of the congress committee René Murat, designer of the visual congress identity Jiří Rathouský. From a series of photographs by Zuzana Humpálová and Jaromír Pešek, in *Typografia,* no. 10/11, Prague, 1970. From the collection of Petra Dočekalová, Prague.

committees. At congresses, speakers typically presented in their mother tongue with simultaneous translation provided during the talks.

The political dimensions of the ATypI and its relevance on a divided European continent were showcased with the selection of Prague as venue for the 1968 congress, which was to be the Association's first event behind the Iron Curtain. Although the congress had to be cancelled in light of the political tensions in Czechoslovakia that culminated in the Prague Spring, the ATypI sent a strong message in postponing the event to the following year. In doing so, the Association underlined the significance of building relationships between the two sides of the Curtain, despite political differences imposed on government level (**fig. 3.18**). The ATypI confirmed this attitude in holding the 1975 congress in Warsaw.

The 1969 congress is remarkable in another aspect: it marks the Association's first event fully dedicated to 'typographic opportunities in the digital age'. Similarly to a series of papers published in JTR in the late 1960s, many of the presentations were delivered in response to the emerging CRTs and to optical character recognition (OCR), which had improved over time and brought forward new alphabet designs. While Zapf addressed challenges of designing for CRT systems more generally, Heinz H. Schmiedt referred to Hell's Digiset CRT photocomposition machine more specifically, a device that could store fonts of lettershapes in a binary format (see 4.1.1) and had been first introduced to the public in 1965. Others identified methods and criteria under which research into legibility was conducted at the time, raising questions over what may be regarded as acceptable typography. Dutch graphic designer Wim Crouwel gave a remarkable presentation about 'Type design for the computer age', propagating a new terminology declined in 'cells', 'nuclei' and 'units'. His paper is determined in tone, demanding in his arguments, slightly provocative in questioning whether the term 'typography' could be sustained at all in the light of drastic change.[96] In his closing talk, former *Typographica* editor Herbert Spencer specifically excluded Crouwel's contribution from his summary of insights gained during the congress.[97]

On a separate level to what was discussed in Prague, the congress graphics remain in the collective visual memory. In an almost prototypical way, the visual identity of the 1969 ATypI congress covers all of the dimensions of a conference format from announcements and brochures to banners at the venue. Its visual theme represents an iconic diagram of lowercase 'a' letters spanning from historic shapes such as Venetian old style, Renaissance and transitional style to sans serif and a rather peculiar 'a' of the much discussed controversial New Alphabet designed by Crouwel (**fig. 3.19**). This grid-based alphabet, squarish in appearance, was proposed for use on CRTs in 1967, although early drafts even predate the

96 Crouwel 1970, p. 58.

97 Spencer 1970, p. 71. Spencer was the founder and editor of *Typographica* (not to be confused with *Typografia*) from 1949 to 1967. He was also an editor of *The Penrose Annual* from 1964 to 1973.

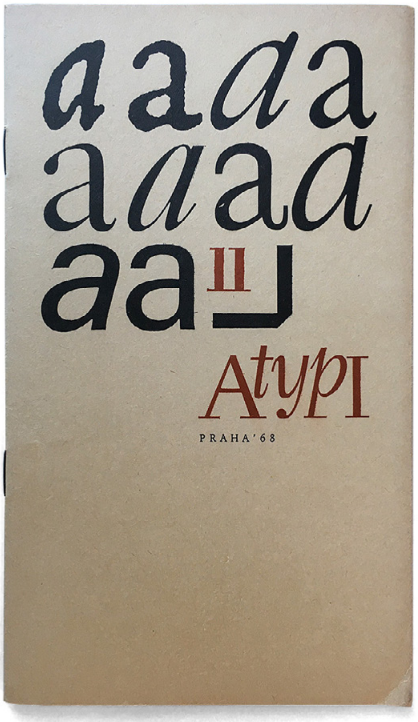


Fig. 3.19 First announcement of an ATypI congress to be held in Prague in 1968, with a typographic theme and logotype designed by Czechoslovakian typographer Jiří Rathouský. The typographic theme is a diagram of historic and contemporary letter-shapes, FLTR and top to bottom: Venetian humanist (Bembo), French renaissance (Garamond), transitional (Janson), contemporary Czech book typeface (Týfa), rational grotesque (Univers), 'digital' (New Alphabet). Photographed by the author [CdD].

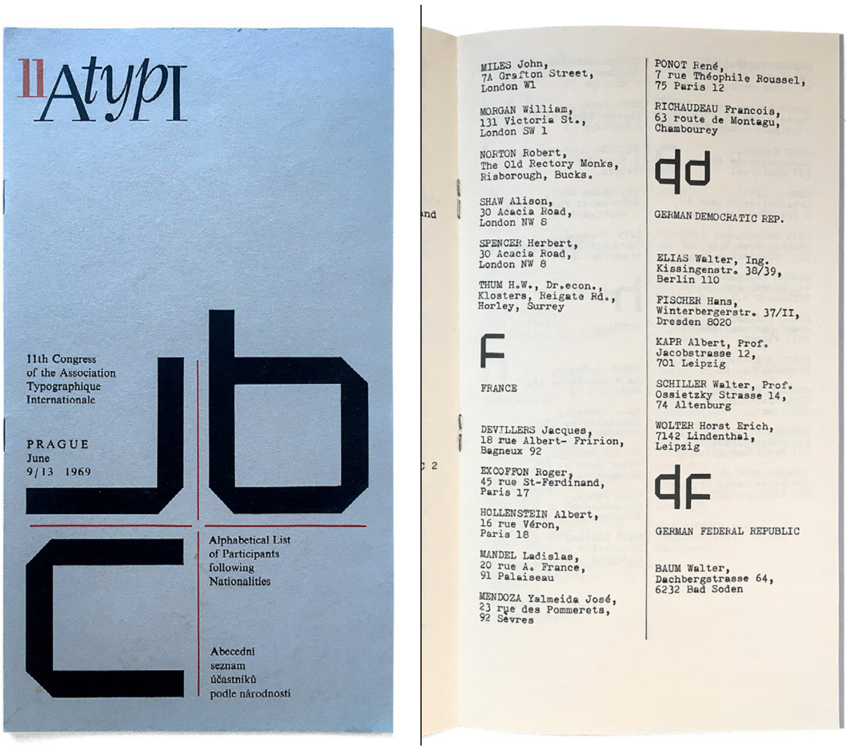


Fig. 3.20+21 The participant list, designed by Rathouský, makes prominent use of Wim Crouwel's New Alphabet, introduced in 1967 Photographed by the author [CdD].

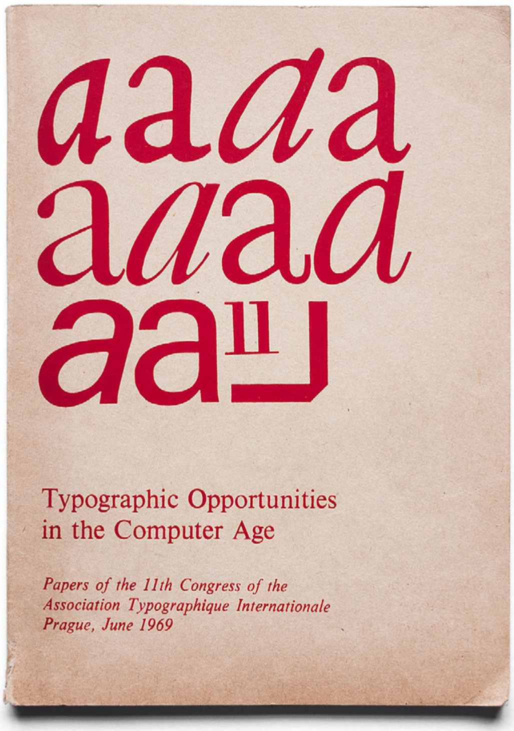


Fig. 3.22 Published proceedings of the 1969 ATypI congress in Prague (*Printing Matter* no. 8, ATypI). Photographed by the author [GL].

technology.[98] The New Alphabet was actually not available for CRT composition, instead it could only be hand-lettered from dry transfer sheets supplied by French manufacturer Mecanorma. Nevertheless, the use of the New Alphabet in all the printed communication, lends the congress an almost iconic visual identity in retrospect (**figs. 3.20+21**). According to Crouwel's own words, the New Alphabet was 'not fit for use, but […] fit for discussion', which has led Christopher Burke to conclude that the alphabets may have been considered a 'provocation and stimulus' rather than a genuine proposal against established conventions in letterform design.[99]

Ironically, the congress papers of *Typographic opportunities in the computer age* are completely printed letterpress, co-published by ATypI's own *Printing Matter* series (**fig. 3.22**), issued by the Czechoslovak publisher *Typografia,* who also released a special edition journal (of the same name) fully dedicated to the event, including responses from foreign trade journals and photographic documentation in a 16-page supplement.[100]

As of today no published accounts of a complete ATypI history exist. In 2018, former ATypI president John D. Berry (from 2007 to 2013) took to task 'a series of short books documenting the history of the [ATypI]', of which merely a draft has been disclosed online so far, roughly covering the Association's first five years.[101] Alice Savoie's unpublished thesis investigates ATypI's attempts in protecting intellectual property of typefaces with an emphasis on the Association's first decade.[102] As a result, the following research, focused on ATypI's endeavours in education and research at the intersection of technology in a very specific environment, mainly draws upon conference programmes, published congress papers as well as primary source material including internal committee reports, proposals and business correspondence.

These documents not only carry valuable information, they also reveal aspects of a different nature on a visual level, such as versions of a continuously evolving ATypI logotype. Although such logotypes are typically created to endure, it is perhaps in the DNA of a typographic association to identify frequent change in its visual appearance. In addition to changing letterheads, each congress is equipped with a custom arrangement of the letters A-Typ-I.[103] While the change of the

98 Burke 2021, p. 20.

99 Ibid.

100 See *Typografia,* no. 10/11, 1970.

101 The draft includes accounts of the Association's preliminary meetings, preconditions of its formation and early attempts in protecting typefaces, see Berry 2019.

102 See 'Defending typefounders' rights: Charles Peignot and ATypI', in Savoie 2014, pp. 193–201.

103 Even in plain text, protocols and correspondence, several versions of the acronym can be found in the early years of the Association: A.Typ.I., A.TYP.I. and ATYPI are most common. In recent years 'ATypI' has become the customary spelling; for consistency it is used throughout this thesis, while alternatives are preserved in original citations.

Fig. 3.23 Incomplete timeline of ATypI logotypes (1960–1988), potential case studies of change in aesthetics, design decisions and technology. Collected and scanned from original documents [DTGC, ATypI collection].

- A 1960 letterhead
- B 1969 Prague
- C 1973 Copenhagen
- D 1973–1980s letterhead
- E 1974 Basle WS
- F 1975 Warsaw
- G 1976 Reading WS
- H 1978 The Hague WS
- I 1981 Mainz WS
- J 1983 letterhead
- K 1983 Stanford WS
- L 1985 Hamburg WS
- M 1985 Kiel
- N 1986 letterhead
- O 1988 Gdansk WS

Fig. 3.24 Sketches of the 1976 ATypI working seminar logotype on drafting paper, designed by Sue Walker for the University of Reading. Photographed by the author at DTGC.

letterform style is rather obvious, typographic variations of the acronym are just as revealing of the zeitgeist. Collected over time, these marks offer their own chronology of the Association's history (**fig. 3.23**). More than visual clues of changing aesthetics, each logotype could serve as a case study of design decisions and of the tools available at the time (**fig. 3.24**). This is particularly true for the 1983 ATypI working seminar, where the tools used in the making of the event's logotype eventually became the subject of a debated. The case is investigated in more detail in section 3.4.3.

3.4.1. The ATypI working seminar format

As the Association continued to grow in the early 1970s, its attention was drawn beyond the initial concerns for typeface protection to achieving standards in typeface classification and in the education of type and typography. In the midst of reforming design education in the academic landscape (see section 3.2) and in response to the new technical requirements of designing and using type, the ATypI sought to tackle these challenges in establishing a stronger alliance between type designers, manufacturers, typographers and teachers within the Association: in 1972 it formed the Committee for Education in Letterforms as 'a bridge between those who teach and those who use or make letter forms'.[104] The following year, the committee was given a prominent platform at the 1973 congress in Copenhagen that was completely dedicated to these endeavours.

The 1973 congress laid the foundation of ATypI's commitment to design education, not only because it was the Association's first event organised in cooperation with an academic institution, the Graphics College of Denmark,[105] but also because it offered an open 'Schools Discussion Forum', during which representatives of different countries presented their institution's curricula and teaching methods. Among the presenters were Wim Crouwel, professor at Delft Institute of Technology, Max Caflisch of the Zurich Kunstgewerbeschule, Armin Hofmann of the Basel Kunstgewerbeschule and others. The presence of Nicolete Gray, a calligrapher and art historian who taught at the Central School of Art and Design in London, must surely be regarded as progress within the ATypI, traditionally dominated by male speakers.[106] In addition to a group of educators, some representatives of type manufacturers who offered type design training at vocational evening schools were also included in the programme, thus initiating the desired intersection between the disciplines. In anticipation of ATypI's acknowledged 'language problem', the organisers pre-circulated written papers of the presentations, but decided to split the congress hall into three sections for follow-up discussions to take place independently in English, French and German in each of the respective parts.[107] Although congress attendees were encouraged to switch

104 From the official announcement of the 1973 ATypI congress in Copenhagen, undated [DTGC, ATypI collection].

105 Official English name of Den Grafiske Høiskole, an institution that merged into Danmarks Medie- og Journalisthøjskole in 2008.

106 Nicolete Gray played an active role in the early years Committee for Education in Letterforms, where she was also engaged in the organisational committee of the early events. In 1982, the ATypI initiated the exhibition *The art of lettering and the march of history,* co-organised by Gray with Nicholas Biddulph at the Central School of Art and Design, 2–31 March 1982. It would be desirable to pursue further research on the role of Gray in the ATypI and its committees.

107 From the official announcement of the 1973 ATypI congress in Copenhagen, undated [DTGC, ATypI collection].

Fig. 3.25 The publication *Dossier A–Z 73* was prepared in anticipation of the 1973 ATypI congress in Copenhagen. It is comprised of a medeley of contributions from early members of the association, including Gerrit Noordzij's preliminary thoughts of his theories later published in *De Streek,* 1985 (*The Stroke,* 2005). Photographed by the author [FU].

between the groups, it remains highly doubtful whether separated and simultaneous discussions in each of the three languages could actually meet the objectives of exchanging teaching methodologies across borders or even fulfil the demands of an international congress. In compiling contributions of the 'Schools Discussions Forum' well in advance of the congress, editors Fernand Baudin and John Dreyfus anticipated the event with an exceptional publication (**fig. 3.25**).[108] This ATypI 'dossier' has been cited in the past and continues to draw attention.[109]

With the experience of the 1973 congress in Copenhagen, the ATypI sought to reinforce its dedication to design education, while maintaining a stronger presence among academic institutions, primarily in Europe. Instead of competing with the programme of its annual congresses traditionally aimed at the type industry, the idea was to establish a second, hands-on format as a counterpoint that would be held every other year at different design schools and universities. Just a few weeks after the Copenhagen congress, it was first announced that a 'summer seminar' would be hosted at the Basel Kunstgewerbeschule in the summer of 1974.[110] Ultimately the event was held in late November that year and the format became known as a 'working seminar'.[111] The choice of Basel is not a surprise: in addition to Hofmann, who had delivered the keynote in Copenhagen, other faculty members of the school were well represented in the education committee, with André Gürtler and Christian Mengelt as its chairman and vice-chairman. As a result, the initial concept of a 'working seminar' was modelled on the event hosted in Basel.

In addition to Gürtler and Mengelt, at least three other recurring figures remained influential in the committee's activities for at least a decade: Michael Twyman of the University of Reading, Gerrit Norrdzij of KABK in The Hague and Hans Peter Willberg of Fachhochschule Mainz, who took turns in reprising the roles of chairman and vice-chairman.[112] The institutions they represented were also selected as venues for the first four working seminars, in that order.

Under the theme 'The teaching of letterforms, signs and symbols' an organization committee of 13 members devised a full week's programme from

108 See Baudin 1973.

109 More recently, Erik van Blokland praised the publication and emphasised Gerrit Noordzij's article as an early source of preliminary thoughts on the letterform design approach of 'translation' and 'expansion' that later went into the so-called 'Noordzij cube', a model that has been propagated in the type design programme of KABK The Hague for decades. In a lecture by van Blokland, *The cube: pratical research in theoretical models,* The Cooper Union, New York City, 17 June 2019.

110 Letter by general secretary Karl Schneider to ATypI members, 7 November 1973 [DTGC, ATypI collection, folder 'Education committee'].

111 Working seminars of the original series were held in Basle (1974), Reading (1976), The Hague (1978), Mainz (1981), Stanford (1983), Hamburg (1985), Gdansk (1988) and Budapest (1992).

112 1972–1974 chairman A. Gürtler, vice-chairman C. Mengelt; 1974–1977 c. M. Twyman, vc. G. Noordzij; 1977–1981 c. G. Noordzij, vc. H. P. Willberg.

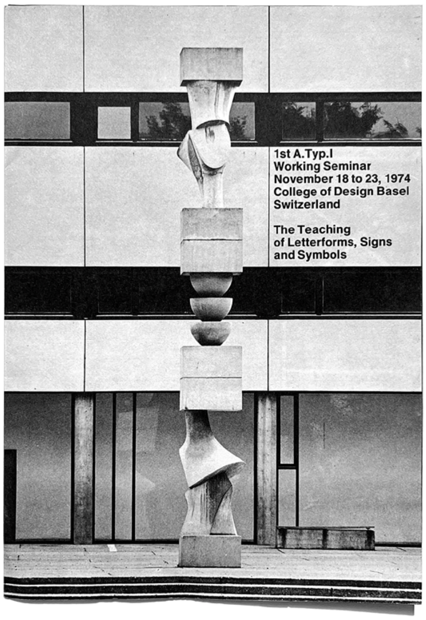


Fig. 3.26

Fig. 3.27

Fig. 3.28

Fig. 3.29

Programme of the first ATypI working seminar (**3.29.**) in 1974 at Basle School of Design. As a counterpoint to ATypI's annual congresses, the seminar offered a mix of group discussions (Armin Hofmann speaking, Hans Eduard Meier and a young Gerard Unger left of him, **3.27.**), evening lectures (Herb Lubalin, **3.28**) and workshops (**3.29.**). Photographers unknown [DTGC, ATypI collection].

November 18 to 23 (**fig. 3.26**), comprised of three main components: daily discussion sessions, evening lectures, and different workshop groups (**figs. 3.27–29**).[113] The main objective of the seminar was for educators to exchange their experience in teaching the design and use of letterforms by having genuine discussions and by working on assignments set by the respective workshop instructors. The costs of the working seminar were estimated at 60,000 DM,[114] which was made possible through extensive financial contributions by various manufacturers.[115]

Discussion sessions on the challenges that institutions faced and dealt with differently, are clearly a continuation of the forum introduced in Copenhagen, only this time the organizers did not separate the debate into language groups. Although the official language of the seminar was English, with translations offered in French and German, this approach was met with some criticism. Apparently, the presence of three language groups caused some restriction among participants as nuances in questions and answers got lost in translation. Michael Hostettler concluded in his review of the session:

> It was possible for some questions to be clarified. As an observer, however, I had the impression that the majority of these were not. No real dialogue developed among the AGS administration, the seminar leaders, and the seminar participants. But in the short time allotted, such a dialogue was not really possible.[116]

This sort of criticism was repeated until the early 1980s. Another critical look at those workshop sessions reveals little attention spent on issues of digital technologies in the classroom, despite the discussions set in motion in Prague in 1969.

113 The organizational committee consisted of Aaron Burns, Nicolete Gray, André Gürtler, Ernest Hoch, Alfred Hoffmann, Walter Jungkind, Christian Mengelt, Niklaus Morgenthaler, René Ponot, Ralph Prins, Karl Schneider, Michael Twyman and Hans-Peter Willberg. See Rudolf Hostettler, 'ATypI working seminar: the teaching of letterforms, signs and symbols', in *Typografische Monatsblätter,* no. 8/9, St. Gallen, 1975, p. 500.

114 From a letter (in German) by general secretary Karl Schneider to ATypI members, 7 November 1973 [DTGC, ATypI collection, folder 'Education committee']. Taking inflation into consideration, 60,000 DM in 1974 roughly corresponds to 95,000 Euros in 2022.

115 Apart from the ATypI, the 1974 Basel working seminar was sponsored by H. Berthold AG, J. Bopst+Fils S.A., Joh. Enschedé en Zonen, Haas Type Foundry Ltd., Senator Robert Haitz of Berlin, Dr. Ing. Rudolf Hell GmbH, International Typeface Corporation, Linotype-Paul Ltd., Letterform Research and Design Team, Mergenthaler Linotype Co., Mergenthaler Linotype GmbH, Società Nebiolo S.p.A., Fundición Tipografica Neufville S.A., D. Stempel AG. Lettergieterij vh N. Tetterode and Typographen AB. See 1974 Basel working seminar, sponsors list, undated [DTGC, ATypI collection].

116 Rudolf Hostettler, 'ATypI working seminar: the teaching of letterforms, signs and symbols', in *Typografische Monatsblätter,* no. 8/9, St. Gallen, 1975, p. 505/7.

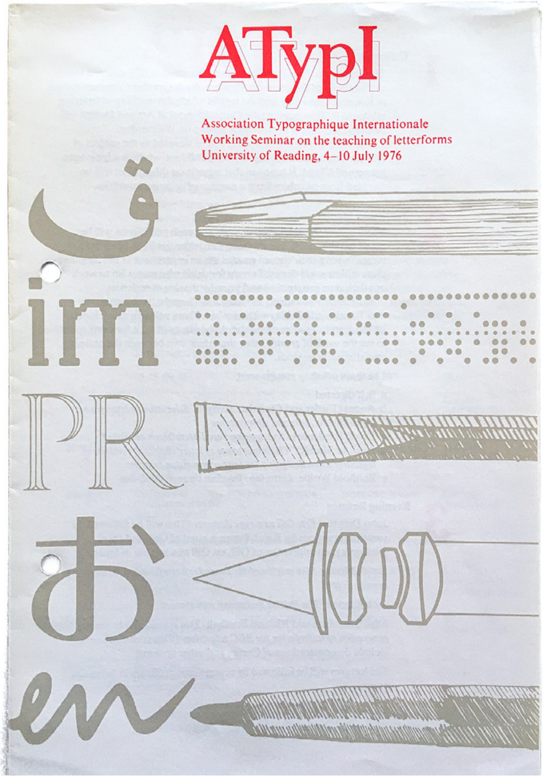


Fig. 3.30 Original announcement of the second ATypI working seminar at Reading. Reproduced by the author [DTGC, ATypI collection].

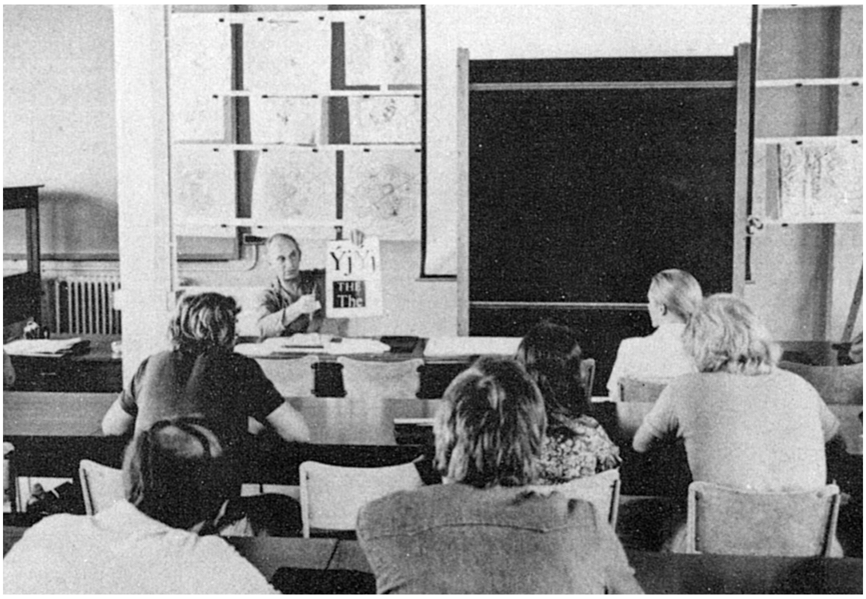


Fig. 3.31 Ladislas Mandel gave a workshop on 'The importance of letter shapes in relation to legibility when designing text composition systems' during the working seminar at the University of Reading in 1976. Reproduced from a series of photographs by Greg Prygrocki and Peter Bartl in the *Summary Report of the second working seminar on the teaching of letterforms*, Reading, 1978 [DTGC, ATypI collection].

In preparation of the second working seminar held at the University of Reading in 1976 (**fig. 3.30**), Twyman, who had been elected as Gürtler's successor on the education committee, expressed his hopes that this event would be less ambitious in scope than the previous one.[117] The emphasis of the Reading seminar laid on the teaching of handwriting in schools, an effort led by Nicolete Gray. While Gürtler and Mengelt reprised their workshop on signs and sign systems, David Kindersley offered a workshop on letter spacing, Ladislas Mandel discussed issues of legibility in relation to the design of letterforms for text composition systems (**fig. 3.31**). Other sessions on lettering and letterpress printing gave the working seminar a rather analogue orientation. Perhaps a demonstration by Richard Southall and John Chambers on *Two approaches to the machine generation of letterforms for BBC television* was the closest to a discussion on the challenges and opportunities of working with type in a digital environment. Although initial plans to publish a full report of the Reading seminar in *Visible Language* were never realised, a detailed account of the proceeding was issued by the Department just in time for the 1978 working seminar in The Hague.[118] Overall, it should not be underestimated that the 'working seminar' also served as a opportunity to reach out to an emerging generation of new designers, thus potentially new ATypI members: from 1974 to 1975 membership admission more than doubled.[119]

Since the Reading seminar, demands had been made to place an emphasis on research activities within the ATypI. An attempt to extend the Association's activities in research and knowledge transfer was first expressed by Ladislas Mandel who proposed to establish an 'ATypI research and information centre'.[120] Ultimately these plans were integrated in the education committee: in changing the name to 'Committee for Education and Research in Letterforms' (CERL) its members reinforced a focus that was already visible in Copenhagen. Furthermore, in order to firmly establish their interests represented at the highest level of the ATypI, the committee proposed that its chairman would hold a seat on the Board of Directors as part of its official capacity.[121] All of these developments are proof of a quickly expanding community and of a growing interest in its activities within and beyond the ATypI.

117 From the protocol of an education committee meeting in Warsaw, 30 September 1975 [DTGC, ATypI collection, folder 'A.Typ.I ab 1975 Warschau'].

118 See *Summary report of the second working seminar on the teaching of letterforms, 4–10 July 1976,* University of Reading, DTGC, 1978.

119 While 21 members joined and 6 members left the ATypI in 1974, the following year the ratio was 45 to 1. See report (in German) of the general assembly in Warsaw, 30 September 1975 [DTGC, ATypI collection, folder 'A.Typ.I ab 1975 Warschau'].

120 Documented in the protocol of an education committee meeting held in Reading, 10 July 1976 [DTGC, ATypI collection, folder 'Education committee'].

121 Documented in the protocol of an education committee meeting held in Lausanne, 28 September 1977 [DTGC, ATypI collection, folder 'Education committee'].

Fig. 3.32 During a field trip to the Stempel type studio, participants of the Mainz working seminar receive insights into the Ikarus digitization process. Charles Bigelow is seen on the right. Photographer unknown, reproduced from *Der Polygraph,* no. 10, 1982.

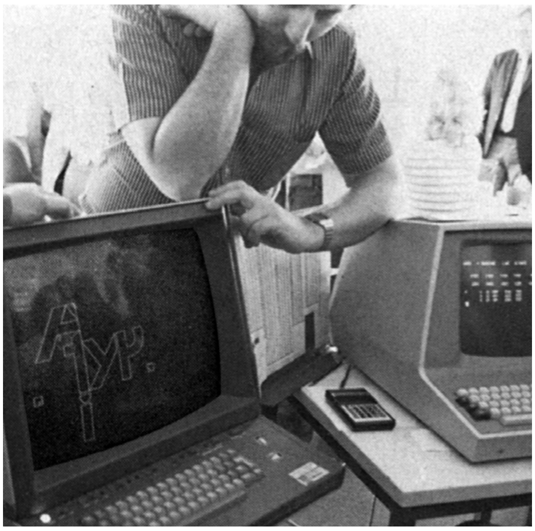


Fig. 3.33 Digitization of the 1981 Mainz working seminar logotype using Ikarus on a workstation at the D. Stempel type studio. Günter Flake of URW leans over the monitor. Photographer unknown, reproduced from *Der Polygraph,* no. 10, 1982.

Lastly, the committee sought to improve its industry relationships. Some of these efforts included the arrangement of students who could gain industrial experience through internships with ATypI member firms.[122] However, the absence of industry representatives during the third working seminar hosted at KABK in the Hague was interpreted as a lack of interest by committee president Noordzij:

> We are only making slow progress with the tasks in our programme, because we lack regular contact. Relationships of the industry and education, exchange between students and lecturers, the establishment of specialised typeface studies und the terminology of type, all of these aspects remain untouched. Perhaps we need a newsletter to finally tackle these tasks. The seminars share the causes of A.TYP.I with the public in an informal way. [...] Perhaps the A.TYP.I should consider using this open-mindedness for our interests. Also, next time the industry need not be so obviously absent: cultural interest is their only right to exist after all.[123]

Although Noordzij picked up on the newsletter idea only much later, introducing the first issue of *LetterLetter* in the Winter of 1984, his criticism of industry presence was tackled in preparation for the programme of the fourth ATypI working seminar at Fachhochschule Mainz under the chairmanship of Hans Peter Willberg. As a representative of URW, Veronika Elsner gave a slide-show presentation of the Ikarus system on how it could be used by type and graphic designers alike.[124] Two days later, during a field trip to the near-by Stempel type foundry in Frankfurt/Main, participants then had a chance to see live-demonstrations of an Ikarus system in use (at the example of the seminar logotype, **figs. 3.32+33**). The session was led by Stempel's art director Werner Schimpf alongside Elsner and her URW colleague Günter Flake. As the Stempel foundry still cast metal type during the early 1980s,

122 Documented in the protocol of an education committee meeting held in Reading, 10 July 1976 [DTGC, ATypI collection, folder: 'Education committee'].

123 Translated from the German original in a report of the working seminar in The Hague by G. Noordzij, undated (c. July 1978) [DTGC, ATypI collection, folder 'Education committee']: 'Wir kommen mit diesen Aufgaben in unserem Programm nur mühsam voran, weil der laufende Kontakt fehlt. Beziehungen von Industrie und Unterricht, Austausch von Studenten und Dozent-en, die Einrichtung von spezialisierten Schriftstudien und die Terminologie der Schrift, das alles liegt noch ungeschnitten auf unserem Tisch. Wahrscheinlich brauchen wir ein Mitteilungsblatt, um diese Aufgaben endlich einmal anfassen zu können. Die Seminare bringen die Anliegen der A.TYP.I auf ungezwungene Weise in das Interesse der Öffentlichkeit. [...] Vielleicht sollte die A.TYP.I sich einmal überlegen, wie diese Aufgeschlossenheit für unsere Interessen ausgenützt werden könnte. Ein nächstes Mal braucht die Industrie auch nicht so auffallend zu fehlen: Das kulturelle Interesse ist ja ihre einzige Existenzberechtigung.'

124 Elsner had attended the Reading seminar as a participating student from Hamburg. The previous year, at the 1975 congress in Warsaw, she had first met Peter Karow and joined URW full-time after graduating in 1977.

discussions were held on the translation of physical letterforms into dematerialized numerical formats.

The final edition of the working seminars was hosted in Budapest, for the first and only time concurrent to the 1992 annual congress. Although there were some new faces,[125] Noordzij, Twyman and Weingart remained key speakers. With its simultanity to the congress, the seminar certainly lost some of the attention and independence that had been crucial for the development of previous editions and after 1992 the working seminar series was discontinued.

A much more informal format was being established by a new generation of type designers from within the ATypI the following year. During the 1993 congress in Antwerp, David Berlow and Petr van Blokland, recipient of ATypI's 1988 Prix Charles Peignot and a former student of Noordzij, set up TypeLab 'as a playground for the ATypI participants who'd want to learn something about the subject that ATypI was meant for'.[126] In what has been described as a 'coup', the sessions were first held at the conference venue's lunchroom with approval of the main congress sponsor, but against an appalled 'ATypI establishment'.[127] Congress participants accepted the new format and in the long run TypeLab established itself as a regular side programme, almost as a second, simultaneous conference.

Noordzij remarked, 'the seminars are the most successful activity of ATypI'.[128] Certainly, they changed the debate culture of typography conferences, shifting from speaker-centred sessions to workshop formats and smaller stages that let the audience become involved. The working seminar format was crucial in creating a new environment in response to an emerging community and must certainly be regarded as a forerunner of TypeLab and similar concepts that re-appeared elsewhere in recent years.[129] The working seminar format was resurrected by the ATypI only more recently: in 2019 and 2020 events were held in Colombo, Puebla, and in Amiens shortly before the beginning of the Covid-19 pandemic.[130]

125 E.g. workshops by Alison Black and Jonathan Hoefler on Macintosh-based software for type design and typography.

126 See Petr van Blokland's original 'call for TypeLab event', distributed by David Lemon through an e-mail list, 24 June 1993, archived here: <https://groups.google.com/g/comp.fonts/c/E8xYeDbEN4A> (last visited 20 November 2022).

127 Middendorp 2018, p. 186.

128 Noordzij 1984/85, p. 1.

129 Several years after TypeLab was discontinued with the ATypI congresses, Petr van Blokland revived the format under the auspices of Typographics in 2015, an annual conference hosted at The Cooper Union, New York. Between 2016 and 2018 TYPO Labs was formed as a technology-focused spin-off of the annual TYPO conference in Berlin, before both events were discontinued after 2018.

130 See Leonidas 2018.

3.4.2. The 1983 working seminar

The 1983 ATypI working seminar at Stanford University was different from earlier editions of this format in many regards. In the 25-year history of the ATypI it signifies changes to previously common procedures and marks many 'firsts'. Notably, it was the first of four ATypI events ever held in the United States,[131] while also being the Association's first event ever outside of Europe. The underlying cultural implications of such an environment change are considered here among several other factors. Although it is regarded as a highpoint of discourse here, the Stanford seminar has not received much attention elsewhere apart from a previously published piece by the author.[132] This section explores why Stanford was selected as a venue and reveals the planning that went into the seminar. It investigates the methodology behind the programme and considers who was invited to contribute, which technologies were presented there and who attended the sessions. Finally, this section also regards criticism and reviews, and sheds light on the aftermath of the working seminar that culminated in tensions between Charles Bigelow and the ATypI.

Stanford as the 'superior' venue

Preparations for a 1983 ATypI working seminar began with Charles Bigelow's appointment as CERL president in 1981, while Gürtler was elected as his deputy. Bigelow had attended the previous seminar in Mainz, where he familiarized himself with the format, which was however not going to serve as an example for his programme. Early on he articulated that the 1983 seminar should 'contribute from a perspective complementary, but not identical to the perspectives of previous seminars'.[133] Initially, the committee held talks with Rhode Island School of Design (RISD) as a possible host, where Bigelow had entered a full-time teaching position in 1978, but after just three months of planning the collaboration was terminated in favour of Stanford.[134] In a long letter to ATypI president Martin Fehle,[135] Bigelow stresses that 'Stanford is a much superior choice to any other location, including

131 In the following years, the ATypI hosted congresses in New York (1987), in San Francisco (1994) and in Boston (2000).

132 See Ulrich 2017.

133 Working seminar proposal by Charles Bigelow, circulated to ATypI board and CERL, undated, though likely late 1981 due to clues in the text [DTGC, ATypI collection, folder 'ATYPI Working-Seminare']

134 Letter by Bigelow to ATypI president Fehle, cc: Gürtler, Hoffmann, 2 October 1981 [Ibid.].

135 Martin Fehle (1925–2008) was ATypI president from 1977 to 1992. During most of his long tenure he was also associated to Haas as a consultant of font licensing and finances. Alongside Alfred Hoffmann who was CEO at Haas and a member of ATypI since 1957, and his secretary Roswitha Jung, the Swiss type manufacturer maintained a certain influence on the ATypI board.

RISD'.[136] Located in Palo Alto, Stanford University was based in the heart of Silicon Valley, known for its density of so-called 'high-technology' companies such as Xerox and Hewlett-Packard as well as several emerging firms like Apple and Adobe. Stanford, often deemed the computer science counterpart to the MIT in the United States, had established itself as the academic hub on the West Coast, as a close collaborator of the neighbouring tech industry and as an educator of prospective recruits. Equipped with the resources of Stanford's prestigious computer science programme, Bigelow could be sure to rely on an infrastructure that enabled the demonstration and use of a handful of different computer systems and therefore supply a '"hands-on" design experience for the participants; a unique circumstance available almost nowhere else'.[137]

However, the choice of Stanford was also influenced by Bigelow's career decisions. In the early eighties, Bigelow had published two significant papers on 'aesthetics vs. technology' in separate issues of *The Seybold Report* (see 3.1.3) that positioned him as an expert of digital type who understood the requirements of contemporary typesetting systems and their implications on the design of letter-forms, but also as an advocate of historic shapes who was willing to maintain typographic traditions despite or through the use of new technologies.[138] Bigelow and Donald Knuth had met for the first time during a Seybold seminar in 1980.[139] Following this encounter, Bigelow gained his first experience in working with Metafont, and in the autumn of 1982 was appointed assistant professor of the newly formed Digital Typography programme.[140] There is little doubt that these circumstances and Bigelow's relocation from New England to California ultimately supported a decision in favour of Stanford. Eventually, organising the ATypI working seminar became a significant opportunity for Bigelow to position himself as a new member at the department. At the same time, he could establish Stanford as the technologically-advanced voice within the ATypI community.

Devising the working seminar programme

At the 1983 seminar, Bigelow wanted to create a space that allowed the evaluation of different 'computer-aided design systems' side by side. This opportunity was aimed at mainly three groups that made up the majority of participants invited for the seminar: independent designers who could evaluate the systems for personal use in their studios, educators who could test them for inclusion in their curricula, and manufacturers seeking to integrate such systems in their existing businesses.

136 Working seminar proposal by C. Bigelow, c. late 1981 [DTGC, ATypI collection, folder 'ATYPI Working-Seminare'].

137 Letter by C. Bigelow to ATypI president M. Fehle, 2 Oct. 1981, p. 2 [DTGC, ATypI collection, folder 'ATYPI Working-Seminare'].

138 See Bigelow 1981, Bigelow 1982, and another separate article in vol. 11, no. 12, 1982, pp. 10–19.

139 Charles Bigelow in an interview with the author, 8 September 2017 [audio file 02, 09:25]

140 Walden 2018, p. 97.

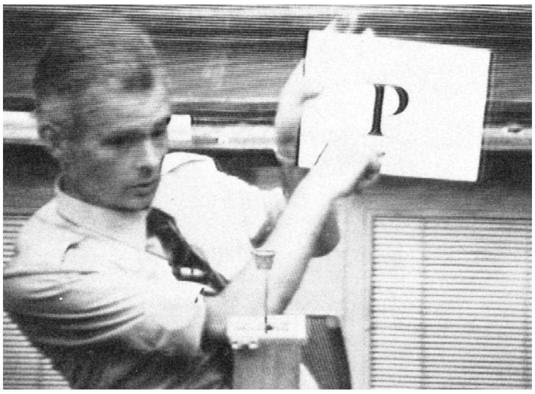


Fig. 3.34 Still from Henk Drost's filmed, but unreleased demonstration of punch-cutting by hand. Camera unknown reproduced in *Visible Language,* vol. 19, no. 1, 1985, p. 100.

Fig. 3.35 Lida Lopes Cardozo instructs Donald Knuth in stonecutting. Photograph by David P. Comberg, reproduced from *Visible Language,* vol. 19, no. 1, 1985, p. 59.

Bigelow identified 'quality' of historic and contemporary letterforms and technical limitations on quality as the central criteria for evaluation.[141] Maintaining the quality of digital letterforms against the challenge of low-resolution output are Bigelow's main concern in his second *Seybold* paper, following a first paper on historical models and the preservation of '"tradition" in the age of electronics'.[142] He repeated this concept in the seminar by integrating traditional 'hand-technologies' such as stone-carving and punch-cutting (**figs. 3.34+35**). On the one hand, digital design tools were introduced 'as future aids to the visual and manuals skills', while the seminar emphasized traditional crafts as 'a standard for future quality in type technology' on the other.[143]

Bigelow was also aware that the ATypI would take some convincing of his agenda. Naturally, at a time of transition, some of the established manufacturers were reluctant in investing in new technologies. ATypI president Fehle and long-time member Alfred Hoffmann were both affiliated with Haas, one of the last metal type foundries in Europe that had not integrated digital type systems into its line of business. In an early programme proposal circulated to the ATypI board, Bigelow therefore chose his words carefully:

> Many of the alphabets have been poorly designed by engineers, or pirated from type manufacturers. The results are inferior letters which are a disservice to the reading public, and an affront to the taste and skill of experienced designers and manufacturers. Therefore, it is time for the designers and educators of ATypI to grasp this new technology. [...] we must persuade the engineers and programmers to provide us with effective design tools for creating digital type. And we must persuade the "high-technology" manufacturers to appreciate and support the work of lettering designers and educators, and to ethically license the offerings of existing type manufacturers.[144]

The quest for the working seminar was a balancing act: winning over designers to grasp the essence of new technologies, while urging 'high-tech' manufacturers to acknowledge letterform history and consult type designers. The final seminar title 'The computer and the hand in type design' has got to be seen in this context and Bigelow presented an argument very much in accordance with the base of ATypI and its founding principles.

Although the education committee had changed its name in 1977 to underline efforts in research, Bigelow seemed to conclude that the first four seminars had

141 Working seminar proposal by C. Bigelow, c. late 1981 [DTGC, ATypI collection, folder 'ATYPI Working-Seminare'].

142 See Bigelow 1981 and Bigelow 1982.

143 Working seminar proposal by C. Bigelow, c. late 1981 [DTGC, ATypI collection, folder 'ATYPI Working-Seminare'].

144 Ibid.

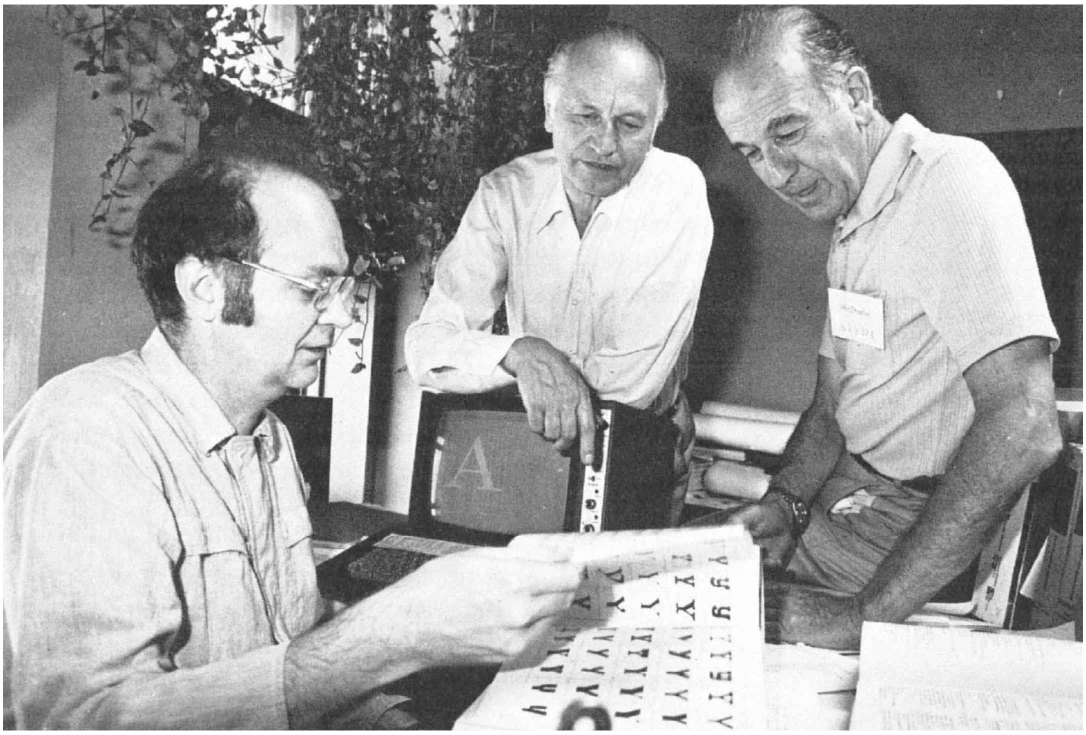


Fig. 3.36 Photograph of Donald Knuth, Hermann Zapf and John Dreyfus during the 1983 ATypI working seminar at Stanord. Zapf leans over a monitor displaying a letter 'A' generated in Metafont. Photographer unknown, reproduced from *Visible Language,* vol. 19, no. 1, 1985, p. 34.

been dedicated too much on teaching and suggested that the Stanford seminar would be the first to focus on research.[145] Research on historical, aesthetic and technical aspects of digital type design are best represented in the 1983 talks of Gürtler, Mengelt and Carter.

As planning for the working seminar progressed, Lynn Ruggles, one of Bigelow's research associates at Stanford, had prepared a list of digital type systems, which was circulated as an internal technical report (reviewed in more detail in chapter 4.1.) just a few months before the start of the seminar.[146] This technical report documents 15 different systems and can be regarded as a 'longlist' under consideration for possible demonstrations during the working seminar, while an internal draft of the seminar agenda shared with the board contains the corresponding 'shortlist' of six systems: Metafont, Ikarus, Elf, PM Spiral, Fred, LIP (listed in that order).[147] Apparently, the committee's inability to contact the developers of PM Spiral in time, resulted in its omission from the programme,[148] although Spiral inventor Peter Purdy eventually attended the working seminar.[149]

The line-up of contributors

Following Bigelow's circulated proposal, the final list of speakers gives evidence of an impeccable medley of punchcutters, computer scientists, engineers as well as leading and emerging type designers. The seminar contributors can roughly be divided into three groups: representatives of old handcraft guilds, developers of digital type systems and type designers, all of which had an affiliation with at least one of the systems. Looking back on a 40-year career, Zapf was the most distinguished type designer among the group who enjoyed a good reputation, particularly so in the United States (**fig. 3.36**), which became evident in the large crowd that attended the evening lectures.[150] Matthew Carter and Bram de Does were also established designers, while Gürtler, Mengelt, Unger and Bigelow represented an emerging generation who acknowledged the past, while embracing the latest digital technologies (**fig. 3.37**).

145 Charles Bigelow in correspondence with Richard Southall, 15 July 1982 [DTGC, Richard Southall collection, box 5].

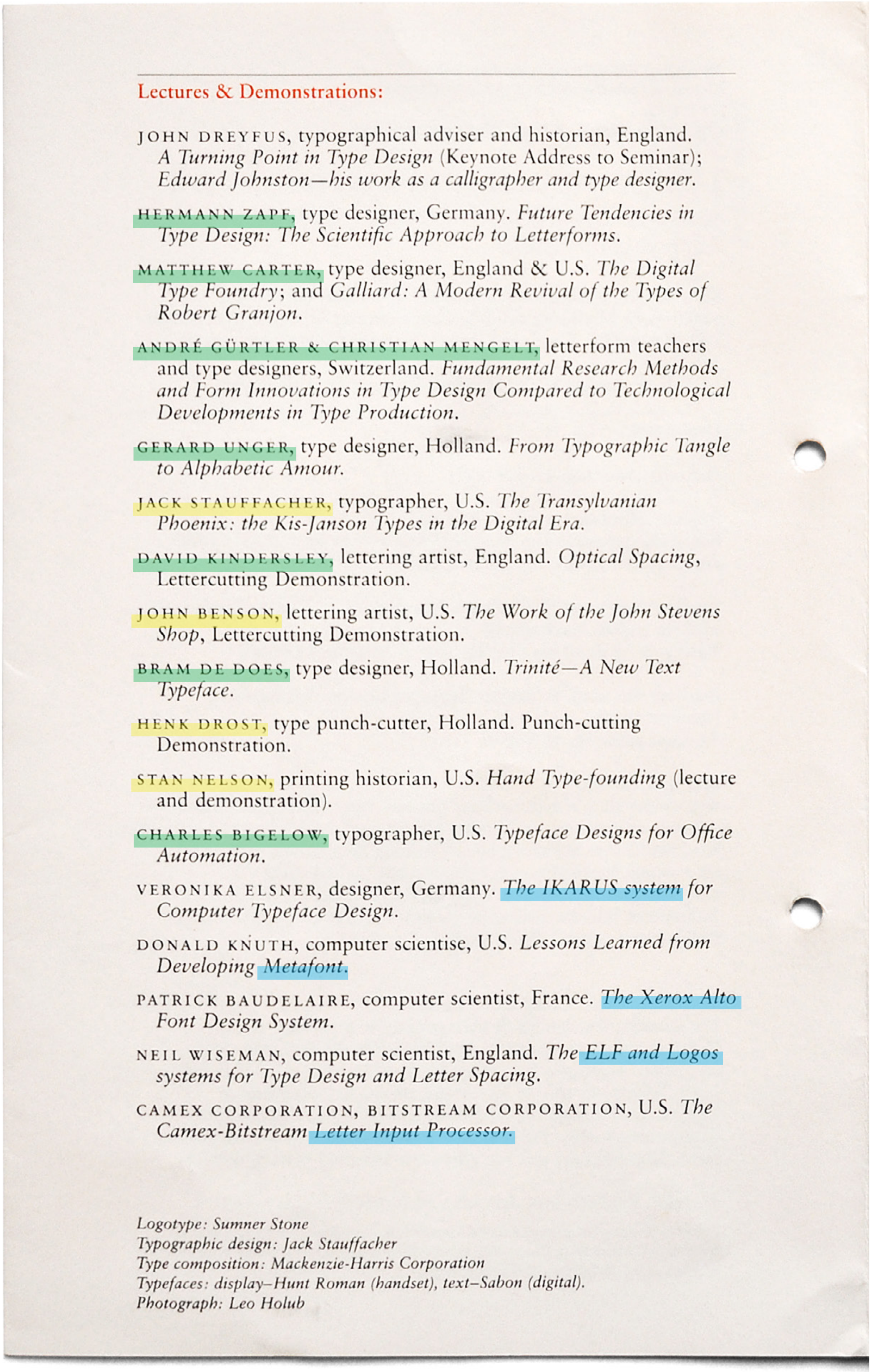
146 See Ruggles 1983, also issued as COINS technical report, no. 83-12, Department of Computer and Information Science, University of Massachusetts, April 1983.

147 Undated draft proposal by C. Bigelow in German (translation by A. Gürtler), *1983 ATypI Arbeitsseminar.* A note at the bottom indicates [DTGC, ATypI collection, 'ATypI working seminar, 5) Stanford 1983']. Bigelow also briefly mentions all six systems in his popular 'Digital typography' paper, see Bigelow 1983, p. 118 f.

148 Charles Bigelow in correspondence with the author, 16. November 2021.

149 See the 1983 ATypI working seminar attendee list [DTGC, Richard Southall collection, box 5].

150 Evening lectures were open to the public; Zapf's talk attracted over 350 attendees.



Lectures & Demonstrations:

JOHN DREYFUS, typographical adviser and historian, England. *A Turning Point in Type Design* (Keynote Address to Seminar); *Edward Johnston—his work as a calligrapher and type designer.*

HERMANN ZAPF, type designer, Germany. *Future Tendencies in Type Design: The Scientific Approach to Letterforms.*

MATTHEW CARTER, type designer, England & U.S. *The Digital Type Foundry*; and *Galliard: A Modern Revival of the Types of Robert Granjon.*

ANDRÉ GÜRTLER & CHRISTIAN MENGELT, letterform teachers and type designers, Switzerland. *Fundamental Research Methods and Form Innovations in Type Design Compared to Technological Developments in Type Production.*

GERARD UNGER, type designer, Holland. *From Typographic Tangle to Alphabetic Amour.*

JACK STAUFFACHER, typographer, U.S. *The Transylvanian Phoenix: the Kis-Janson Types in the Digital Era.*

DAVID KINDERSLEY, lettering artist, England. *Optical Spacing*, Lettercutting Demonstration.

JOHN BENSON, lettering artist, U.S. *The Work of the John Stevens Shop*, Lettercutting Demonstration.

BRAM DE DOES, type designer, Holland. *Trinité—A New Text Typeface.*

HENK DROST, type punch-cutter, Holland. Punch-cutting Demonstration.

STAN NELSON, printing historian, U.S. *Hand Type-founding* (lecture and demonstration).

CHARLES BIGELOW, typographer, U.S. *Typeface Designs for Office Automation.*

VERONIKA ELSNER, designer, Germany. *The IKARUS system for Computer Typeface Design.*

DONALD KNUTH, computer scientise, U.S. *Lessons Learned from Developing Metafont.*

PATRICK BAUDELAIRE, computer scientist, France. *The Xerox Alto Font Design System.*

NEIL WISEMAN, computer scientist, England. *The ELF and Logos systems for Type Design and Letter Spacing.*

CAMEX CORPORATION, BITSTREAM CORPORATION, U.S. *The Camex-Bitstream Letter Input Processor.*

Logotype: Sumner Stone
Typographic design: Jack Stauffacher
Type composition: Mackenzie-Harris Corporation
Typefaces: display–Hunt Roman (handset), text–Sabon (digital).
Photograph: Leo Holub

Fig. 3.37 The officially announced, yet incomplete line-up of contributors. Three groups are emphasized by the author: type designers, representatives of analogue crafts, digital type systems. Reproduced by the author [DTGC, ATypI collection, 'ATYPI Working-Seminare: Stanford 1983'].

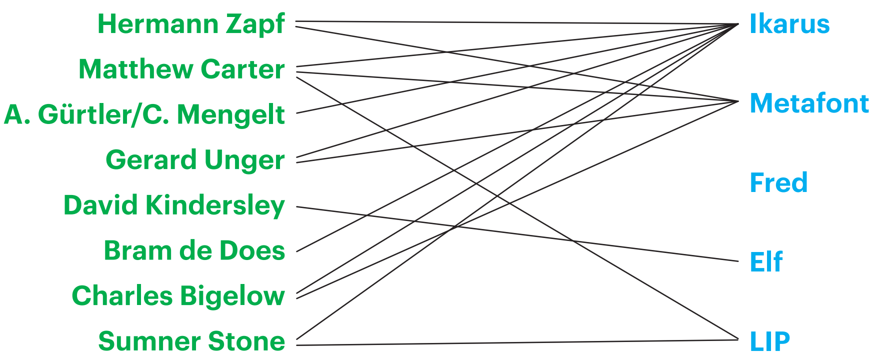


Fig. 3.38 Type designers and their affiliations with digital type systems presented at Stanford.

Three talks are missing on the announcement, two of which even remained unannounced to the last minute and have been re-discovered through archival research by the author. A particularly noteworthy finding is the presentation by David Saunders of Monotype on 'Recent developments of the printed image as seen by a manufacturer of typography', as it represents the only contribution by an established company with a history in hot-metal technologies and therefore poses a unique perspective to the seminar.[151] Sumner Stone who designed the working seminar logotype gave a talk about its design process,[152] and Philippe Coueignoux who had completed a doctoral thesis on the analysis of parametric outline components of digital letterforms at MIT in 1975, was invited to present his research at the seminar (at age 34 he was the second-youngest presenter).[153]

As stated above, all of the systems presented during the Stanford seminar had at least one connection to another seminar speaker (**fig. 3.38**). Metafont, devised by Knuth at Stanford with improvements, contributions and feedback from Bigelow, Carter, Unger and Zapf clearly had the home advantage, while Neil Wiseman, the lead developer of Elf, had only one ally in Kindersley. LetterIP was developed by Camex with input from Bitstream, a new manufacturer co-founded by Carter with Mike Parker in 1981. Bigelow had been in touch with both of them since 1977, when they still worked at Linotype. Fred was devised by Xerox PARC, where Knuth was a consultant in the late 1970s. While these four systems were new to an ATypI event, Ikarus had already been established as a regular guest. It is fair to call Ikarus a child of the ATypI: its first ever presentation to the public was during the 1975 ATypI congress in Warsaw and a full demonstration of the system was already offered to an audience at the 1981 working seminar in Mainz.

Criticism of the Stanford seminar

The official participant list exceeds those of earlier seminars in numbers and is proof of a more diverse community than previously documented at ATypI events in Europe: it reveals more female attendees than before and also includes type manufacturers, engineers and journalists from South and East Asia, many of whom were already in exchange with members of the Digital Typography

151 See Saunders 1983.

152 Knuths refers to Stone's presentation in his own talk, see Knuth 1985, p. 47. Stone's paper is archived [CC, CSC 030, box 5, folder 1]. Scans of the original presentation slides have been obtained from the personal collection of Sumner Stone through e-mail correspondence, 28 February 2017 (see a selection of slides in 3.4.3).

153 See Coueignoux 1975 (also see 3.2 and 4.1.3).

Group.[154] At the same time, it is rather conspicuous that Bigelow's predecessors Noordzij, Twyman and Willberg, three of the most active committee figures of the previous decade, did not attend the event.

The 1983 working seminar was different from previous ATypI events, perhaps too much change for some older members of the Association. Selected criticism is evident in a noteworthy protocol drawn up by Hoffmann, circulated to the board of Haas, including ATypI president Fehle who had also not attended the seminar:[155] Hoffmann claims, only by intervening in time, the ATypI was able to prevent the working seminar from becoming focused solely on computer technology. This claim does not hold against all the evidence brought forward in this section, proving that Bigelow had planned out a seminar on 'the computer and the hand' from the start.[156] With regard to the seminar format, Hoffmann concluded that by inviting not only educators, but manufacturers, 'basically it differs very little from an ATypI congress'. Although this observation may be true, the decision to do so was clearly a reaction to internal criticism brought forward earlier (see 3.4.1).

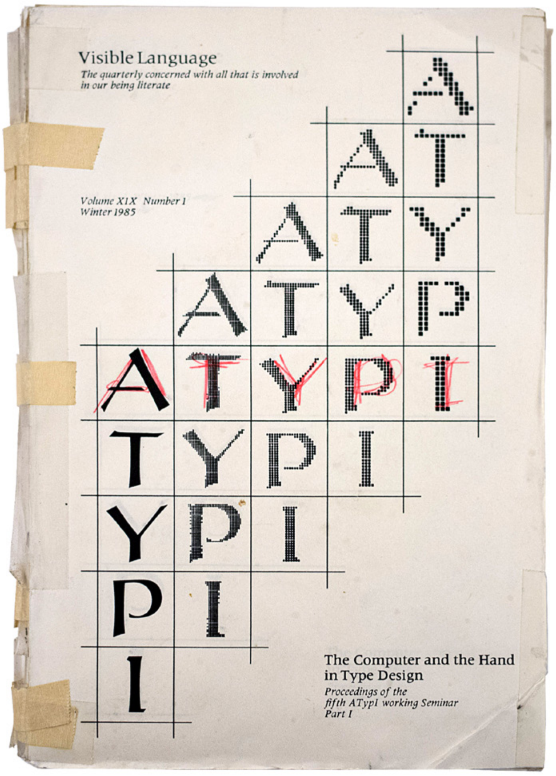
Just a few months before the start of the seminar, even Aaron Burns, president of ITC and an early American member of ATypI, distanced ITC and himself from Bigelow's plans. During a board-of-directors meeting he had questioned costs and budgetary issues in connection to the Stanford seminar and later clarified, 'at no time should my name or ITC's be used in any way as being on his committee or responsible for any of the arrangements that are being made in this matter'.[157] Apart from any personal issues that may have been behind this, it is also proof of different interest groups within a maturing association. The differences between the ATypI board and Bigelow culminated in a disagreement over the financing of the seminar proceedings.

154 Based on a quick census of the official 'participant list' [DTGC, Richard Southall Collection, box 5], counting 159 participants. However, the list appears to be inaccurate; investigations revealed attendees who are not on the list, while other reports and reviews estimate between 120–140 participants. Some evening lectures reached an audience of 350, as they were generally open to the public. Previous working seminars had been attended by less than 100 participants.

155 In the late 1950s, Alfred Hoffmann (not to be confused with Armin Hofmann), became treasurer of the ATypI, a position he held for many years. Hoffmann was primarily associated with the Haas Type Foundry in Münchenstein/Basel (his father Eduard Hoffmann had directed the development of Neue Haas Grotesk/Helvetica). With Fehle and Hoffmann in leading positions, Haas retained much influence in the ATypI.

156 Protocol of the 1983 ATypI working seminar by A. Hoffmann, 31. Aug. 1983 [DTGC, ATypI collection, 'ATypI working seminar, 5) Stanford 1983'].

157 In a letter by A. Burns to K. Schneider, general secretary of ATypI, 24 March 1983 [DTGC, ATypI collection, folder 'ATYPI Working-Seminare, 5) Stanford 1983']. The points were raised at the Board of Directors meeting held during the 1982 ATypI congress in Beaune, France.



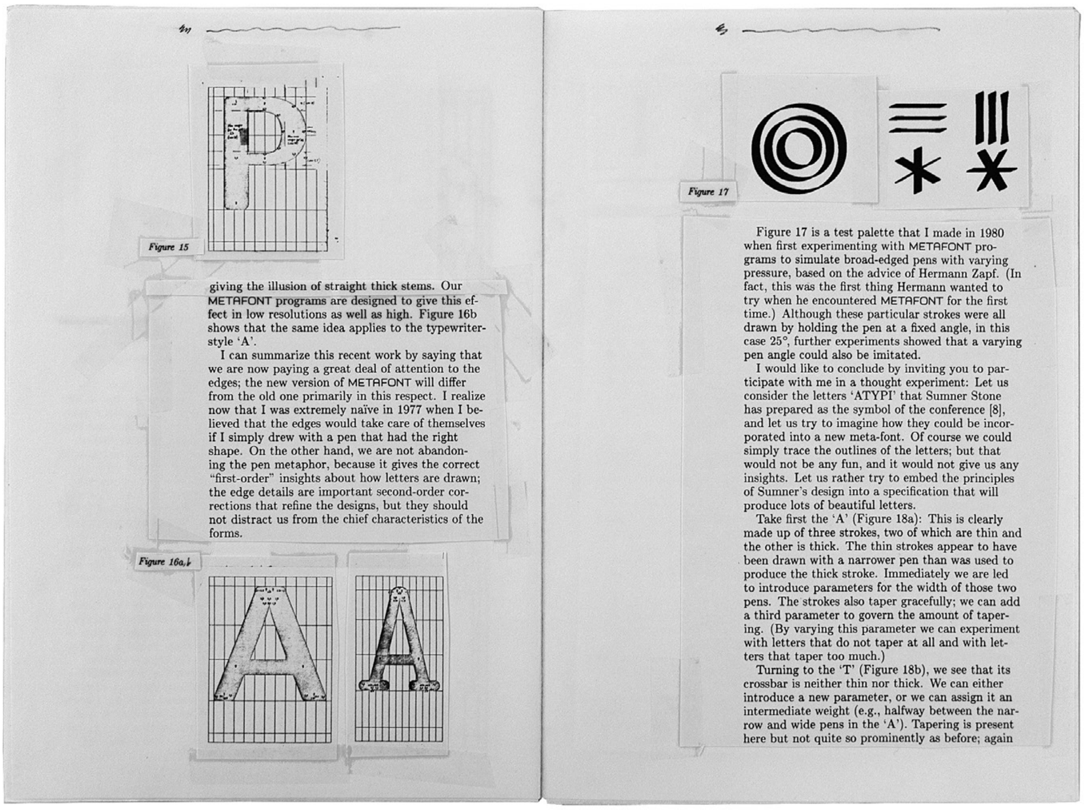


Figure 15

giving the illusion of straight thick stems. Our METAFONT programs are designed to give this effect in low resolutions as well as high. Figure 16b shows that the same idea applies to the typewriter-style 'A'.

I can summarize this recent work by saying that we are now paying a great deal of attention to the edges; the new version of METAFONT will differ from the old one primarily in this respect. I realize now that I was extremely naïve in 1977 when I believed that the edges would take care of themselves if I simply drew with a pen that had the right shape. On the other hand, we are not abandoning the pen metaphor, because it gives the correct "first-order" insights about how letters are drawn; the edge details are important second-order corrections that refine the designs, but they should not distract us from the chief characteristics of the forms.

Figure 16a,b

Figure 17

Figure 17 is a test palette that I made in 1980 when first experimenting with METAFONT programs to simulate broad-edged pens with varying pressure, based on the advice of Hermann Zapf. (In fact, this was the first thing Hermann wanted to try when he encountered METAFONT for the first time.) Although these particular strokes were all drawn by holding the pen at a fixed angle, in this case 25°, further experiments showed that a varying pen angle could also be imitated.

I would like to conclude by inviting you to participate with me in a thought experiment: Let us consider the letters 'ATYPI' that Sumner Stone has prepared as the symbol of the conference [8], and let us try to imagine how they could be incorporated into a new meta-font. Of course we could simply trace the outlines of the letters; but that would not be any fun, and it would not give us any insights. Let us rather try to embed the principles of Sumner's design into a specification that will produce lots of beautiful letters.

Take first the 'A' (Figure 18a): This is clearly made up of three strokes, two of which are thin and the other is thick. The thin strokes appear to have been drawn with a narrower pen than was used to produce the thick stroke. Immediately we are led to introduce parameters for the width of those two pens. The strokes also taper gracefully; we can add a third parameter to govern the amount of tapering. (By varying this parameter we can experiment with letters that do not taper at all and with letters that taper too much.)

Turning to the 'T' (Figure 18b), we see that its crossbar is neither thin nor thick. We can either introduce a new parameter, or we can assign it an intermediate weight (e.g., halfway between the narrow and wide pens in the 'A'). Tapering is present here but not quite so prominently as before; again

Fig. 3.39+40 Mock-up for the special issue of *Visible Language* on the working seminar proceedings. The double spread shows the nature of paste-ups and pre-composed text for final corrections. Photographed by Norman Posselt [CC, CSC 030, box 9].

The ATypI language aspect

Since the early days, the congresses of the ATypI were characterized by their trilingualism, which had the frequent side effect of discussion groups separated by language. Even though it was announced in three languages, the Stanford seminar was the first to break with this tradition once the events began. According to one report, some speakers took 'quick English and plenty of acronyms' for granted.[158] At the same time, the monolingual discussions were praised for creating an easier sequence of discussions and, based on this experience, it was suggested to carry out future ATypI events in English only.[159] Within the ATypI community, Stanford 1983 may have served as a harbinger of the general notion that English eventually did become the primary language for discussions on computing issues and all things digital.

Published proceedings of the working seminar

As had been good practice with the ATypI congress proceedings of 1969 and 1973, Bigelow desired a publication of all the seminar contributions. With Ruggles and himself as co-editors, the publication was planned as a two-volume special edition in *Visible Language,* rekindling Merald Wrolstad's original idea of a close co-operation between ATypI and the journal (see 3.3.). The design concept for both volumes is remarkable: each article was to be set in a different typeface either designed by the respective speakers or associated with them: Knuth's paper was composed in Computer Modern, Stauffacher's in Kis/Janson, Zapf's in his own typeface Aurelia, and so on. For this endeavour, Bigelow assembled a team including Cleo Huggins, Dan Mills, Lynn Ruggles and David Siegel of the Digital Typography Group, with support from Kris Holmes as production manager (**fig. 3.39+40**). Similar to Spiekermann's efforts in *Baseline* no. 6 (see 3.3), using different typefaces meant processing the papers on different composing machines. Although the majority of papers could be typeset on devices in California, other articles were produced in Kiel, in Oxford, and some in Osaka.[160] All design work as well as preparations for production were carried out at the Bigelow & Holmes studio in San Francisco, while expenses were covered by Bigelow's MacArthur grant.[161] Ultimately, *Visible Language* covered the cost of printing and distributed copies free of charge to all members of the ATypI.

158 Protocol of the 1983 ATypI working seminar by Alfred Hoffmann, 31. Aug. 1983 [DTGC, ATypI collection, folder 'ATYPI Working-Seminare, 5) Stanford 1983'].

159 Ibid. Hoffmann implies that there were only few prominent figures left in the ATypI ('einige Deutsche und einige Franzosen') who did not have a good command of the English language.

160 See colophon in *Visible Language,* vol. 19, no. 1, 1985, p. 167 f.

161 Charles Bigelow in an interview with the author, 8 September 2017 [audio file 01, 04:55].

Unpublished papers of the working seminar

The second volume of the working seminar proceedings was never published as planned. Incomplete archival records of Bigelow's correspondence with the ATypI Board show signs of a disagreement between the two parties. In a three-page letter to president Fehle in the summer of 1986, Bigelow recounts the financing of the Stanford seminar and of the editing and publishing of its first volume of proceedings. While Dreyfus explained in his opening statements that 'high proportions of ATypI's funds had been allocated to educational activities' during the previous decade (before 1983),[162] according to Bigelow, the Stanford seminar did not receive direct financial support from the ATypI and was instead partially funded by participant fees, while receiving additional funding from Stanford research grants and from Bigelow's own MacArthur grant in addition to his 'donation of time' and that of the speakers.[163] In the letter, he comes to the conclusion that ATypI should therefore pay for the second volume if it was going to be published. Bigelow recalled the events in 2017, adding that admitting non-members by charging them a higher participant fee was a concession that appealed to the 'business-like sense' of the ATypI Board.[164] On Fehle's behalf, board member Walter Greisner explained that the Association only had limited funds available and needed to be informed of the full costs before committing to it.[165] Moreover, it was suggested whether some of the papers could be published in the *Gutenberg Jahrbuch* instead of *Visible Language*.[166] Bigelow did not attend the 1986 congress in Basel and some Board members seemed to think that he was hesitant to renew his membership.[167]

The situation had reached an impasse well into March 1987 until Fernand Baudin stepped in to mediate between the parties. As a long-time member since the early days of the Association, and as a friend of Bigelow, Baudin seemed an ideal canditate to moderate this disagreement.[168] He wrote letters to both sides and kept the process transparent by sending copies to everyone involved. Baudin made it clear to the board that Bigelow and his students deserved all the credit for a seminar he considered a 'model of its kind' and insisted that they owed Bigelow and

162 Dreyfus 1985, p. 13.

163 In a letter by Bigelow to M. Fehle, 31 July 1986, cc: Baudin, Greisner, Hoffmann, Wrolstad, Zapf [DTGC, ATypI collection, folder 'ATYPI Working-Seminare, 5) Stanford 1983'].

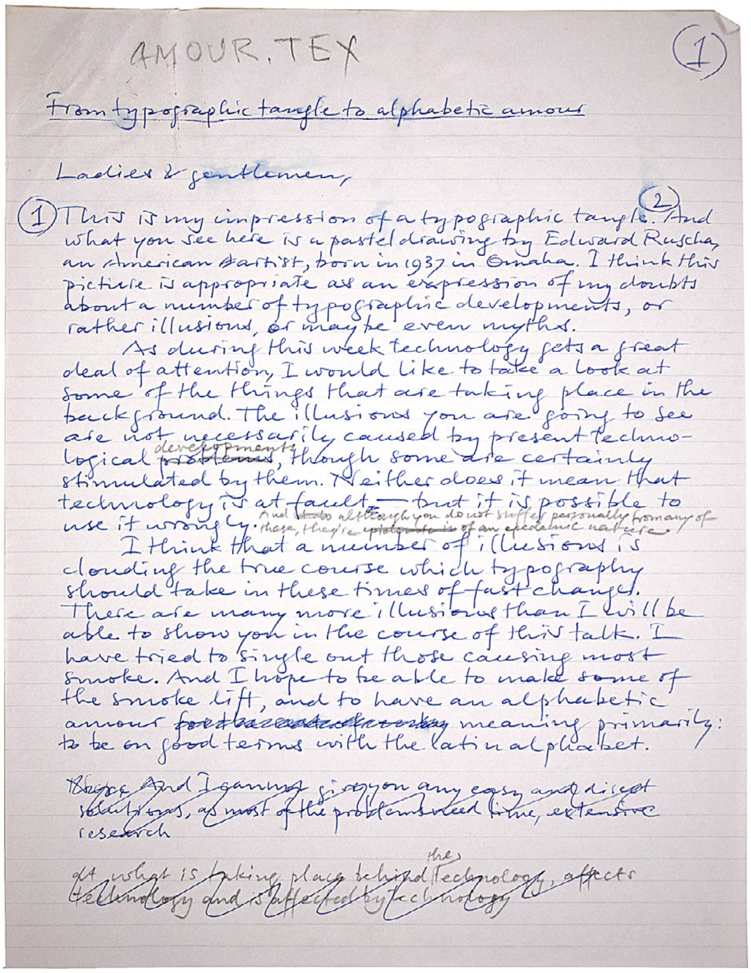
164 Charles Bigelow in an interview with the author, 8 September 2017 [audio file 01, 00:01].

165 In a letter by Greisner to Bigelow, 29 August 1986, cc: Fehle, Baudin, Fuchs, Latham [DTGC, ATypI collection, folder 'ATYPI Working-Seminare, 5) Stanford 1983'].

166 Ibid.

167 In a letter by ATypI vice president Gottschall to secretary Jung, 10 November 1986 [Ibid.].

168 Baudin was affiliated with the Brussels branch of the Amsterdam Type Foundry when he joined ATypI. He later worked as an independent typographer and book designer. For a detailed monograph and biography see Elly Cockx-Indestege, *Fernand Baudin: typograaf, typographiste, book designer,* Amsterdam: De Buitenkant, 2002.



AMOUR.TEX (1)

From typographic tangle to alphabetic amour

Ladies & gentlemen,

(1) This is my impression of a typographic tangle. (2) And what you see here is a pastel drawing by Edward Ruscha, an American artist, born in 1937 in Omaha. I think this picture is appropriate as an expression of my doubts about a number of typographic developments, or rather illusions, or maybe even myths.

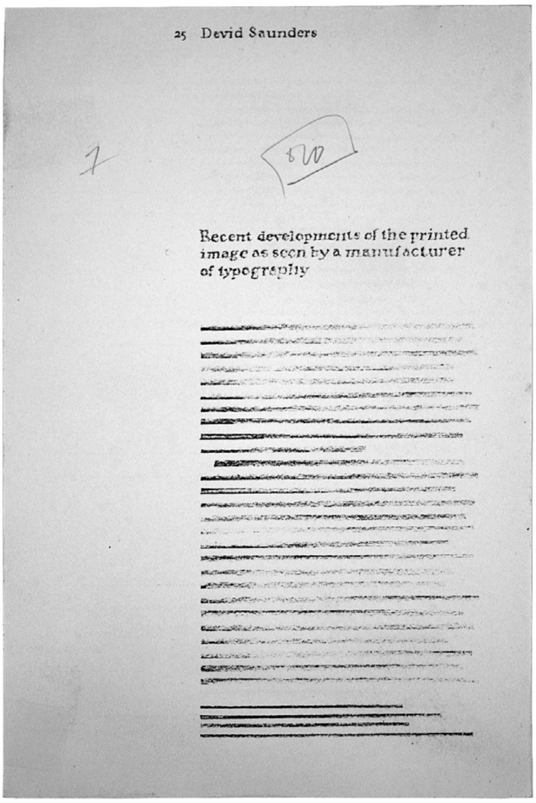
As during this week technology gets a great deal of attention, I would like to take a look at some of the things that are taking place in the background. The illusions you are going to see are not necessarily caused by present technological ~~problems~~ developments, though some are certainly stimulated by them. Neither does it mean that technology is at fault — but it is possible to use it wrongly. And although you do not suffer personally from many of these, they're of an epidemic nature.

I think that a number of illusions is clouding the true course which typography should take in these times of fast change. There are many more illusions than I will be able to show you in the course of this talk. I have tried to single out those causing most smoke. And I hope to be able to make some of the smoke lift, and to have an alphabetic amour meaning primarily: to be on good terms with the latin alphabet.

~~And I cannot give you any easy and direct solutions, as most of the problems need time, extensive research~~

~~at what is taking place behind the technology, affects technology and is affected by technology~~

Fig. 3.41 Manuscript of Gerard Unger's unpublished paper 'From typographic tangle to alphabetic amour'. Photographed by Norman Posselt [CC, CSC 030, box 5, folder 2].



25 Devid Saunders

Recent developments of the printed image as seen by a manufacturer of typography

Fig. 3.42 Mock-up of David Saunders' unpublished paper on 'Recent developments of the printed image as seen by a manufacturer of typography'. Photographed by Norman Posselt [CC, CSC 030, box 4, folder 3].

Wrolstad an appropriate response.[169] He then advised Bigelow not to 'punish' himself and his audience by pulling out, and encouraged him to reopen the talks.[170] However, in another unfortunate turn of events, Wrolstad passed away on 1 April 1987. In his final response to Greisner, Bigelow is clearly disappointed at the Board's 'reluctance' to provide funding for the proceedings, but concludes that with the death of Wrolstad it was ultimately impossible to publish the proceedings with *Visible Language* at all and put the second volume to rest.[171] Bigelow suspended his annual fees only temporarily and resumed his ATypI membership in 1989.[172]

Baudin was also disappointed by the outcome and acknowledged that it was apparently Bigelow's grant that sponsored his attendance of the Stanford seminar.[173] Of all the Board members, perhaps Baudin understood best the efforts that went into editing and producing a volume of such a conference publication. In fact, the 1973 *Dossier A–Z* (see 3.4.1), co-edited and designed by himself, was the Association's last publication before Bigelow's 1985 Stanford proceedings. In addition to his role at ATypI, Baudin was an active member of the Compagnons de Lure, for whose annual gatherings (Recontres de Lure) he designed and published a series of reports (also called 'dossiers').[174] Some speculation could be made with regard to the representation of metal type foundries on the Board: Greisner was the last CEO of Stempel, liquidated in 1986, followed by Haas, whose 400-year history ended in 1989.[175] The conflict of technologies during a transitional period must certainly be considered in this controversy.

After Bigelow had sent all the working seminar material, including manuscripts and typescripts of the unpublished papers (**figs. 3.41+42**), to the Cary Collection at RIT, he relocated to Rochester himself and began teaching there in 2006. A decade later, *Visible Language* editor Mike Zender invited Bigelow and Kevin Larson to co-edit the 50-year anniversary issue of the journal. This occasion became an opportunity to publish two remaining papers of the 1983 working seminar: those by Baudelaire on Fred and of Carter on the Camex LIP system as 'fascinating archaeological digs into the early history of digital type'.[176]

169 Translated from the original French 'un modèle du genre', in a letter by Baudin to Fehle, cc: Greisner, Hoffmann, 18 March 1987 [DTGC, ATypI collection, folder 'ATYPI Working-Seminare, 5) Stanford 1983'].

170 In a letter by Baudin to Bigelow, cc: Fehle et al., 8 May 1987, [Ibid.].

171 In a letter by Bigelow to Greisner, 14 May 1987 [Ibid.].

172 Membership inquiry by Bigelow to ATypI secretary Jung, 16 February 1989 [Ibid.].

173 In a letter by Baudin to Bigelow, cc: Fehle et al., 21 June 1987 [Ibid.].

174 Cockx 2016, p. 152. All of Baudin's Dossiers (including the 1973 ATypI publication) carry his distinctive handwriting. Also see Coline Sunier & Charles Mazé (eds.), *Dossier Fernand Baudin,* Brussels: Prix Fernand Baudin Prize ASBL, 2013.

175 The author writes about this period in 'Last man casting', in *Eye,* vol. 25, no. 98, London, 2019, pp. 76–81.

176 C. Bigelow, K. Larson, 'Reflecting on 50 years of typography', in *Visible Language,* vol. 50, no. 2, Cincinnati/OH, 2016, p. 8.

In the introduction to the published proceedings, Bigelow explains the contributions offered 'snapshots of an obscure landscape intermittently illuminated by flashes of lightning, in which we glimpse scenes of where we are heading, where we have been, and where we might be if we choose a different path.'[177] The 1983 working seminar at Stanford offered a state of digital type design, making it a highpoint of discourse and a milestone in a long period of transition. Although the names of John Warnock and Charles Geschke are not on the official participants list, their presence is confirmed by other sources;[178] in less than a year later they did choose 'a different path' by launching the page-description language PostScript which profoundly changed the industry once again in yet another turning point (see 5.3). Through its discussions on technology, the Stanford seminar established an environment in response to a new community. It is remarkable that this environment was established by computer scientists, not by typographers. The ATypI offered a framework for the seminar, but was not decisive in devising its programme. This is why Stanford must be considered as a catalyst for this change and not one of the previous working seminars.

177 Charles Bigelow, 'Introduction' in *Visible Language,* vol. 19, no. 1, 1985, p. 5.

178 Peter Karow recalls meeting Warnock and Geschke at the 1983 Stanford working seminar for the first time. Karow 2019, p. 112.

3.4.3. Discussions around digital type design systems

The previous sections of this chapter have laid the ground work in exploring an emerging community and its environment in which the Stanford working seminar took place. At the heart of the seminar programme were five digital type systems that could be used to create numerically encoded fonts. Central research questions for chapter 4 and 5 arise from the issues discussed during the demonstrations and use of those systems, as well as during the debates held in other sessions of the seminar. This section explores those issues discussed in order to establish a set of criteria under which these systems are investigated in the following chapters.

John Dreyfus, who insisted that the transition from hot-metal type founding to phototype technology in the 1950s posed a 'turning point' in type design (see 3.4.1), declared the industry had reached its 'second turning point' in his opening keynote in 1983.[179] To start the debate, he raised two central questions: 'What kinds of type designs are needed now?' and 'How ought we to approach the problems of designing new types, taking into account the technical changes of recent years and the altered structure of the services which now create printed matter?'[180] Almost all the issues discussed during those five days in August of 1983 relate to Dreyfus' questions in one way or another and in many cases the two aspects are linked.

In relation to these questions, especially to the latter, three issues were centred around the potential of digital type system: Turning ideas of letterform designs into numerical data. Correcting, editing and modifying this numerical data. Preparing the data for output, i.e. for display on monitors, for document composing systems or for an emerging variety of printers. Although there was some fundamental disagreement among the developers of digital type systems on how to deal with the first two issues, the preconditions for the latter were clearer, mostly because the demands to output formats were defined by third-party manufacturers (explained below).

Different models, approaches and formats

One of the fundamental discussions at the 1983 Stanford seminar was an evaluation of which approach could best serve the generating of digital letterforms. The digital type design systems under consideration at the seminar followed different approaches, but followed existing models of numerical description that had been explored during the previous two decades, some of which were based on pre-existing mathematical concepts. Different models, such as *bitmaps* and *outlines,* are not necessarily in competition as they fulfil different purposes. While the systems Fred, Ikarus and LIP evidently all follow the outline model, their developers chose different approaches in order to generate digital letterforms that could be stored in

179 Dreyfus 1985, pp. 13.

180 Ibid., p. 15.

very specific digital formats. These distinctions are relevant and the reasons for them may be based on several factors such as previous research, mathematical preconditions, maintaining aspects of typographic quality, economic issues tied to a business model and others. What kind of models were the systems based on? Which approaches did its developers pursue and why? What kind of aspects influenced those decisions?

Preconditions and motives

Years of research were typically involved in the development of new digital technologies from testing at prototypical stages to making them available for use and possibly implementing them in a larger business framework. Available research grants, academic goals, manpower and economic constraints are just a few possible aspects to consider depending on the environment in which a new system was conceived. The five systems presented at the working seminar exemplify the three most common of such environments: Metafont at Stanford and Elf at Cambridge are results of *academic research,* years of explorations at the scope of graduate and post-graduate programmes, supported by grants over a longer period of time; Fred is the result of industry research at Xerox PARC, a corporate research division of Xerox, developed for internal use and not necessarily with the aim to be integrated in the corporation's product palette; URW's Ikarus and Bitstream's Camex LIP were developed to immediately become *commercial products* in relatively short time spans to function within a specific business model in a competitive market. What did these environments look like and what is the background of the people working there?

In each case a system may have been devised in response to existing challenges or a set of research questions: e.g., the printing press existed before movable metal type was first made,[181] the line-casting machine was invented before typeface were designed for it,[182] therefore the ability to create digitally stored letterforms could have been developed as an echo of another technology and its preconditions. This raises the central question of what gave the impetus to devise digital type design system in the first place.

At the Stanford seminar, individual designers, educators and managers were given the opportunity to evaluate the systems for possible use in a studio, for further research and integration in academic teaching or for potential implementation in type manufacturing, respectively. The presence of Monotype's David Saunders and his unannounced talk marks the only representation of an established type

181 Heinrich Meisner, Johannes Luther, *Die Erfindung der Buchdruckerkunst,* Bielefeld/Leipzig: Velhagen & Klasing, pp. 7 f.

182 Willi Mengel, *Die Linotype erreicht das Ziel,* Berlin/Frankfurt: Linotype, 1955, pp. 40 f. (English title: *Ottmar Mergenthaler and the printing revolution*).

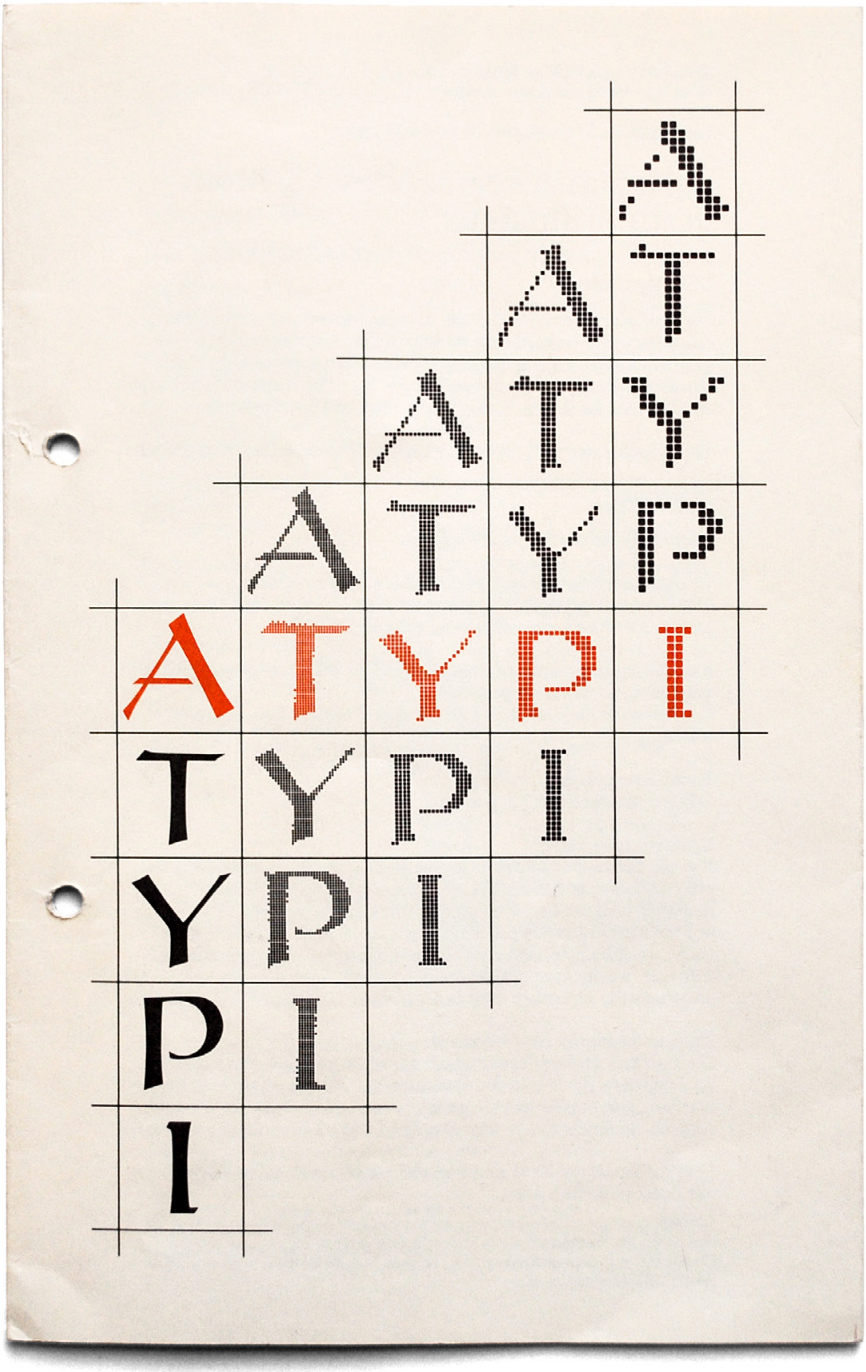


Fig. 3.43 Official announcement of the 1983 ATypI working seminar at Stanford University, designed by Jack W. Stauffacher with a logotype (seen here) by Sumner Stone. Photographed by the author [DTGC, ATypI collection, 'ATYPI Working-Seminare: Stanford 1983'].

manufacturer.[183] This perspective is particularly relevant in contrast to Matthew Carter's introduction of Bitstream as an independent 'digital type foundry' (an expression used during the 1983 seminar and even earlier in the *Seybold Report*), which opened up discussions about old and new ways of pursuing business in the type industry. Were the type design systems devised as a business idea within an existing, but rapidly changing industry? If so, what was the business model? In what kind of particular environment were the systems conceived? How long did it take its developers to devise a functioning system? Was is made for widely use and if so, by who?

Key aspects of quality

One of the main aspects discussed around digital type systems was the concern to provide digitally described letterforms at different resolutions, a theme visibly present in the seminar's announcement (**fig. 3.43**). The numerical data of letters had to be rendered on a 'raster' of single dots (pixels or bits in less colloquial terms) in order to be displayed on monitors or to be printed on so-called 'dot-matrix' output devices such as emerging laser printers. Because resolution on output devices was still comparably limited at the time, particular attention was given to generating low-resolution letterforms. Routines to make these adjustments were integrated in each of the systems, but the methods were quite different.

Overall, this debate was marked by a lack of an established terminology. Bigelow, who had written the aforementioned substantial piece on the principles of low-resolution type, introduced a handful of 'exotic terms' such as 'aliasing', 'sampling', 'filtering' and others, as an 'ordinary-language way of talking about the issue' had not yet been established.[184] Almost every developer of digital type systems used their own, sometimes proprietary terms to describe this process of converting outlined letterforms into bitmaps, although 'rasterizing' was common.[185] The component of the system that could performs this operation is referred to as raster image processor (RIP).[186]

It is precisely the issue of resolution and rasterizing that sparked the conversation around the opening question of 'What kinds of type designs are needed now?' — all of the type designers who spoke at the seminar, touched upon this issue. Concerns of established type manufacturers were centred around the prospects of adapting large existing libraries of printing types for new technologies. Gerard Unger proposed, the suitability of types for digital adaptation and for output on

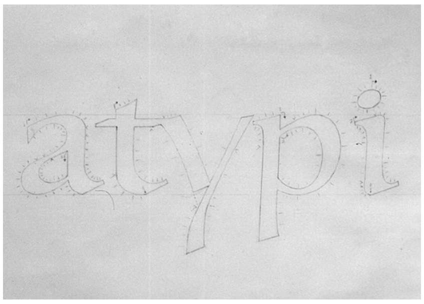
183 See Saunders 1983.

184 Bigelow 1982, p. 3.

185 Burke suggests that the word 'raster' was introduced from German, where it can be used for a photographic 'screen' as well as for a 'grid'. In correspondence with Christopher Burke, 10 February 2023.

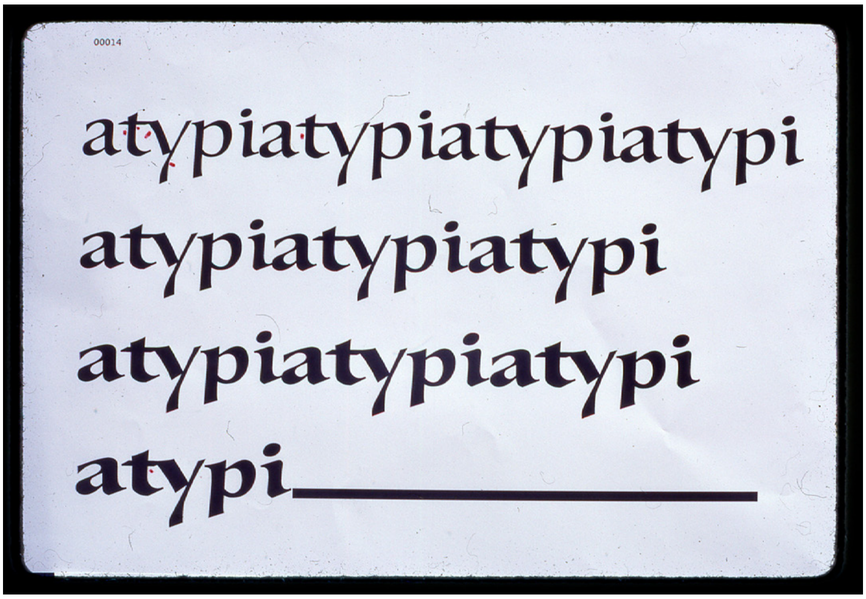
186 Bigelow 2020, p. 8.

A

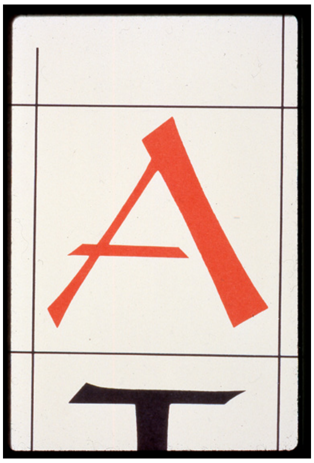


B

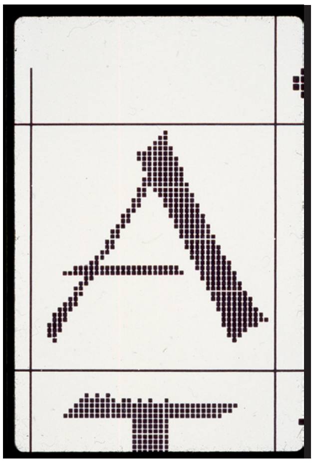
C



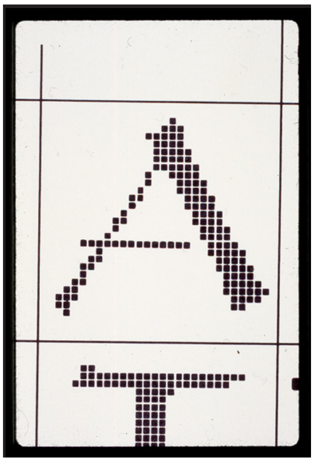
D



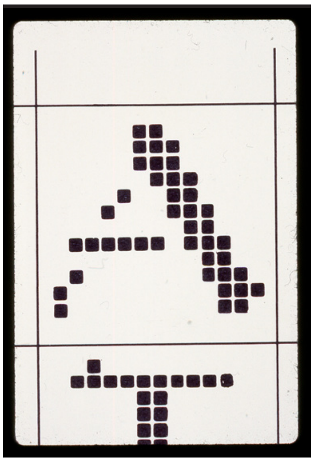
E



F



G



H

Fig. 3.44 A selection of slides from Sumner Stone's 1983 working seminar presentation: (A) initial edged pen sketches for a first design idea; (B) pencil redrawing of the initial appearance specifications with Ikarus digitization points; (C) rubylith frisket of the digitized letterforms; (D) interpolated instances between two digitized extremes; (E) another design idea; (F–H) closeups of final shape rasterized at different resolutions. Reproduced by Sumner Stone [SSt].

low-resolution dot-matrix printers ought to be evaluated on a case-by-case basis; while Century Schoolbook, a sturdy early 1920s text typeface by Morris Fuller Benton, could 'stand a rough time', he argued that Optima, a serif-less roman by Hermann Zapf from 1958, would 'suffer':

> Optima is a delicate typeface not suited to this technique at all. Because Optima is popular at present, it is thought to be a compulsory issue, although there are similar designs which will suit this system much better.[187]

Zapf who touched upon this issue at the example of Optima himself, concluded:

> The design must be reduced to a heart-breaking compromise. The answer to this problem is that Optima was never designed for digital storage. If I had been asked, I would have done a new design, used another principle and another name, but have tailored it to the needs and limitations of today's requirements.[188]

These discussions reveal reflections of design decisions and the challenge to maintain established aspects of quality. Although the new technology posed significant challenges on existing designs through the practice of rasterization for low-resolution output devices, it also offered new possibilities in automated character modification and automatic extension of weights. Type designers tried to find a balance in meeting these new demands, while also considering previously known concepts such optical sizes. These implications are considered in chapter 5.

Creating letterforms

Although Bigelow expressed hopes that designers would be able to concentrate on their designs, instead of on the technical aspects of the systems during the seminar,[189] the merits of those systems were often measured on the ability to interact with them. In question-and-answer session after each demonstration these merits were fought over fierce debates; in one instance a 'somewhat acerbic exchange' between Kindersley and Zapf on behalf of Elf and Metafont respectively.[190] The interactive nature of each system was very different, depending on hardware components such as light-pens on vector display screens, digitizing tablets or standard keyboards, as well as software features such as a user interface and the ability to control the programme through a set of predefined routines. These preconditions are explored in more detail in chapter 4.

187 Unger 1983, p. 13. Eventually this realization led to Unger's development of Amerigo, a typeface released with Bitstream.

188 Zapf 1985, p. 29.

189 Working seminar proposal by C. Bigelow, undated, c. 1981 [DTGC, ATypI collection, folder 'ATYPI Working-Seminare'].

190 Pankow 1984, p. 8.

At the seminar, the ability to create the same design using different systems was demonstrated vividly with the example of the seminar's 'ATYPI' logotype. While Sumner Stone presented his production process using Ikarus to achieve the final result (**figs. 3.44**), in use on the announcement as well as on posters (the results are slightly different), the audience was lectured by Knuth on how this could have been realized using Metafont. The Stanford seminar logotype visualises five stages of the same acronym at different resolutions, gradually transforming from a crisp contour to a coarse bitmap. Stone's presentation slides show analogue sketches of three different directions the design could take before digitizing one of those drawings on a digitizing tablet.[191] As Stone recalls, after his talk, Knuth was 'shocked' that he had tried different design approaches, as he (Knuth) would never do that, but stick with one approach until it worked.[192] At the end of his own presentation, Knuth invited the audience to participate in a 'thought process', using Stone's logotype as an example of how it could have been created alternatively with the underlying principles of Metafont, by identifying the letters' key characteristics and writing parametric algorithms for them (see 5.2.2):

> Of course we could simply trace the outlines of the letter; but that would not be any fun, and it would not give us any insights. Let us rather try to embed the principles of Sumner's design into a specification that will produce lots of beautiful letters.[193]

This case study is an example of different mentalities supported by the use of different systems. Stone did not claim to design a complete alphabet, but a design combination of five letterforms in a specific context. Knuth on the other hand, did not start with an idea in his mind, but with a design already conceived by Stone, reverse-engineering it by means of parametric algorithms that would allow him to generate the remaining 21 letters. These are two different design briefs and different approaches altogether. At the example of such case studies, the underlying approaches of different digital type systems are best described. They engage in a central aspect, which Stone formulated in his talk: the 'dilemma of breathing life into the letter forms which are expressed ultimately as a pattern of ones and zeros'.[194] How can an idea in someone's mind be translated into numerical description? What kind of hardware is needed? Are specific tasks better realized by certain systems? What kind of designs can be realized? If a system is used to digitise existing drawings, can it be considered a *design* system at all?

191 Presentation slides of Stone's Stanford talk on 'The ATypI logotype: a digital design process', 5 August 1983 [SSt].

192 Sumner Stone in correspondence with the author, 27 February 2017.

193 Knuth, 1985, p. 47.

194 Stone 1983.

Image redacted

Fig. 3.45 Punchcutter August Rosenberger (left) cut the metal typefaces of Hermann Zapf for over two decades, from the late 1930s to the late 1950s. Both are seen here at the D. Stempel type foundry in 1956. Photograph by Valter Falk, reproduced from Zapf 1996, p. 9.

Image redacted

Fig. 3.46 Donald Knuth and Hermann Zapf explored the possibilities of digital type using Metafont at Stanford University. Photograph by Charles Painter, Stanford News Services.

Image redacted

Fig. 3.47 Veronika Elsner instructed fellow type designer Freda Sack in the use of Ikarus during the installation of workstations at Sack's employer TSI Letraset, London. Photographer unknown, reproduced from Daines 1981, p. 21.

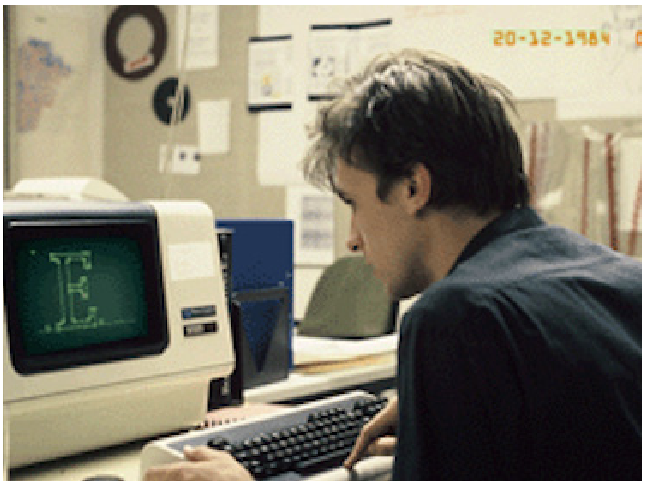


Fig. 3.48 Independent type designer Martin Majoor learned to use Ikarus during an internship at URW in Hamburg in the Winter of 1984. Photograph by Wim Westerveld [MM].

Collaborations and relationships

In his opening remarks, Dreyfus described the working seminar as a coming together of engineers and designers 'for future cooperation in type design'. Based on their approach and possible business models, engineers had a different idea of what this cooperation with designers could look like. For designers this was also a generational question, based on their experience in previous decades. Zapf was familiar with type manufacturing during the metal type era, when designers depended on punch cutters who would carefully interpret their drawings in steel. His relationship with August Rosenberger, head of the punch-cutting department at the D. Stempel type foundry was considered one of mutual respect that lasted for over two decades (**fig. 3.45**).[195] With the implications of such a relationship in mind, Knuth formulated his thoughts on future cooperation:

> I am not proposing that letter designers suddenly abandon their traditional ways and learn all about computer programming; I am proposing that they team up with computer scientists the way they used to collaborate with punch cutters.[196] (**Fig. 3.46**)

In how far was the relationship between designers and computer scientists comparable to that with punchcutters? The communication between designers and the producers of type is identified as a central issue by Southall.[197] What were these relationships like? How were these connections established and how long did they last? At the same time, a new generation of designers began to question the levels of interpretation rooted in this communication and expressed an interest in operating digital type design systems by themselves to become more independent (**fig. 3.47+48**).

Hidden and forgotten contributors

In the introduction to this chapter the risk of tapping into a 'canonical history', as described by Southall and Kinross, has been mentioned. One aim of this thesis is to mention and introduce figures who have been overlooked or may not have received the recognition in accordance with their contributions. The notion of *one* mastermind behind an idea is an antiquated concept, instead achievements of teams should be acknowledged to reveal names beyond the usual suspects. While the speakers list of the Stanford seminar reveals several popular names, some of those figures were still at the beginning of their careers in the early 1980s. One name

195 See Zapf 1996.
196 Knuth 1985, p. 36.
197 Southall 2005, p. 32.

that stands out is Veronika Elsner, not least because she was the only female speaker in the line-up.[198]

Elsner embodies two groups during the time period investigated here: an emerging generation of young graphic designers who are interested in the technological aspects of type manufacturing and are willing to collaborate with engineers and computer scientists. In Knuth's words, she represents a group of individuals 'growing up with feet solidly grounded in both worlds'.[199] The presence of Elsner also symbolises an increase of women represented in the typographic industry, not merely at entry level, but in leading positions and eventually as founders of new businesses. This notion and the contributions of other female type designers at the time has previously been explored by Nancy Stock-Allen.[200] Who are the emerging designers who have not received much attention? What are the names of assistants, overshadowed team members and otherwise hidden figures who contributed to the developments of digital type systems?

198 When Elsner first met Karow at the 1975 ATypI congress in Warsaw she was still a graphic design student at Fachhochschule Hamburg (today: Hochschule für angewandte Wissenschaften, HAW). Karow 2019, p. 59.

199 Knuth 1985, p. 36.

200 See Stock-Allen 2016.

3.3. Conclusion

The introduction of new technologies in the 1960s coincides with the rapid formation of environments of discourse of an emerging community: the establishment of multiple associations that offered new formats of discussion and exchange, publications that engaged in the development of digital type systems, and reform of typographic education in the acadmic landscape as computers arrived on campuses. The ATypI stands out as a key environment of discourse with different interest groups and with the ability to bring together communities from overlapping disciplines. Many of the Association's activities at the time are reflected in *Visible Language,* a relationship that was closely maintained and fostered during this period of transition and change.

Through the 'working seminar' format, a series of events with emphasis on discussions and hands-on demonstrations, the ATypI established a counterpart to its annual congresses that had addressed mostly representatives of large-scale manufacturers, and reached out to a younger audience as well as neighboring disciplines. This convergence of industry, education and technology culminated in the 1983 ATypI working seminar at Stanford University, an event that must be regarded as a milestone in a long transition.[201] The debates held there set the tone for the coming decade; as it initiated a 'digital culture' and built new relationships between designers and computer scientists, the 1983 working seminar set in motion discussions over the most pressing issues of typographic quality and the challenges of technology. At the heart of debate, the working seminar was centered around five digital type design systems. The following chapter explores their underlying methods of numerical description and then investigates these approaches one by one under consideration of a range of primary sources that have previously not been assessed.

201 The methodology introduced in chapter 2 and the investigation made along the way revealed the discovery of the 1983 ATypI working seminar as a key environment of discourse. The case could be made for another event at another place and time; three months prior to the Stanford working seminar, the Institut National de Recherche en Informatique et en Automatique hosted a conference on *La manipulation de documents,* organised by Jacques André at the Universitaire de Beaulieu in Rennes (4–6 May 1983), where similar discussions were held around the examples of digital document design systems. The published conference proceedings reveal over twenty contributions, among them papers by Patrick Baudelaire, Charles Bigelow, Adrian Frutiger and Ladislas Mandel. See J. André, *Actes des journées sur la manipulation de documents,* Rocquencourt: INRIA, 1983, and André 1985.

4. Investigating numerical models

The previous chapter explored the emergence of a field through a new community that began to take shape during the early transitional period of digital type. In focused sections it shed light on environments of discourse that allowed this community to reach out to neighbouring disciplines through just a handful of publications, congresses and a working seminar format that enabled exchange and addressed urgent issues of a rapidly evolving field. The end of the chapter introduced some of the main talking points and vivid discussions held at the 1983 ATypI working seminar at Stanford. This chapter investigates five digital type systems at the heart of those discussions. At the time of their demonstrations at Stanford, two of them had already been around for almost a decade, two more were half that age and one of them was barely two years old. All of them are based on numerical models and share challenges and issues that designers of digital type faced in the 1970s and early 1980s.

In order to assess these *models* and their implication on aspects of digital type in a consistent terminology, this chapter considers a framework of overarching *methods* used to describe letterforms numerically in section 4.1., while the following section 4.2. explores different *approaches* that exploit these methods at the example of specific *systems*. The term *system* typically refers to an entire set-up of (sometimes proprietary) hardware components that enable a software *application* to run.[1] The application can produce at least one or a variety of output *formats*. At the heart of a system these formats refer to the actual encoding of letterforms.

A handful of published and unpublished studies have previously provided overviews of numerical models of digital type, most notably Charles Bigelow (1983, 2020), Kathleen Carter (1986), Peter Karow (1987), Richard Rubinstein (1988) and Richard Southall (1997, 2005). Unfortunately, the terminology used to refer to different numerical models is inconsistent; these differences are acknowledged at the beginning of each section. It is also necessary to presume the biases of each author; apart from Rubinstein each were at some point in their careers associated with one of the systems explored in this chapter. This is pointed out when it is relevant.

Over the course of the twentieth century, the central objective of processing and typesetting text in paragraphs on paper remained the same, even though the technological means of doing so changed profoundly. With the emergence of digital technology, new standards had not yet been established, which is why section 4.1. investigates preconditions and possible influences. Another central research question addresses the place of type designers during this radical and rapid transition.

1 The notion of a system fades with the rise of personal computers, after which several applications could be utilized by the same hardware equipment, especially through PostScript, see 5.3.

4.1. Numerical description for letter-like shapes

The methods of numerical description assessed in this section are linked with the emergence of computer graphics at the beginning of the 1960s. During an earlier transition from metal type to phototype, heavy type cases and brass matrices were replaced by representation on film strips and matrix discs, significantly reducing the weight of a composing room. With the introduction of numerical description, letterforms lost all of their remaining weight, a process referred to as *dematerialization*. Therefore, 'numerical description' refers to the encoding of letterforms in binary codes or other digital formats.

Three different methods are the subject of investigation: bitmaps, outlines and parametric algorithms. Similar arrangements are found in the literature cited in the introduction: Kathleen Carter describes three primary kinds of 'representations' of digital type: 'bit maps', 'outlines', 'parametric representations'.[2] Bigelow differentiates between three 'ideas' in his own grammar: mosaics, outlines, structures.[3] Rubinstein speaks of three different 'tools': bitmap, outline, algorithmic. Southall categorizes them as 'numerical techniques', while Karow summarizes them all under 'formats' and, as the original German title of his book suggests, is generally more concerned with storage than with underlying concepts.[4] His list of formats is accordingly longer (bitmaps, run-lengths, vectors, curves, segmentation, Metafont, etc.), mixing methods, approaches and applications under one umbrella term, which is not found to be a helpful technique in comparing and cross-examining them in chapter 5. This chapter follows the structure established by the majority of authors. Throughout this thesis, the consistent use of the terms *representation* for physical carriers of type (metal sorts, brass matrices, filmstrips, etc.), and *description* when type is encoded by numerical means, follows a distinction cultivated by Southall.[5]

The models are primarily assessed with regard to resolution, which addresses the issues of scaling type in various sizes. Some of the models can be explored best by looking at early applications that utilized them. As has been established in the previous chapter, the typographic community was no harbour for an environment that celebrated explorations into mathematics and computer science. A central question of this section is therefore dedicated to the origins of each method. Some of these may not have been concerned with letterforms initially, which is why emphasis lies on 'letter-like' shapes, not on letters per se.

2 Carter 1986, p. 13–18.

3 Bigelow 2020, p. 8.

4 In the original German edition Karow's book is titled *Digitale Speicherung von Schriften* (1986), which translates to 'digital storage of typefaces', but was changed to *Digital formats for typefaces* in the English version.

5 Southall 1997, p. 32.

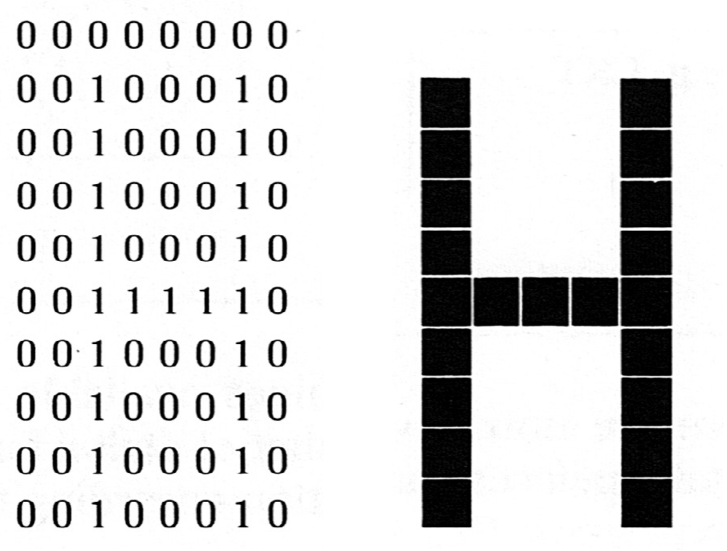


Fig. 4.1 Binary encoding of a low-resolution bitmap sans serif 'H'. Reproduced from Karow 1987, p. 70.

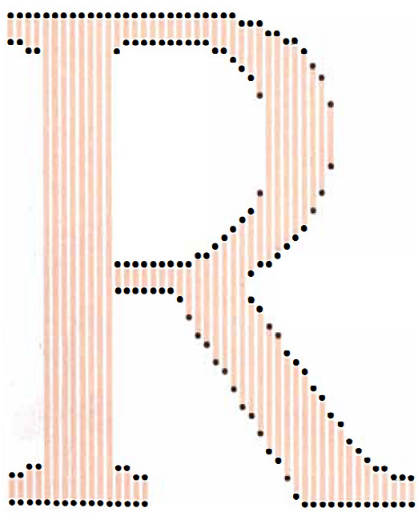


Fig. 4.2 Vertical run-length encoding. Reproduced from Bigelow 1983, p. 118.

4.1.1. Resolution-specific: bitmaps

In the earliest and most basic numerical method of letterform description shapes are electronically stored by means of single 'picture elements', better known as bits or pixels. Single-bit pixels, either black or white, are arranged in a raster of horizontal and vertical parallel rows, a two-dimensional pattern array also known as dot-matrix.[6] The resulting pixel-based images are called bitmaps. Storage of bitmaps follows a simple binary encoding of ones and zeros, either on or off, black or white (**fig. 4.1**). With higher resolution and therefore with larger bitmaps these values increase significantly. A more compressed format counts successive lines of ones and zeros and stores them in 'run-lengths'. This format can be described in either horizontal or vertical alterations of black and white, although the latter is more common (**fig. 4.2**).[7]

In applications of this concept shapes are composed of any number of bits and are considered high- or low-resolution depending on how smooth or coarse the underlying raster is. The resolution-specific nature of bitmaps is a fundamental characteristic with implications for storage and for quality in appearance. The resolution of bitmap shapes is specific to an intended size: some bitmap letterform provide enough resolution for a small range of sizes, but cannot be scaled upwards endlessly before they reveal the ragged contour of assembled squares.[8] Although numerical outlines offer significant improvement to resolution and storage size (see following sub-section 4.1.2), their method should not be regarded as a replacement of bitmap description per se. Outline description is rasterized for most final output on dot-matrix printers and for appearance on screen.

Two preconditions for the description of bitmap shapes in digital typesetting are the principle of breaking up letter-like shapes into single bits and the ability to store those results on a display device. The first aspect was demonstrated in an apparatus called *Typenbildfernschreiber,* a facsimile-based teleprinter introduced by the Kiel-based company of German engineer Rudolf Hell in 1929.[9] More often referred to as *Hell-Schreiber* (Hell writer), this device electronically decomposed

6 In much of the literature 'matrix' is often used synonymously with 'raster', but should not be confused with the matrix that is used as a template in font production (see 5.1.).

7 Karow 1987, p. 75.

8 Southall suggests, bitmap fonts could normally be scaled to a 2:1 or 3:1 range of sizes for character output, see Southall 1993, p. 88 f.

9 Although initially developed for landline press services, it was also used by the German military in WWII. In the 1930s it was mass-produced by Siemens who continued to produce new models of Hell after the war. Siemens eventually acquired Hell in 1981.

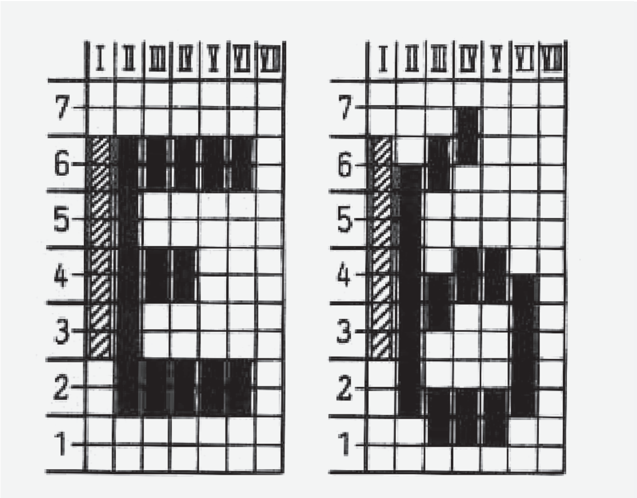


Fig. 4.3 Details of the 7×14 (7×7) Hell-Schreiber bitmap matrix. Reproduced from Siemens & Halske AG, *Siemens-Hell-Schreiber 'GL',* technical manual St Bs 1211/2, October, 1955.

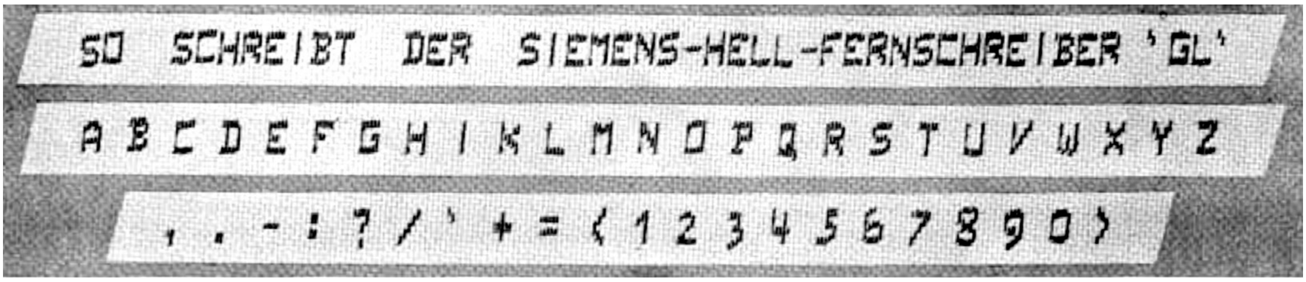


Fig. 4.4 The standard Hell-Schreiber alphabet in reversed stroke contrast and distinct hanging figures, design decisions made in favour of reducing signal errors in transmission. Reproduced from Siemens & Halske AG, *Siemens-Hell-Schreiber 'GL',* technical manual St Bs 1211/2, October, 1955, p. 3.

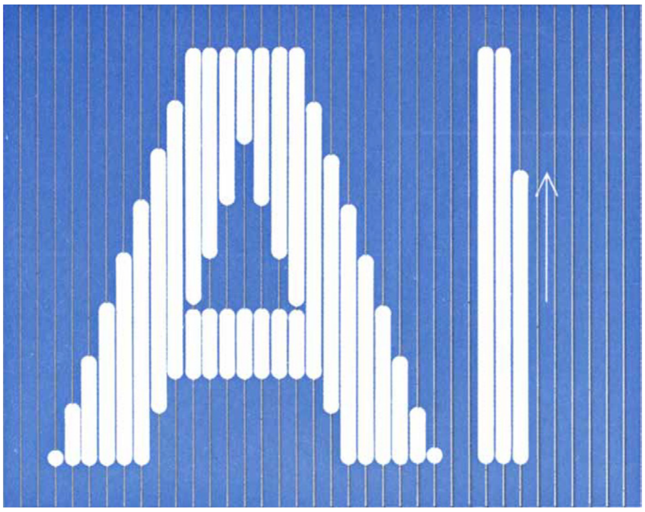


Fig. 4.5 The electronic beam 'paints' vertical lines of letterforms on a cathode ray tube. Reproduced from Walter 1968, p. 68.

letterform fragments to then transmit and re-assemble them in another location.[10] A standard capital alphabet is constructed on a raster of 7×14 units, two vertical units count as one command for transmission (**fig. 4.3**).[11] The design's mono-spaced structure considers side bearings as well as two pixels above and below the capitals, enabling overshoots for so-called 'hanging figures' (usually for better legibility). This feature as well as the character's reversed stroke contrast on such a coarse raster must be regarded as quite sophisticated design decisions in favour of legibility and of the reduction of transmission errors (**fig. 4.4**). More importantly, this device anticipats the idea of assembling letterforms from single dots.

Before they were used to generate letters, computers had been introduced to various processing aspects of phototypesetting systems during the 1960s, some of these developments even begin with the use of punch-tape-operated mechanic casting machines. Romano documents the entry of computers by various manufacturers in much technical detail.[12] The so-called 'second-generation' phototype era is explored by Alice Savoie at the example of Linotype, Monotype and the Lumitype Photon.[13] Models such as the Photon Zip or the Linotron utilized computer speed to increase output, but are still categorized as second-generation devices for combining 'mechanical systems with some basic electronics'.[14] It is the ability to electronically display letterforms on a cathode ray tube (CRT) what distinguishes 'third-generation' phototypesetters from those preceding machines. Characters appeared on the CRT by 'swinging' a built-in electronic beam to create sets of tight vertical lines of varying length (**fig. 4.5**), which has led Walter to refer to them as 'painted' on screen in his aforementioned paper in a 1968 issue of *Scientific American,* that raised some awareness of the topic in the typographic community and beyond (see 3.3.).[15] Many of the technical considerations of CRT devices are thoroughly discussed by Romano.[16]

One early example of the ability to store single bits on a CRT was demonstrated by Tom Kilburn and Freddie Williams at the University of Manchester in 1947, who

10 Conventional teleprinters (or teletypewriters) at the time used arbitrary codes. Whenever an error was transmitted, no character could be displayed. With the bitmap-based Hell-Schreiber however, a signal failure merely resulted in the lack of a single pixel, not in the lack of a complete character.

11 Each vertical stroke of two pixels is assigned to a segment on a camshaft used for transmission. See Siemens & Halske AG, *Siemens-Hell-Schreiber 'GL',* technical manual St Bs 1211/2, October 1955, p. 2.

12 See Romano 2014, pp. 133–158.

13 See Savoie 2014.

14 Ibid., p. 99.

15 Walter 1968, p. 68.

16 See Romano 2014, pp. 191–224.

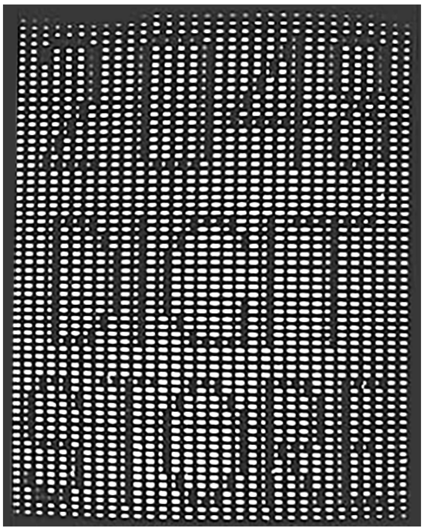


Fig. 4.6 Probably the first bits stored on a cathode ray tube, by Kilburn and Williams at the University of Manchester in 1947. www.digital60.org

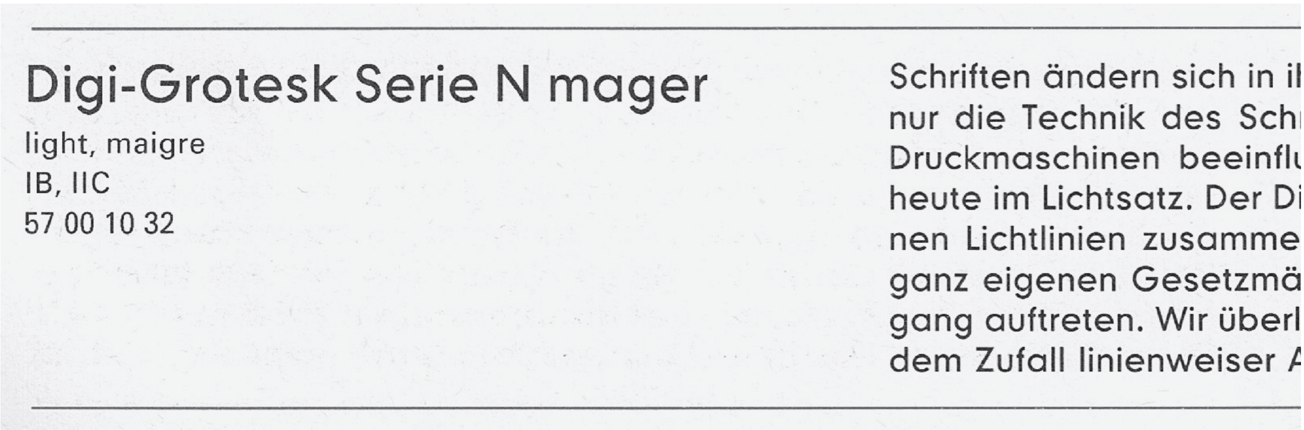


Fig. 4.7 Digi Grotesk (formerly Hell Groteskschrift), revival of Stempel's Neuzeit Grotesk (1932) was probably the first digital font stored on the Digiset. Reproduced from *Hell Index of typefaces*, no. 2, 1980.

successfully displayed capital letters on a 32×64 screen.[17] On a relatively coarse grid at a cap height of 16 units these bitmap letters expose the challenge of rough-edged diagonals, bows and the optically uneven contrast between vertical and horizontal strokes (**fig. 4.6**). This exercise served the purpose of proving that letter-like shapes could be displayed at all. Typographic improvements depended on technological advances. Twenty years later, Holland concludes in a study on CRT systems:

> The most important thing in this new technique, for both user and maker of the equipment, is to agree on what is the *lowest* number of picture elements per character [...] that will produce tolerable typographic standards in the final printed result.[18]

The resolution of CRTs in the 1960s was sufficient enough to adequately render adaptations of existing types at text size. Early CRT models such as the Linotron 505 still required character storage of photo-matrices such as film strips or matrix disks (depending on the manufacturer), while later models abandoned these physical carriers in favour of storage by numerical means. The 'dematerialization' of type ignited a transitional technology known as digital photocomposition; the typesetting machine Digiset 50T1, introduced by Rudolf Hell in 1966, is perhaps the most prominent example of that era.[19] It stored digital pixel images of letterforms for composition on a CRT, then beamed by spots of light for exposure on film, creating a sharp image of higher quality than most results of phototypesetters at the time.[20] After introducing the Digiset, Hell initially built a library of digital adaptations of existing typefaces, licensing some popular designs such as Akzidenz Grotesk, Bodoni, Garamond and Univers from their established competitors. The first complete font produced for the Digiset was probably Digi Grotesk N (initially called Hell Groteskschrift), developed between May and July 1966, which is essentially the first digital revival of the 1930s classic Neuzeit Grotesk (**fig. 4.7**).[21] Technicians at Hell encoded the type by transferring enlarged letter shapes to a dot-matrix using binary values for each coordinate and then stored that description.

17 See website of the anniversary event *Digital 60 Manchester: 60 years of the modern computer*, available at <http://curation.cs.manchester.ac.uk/digital60/www.digital60.org/rebuild/50th/gallery/gallery1/index.html#bits2048> (last visited 17 May 2021).

18 Holland 1967, p. 72.

19 Rudolf Hell first publicly spoke about the Digiset at TPG Paris in June 1965. A prototype that was not yet operational was unveiled at Messe Hannover on 23 April 1966. The first fully operational machine was sold to RCA in June 1966. It was distributed to and made popular by RCA under the name Videocomp in the United States.

20 In the original German the term 'Lichtsatz' (literally 'light-setting') is used to describe this hybrid technology of digital photocomposition. Ironically, 'Hell' translates as 'bright'.

21 *Zeitablauf der Digisetentwicklung,* a timeline documenting the Digiset project available at <www.hell-kiel.de/images/media/Techn_Daten/> (last visited 12 May 2021). Neuzeit Grotesk was originally designed by Wilhelm Pischner for the D. Stempel type foundry in 1932. Earlier trial letters for the Digiset were based on a Garamond style, developed in February 1965.

Image redacted

Fig. 4.8 Optical scanning of a 'type grid card' on a Hell scanning device with punch-tape output. Photographer unknown, reproduced from a Hell brochure [DTGC, special collections].

Image redacted

Fig. 4.9 'Do it yourself': numbers and positions of a custom character are transferred to a coding list as a basis for punch-tapes. Photographer unknown, Reproduced from a Hell brochure [DTGC, special collections].

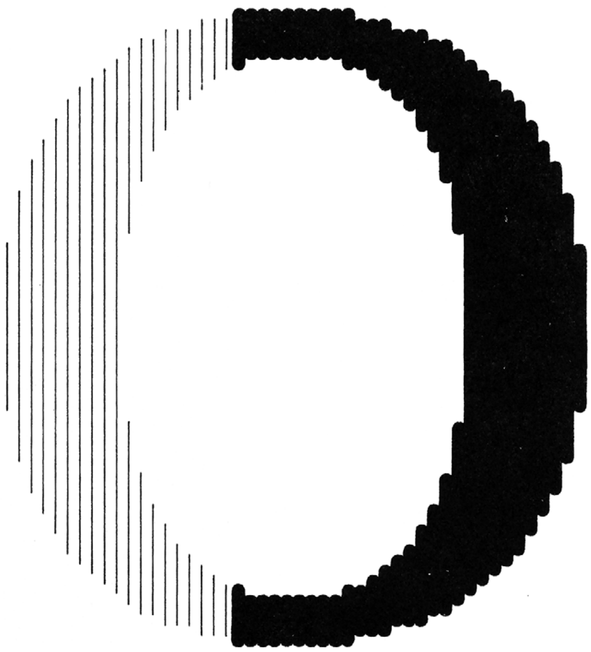


Fig. 4.10 Soft-edge effect of a Digiset bitmap character on photographic output material. Reproduced from Unger 1979, p. 135.

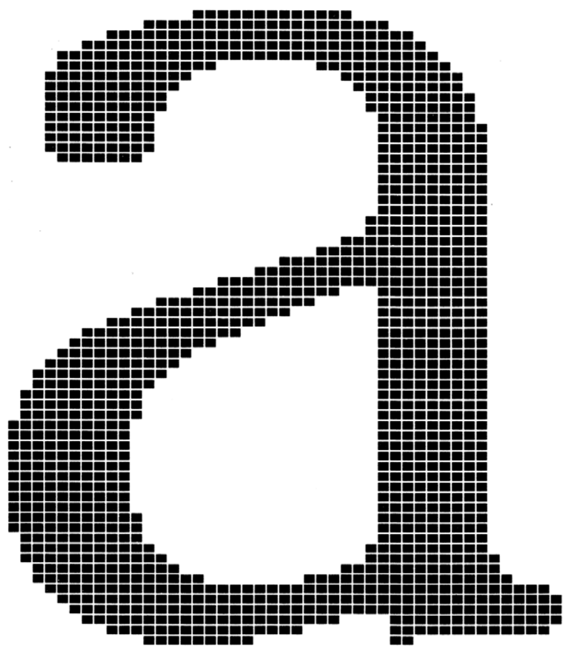


Fig. 4.11 Blown-up bitmap character of Gerard Unger's Demos. Reproduced from Unger 1979, p. 137.

Alternatively, large character masters were captured through optical scanning (also manufactured by Hell, **fig. 4.8**) and then edited by hand. By 1970, this manufacturing process was considered so 'easy' that customers could use a template to create their own Digiset characters for conversion into a digital format by operators at Hell, a service offered at the speed of two hours per letter for 'just a few hundred marks' (**fig. 4.9**).[22]

The issue of developing specific sizes became apparent to Hell after a series of trial letters were developed on a comparably low resolution of a 30×30 raster. As a result, Hell re-established the tradition of optical sizes by introducing different raster templates for pre-defined size ranges, starting at 50×120 for the smallest sizes.[23] Adjustments to letterforms of the same design with regard to different intended sizes is a continuation of a central concept rooted in the metal type era that had vanished in most photocomposition systems. The reconsideration of optical sizes in digital type is discussed in sub-section 5.2.3.

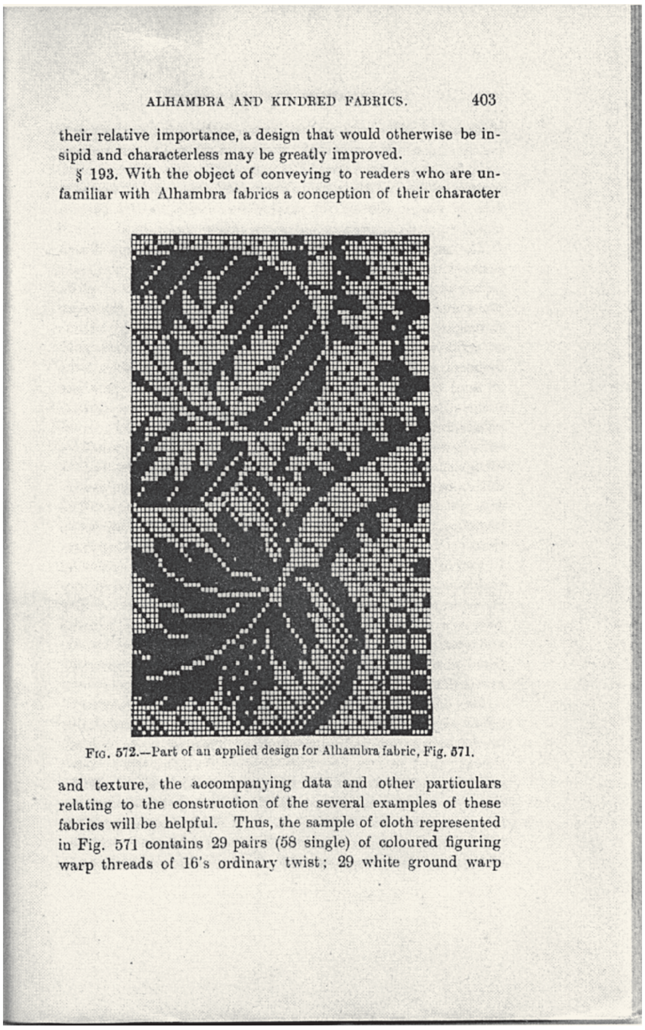
In the early 1970s, Hell appointed Max Caflisch as typographic advisor in an attempt to improve its type department, headed by Roland Fuchs and Peter Käpernick. Eventually Hell commissioned Hermann Zapf in 1971 and Gerard Unger in 1974 to design new original typefaces exclusively for the Digiset machine. The 1976 quartet of Marconi and Edison by Zapf as well as Demos and Praxis by Unger can be considered the first set of original, commercial digital typefaces. The manufacturing process required both designers to produce analogue bitmaps from initial drawings on a 100×120 template, an intermediate resolution intended for sizes between 8 and 16 point. Similar to the 'painting' of characters on a CRT, the Digiset photographically exposed the stored bitmap information from vertical lines on photographic output material, which left a 'soft edge', i.e. a gradual transition between positive and negative areas, which provoked the 'rounding off' and 'filling up' of corners — Unger considered and anticipated these features in his design of Demos (**fig. 4.10**).[24] Anecdotes by the type designers reveal that Zapf used white-out to fill the 'negative' space on the character templates, while Unger followed the opposite approach by filling every black pixel by hand (**fig. 4.11**).[25] Their technical and aesthetic considerations in this process are generally well documented. In their own words by Zapf who recalls, this task was 'no joy for a type designer' in a

22 R. Fuchs, 'Do it yourself: Die Herstellung von Schriftzeichen für den Digiset', in *Klischograph,* vol. 15, no. 1, Kiel: R. Hell, 1970, p. 13 f.

23 Divided up in five optical sizes ranges (labeled I–V), Hell eventually implemented several templates for resolutions ranging from 50×120 (4–8 pt) to 800×1920 (129–255 pt) units. Range II, 100×120 units marked the standard resolution for sizes 8–16 pt. See Rudolf Hell GmbH, *Lichtsetzanlage Digiset 40 T* (technical manual), Kiel, 1977, p. 8.

24 Unger 1979, p. 135 f.

25 See literature in the following two footnotes. According to Karow, it is irrelevant whether ones and zeros are set to black and white or vice versa in the scanning process of these bitmaps. Karow 1987, p. 71.


ALHAMBRA AND KINDRED FABRICS. 403

their relative importance, a design that would otherwise be insipid and characterless may be greatly improved.

§ 193. With the object of conveying to readers who are unfamiliar with Alhambra fabrics a conception of their character

Fig. 572.—Part of an applied design for Alhambra fabric, Fig. 571.

and texture, the accompanying data and other particulars relating to the construction of the several examples of these fabrics will be helpful. Thus, the sample of cloth represented in Fig. 571 contains 29 pairs (58 single) of coloured figuring warp threads of 16's ordinary twist; 29 white ground warp

Fig. 4.12 Unger references H. Nisbet's *Grammar of textile design* (1927) as a source of inspiration. Reproduced by Gerard Unger [GU].

Fig. 4.14 This alphabet (1591) from the collection of Giovanni Ostans is an astonishingly early example of more sophisticated handling of stroke contrast and diagonals at different angles. Reproduced by the author from L. F. Day, *Alte und neue Alphabete,* Leipzig: Hiersemann, 1906, p. 180 [ES].

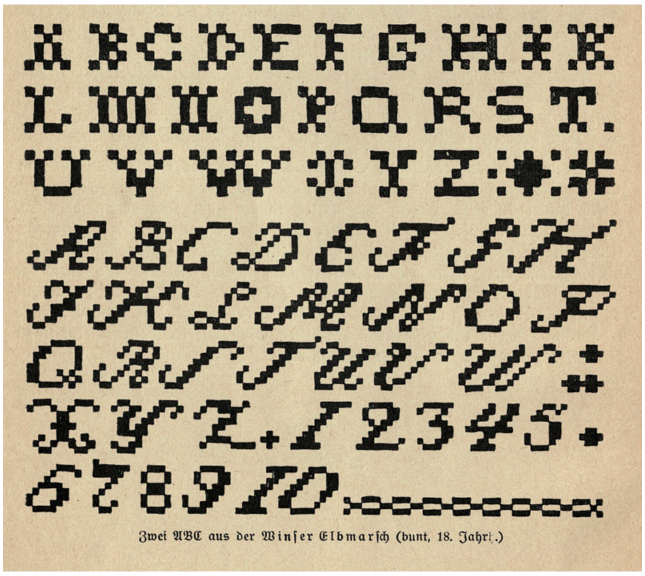


Fig. 4.13 Specimens of upright and cursive alphabets for embroidery from the second half of the eighteenth century, challenged by stroke contrast, slopes and swashes designed on coarse grids. Note the upright '8' in the cursive alphabet. Reproduced by the author from S. Lehmann, *Niedersächsische Stickmuster,* Hanover: Kusedruck, 1936, p. 8 [FU].

Gutenberg-Jahrbuch,[26] and by Unger who describes the attempt in matching his 'own desire for aesthetic as well as perceptual quality with the necessary restrictions of technology' in the aforementioned paper in *Visible Language* (see 3.3.).[27] A much more comprehensive investigation of all of Unger's designs for the Digiset has recently been produced by Burke.[28] All of these accounts hint at a lack of standards and guidelines when both type designers were first confronted with the design of characters for a technology that had little in common with the production process they knew.[29]

Unger cites Nisbet's *Grammar of textile design* (1927) as a source of inspiration for drawing shapes on the Digiset (**fig. 4.12**).[30] Grid-based letterforms are referenced in needle work for textiles as early as in the first half of the sixteenth century. Alphabets, borders and ornaments were published in collections of pattern templates, which offered examples of family names, initials and illustrations in lace, embroidery and needlepoint work. A lot of published designs from the second half of the eighteenth century, especially those that show upright and cursive variants on coarse grids, pose legibility challenges as soon as stroke contrast is introduced (**fig. 4.13**). Although Unger worked on a many times finer grid, these exercises in contrast understandably provided some insight into working under certain constraints. An alphabet from the collection of Giovanni Ostans, designed for lacework in 1591, offers more refined handling of stroke contrast and diagonals in different angles on a smoother grid (**fig. 4.14**). When it was published three hundred years later, its appearance was considered unrelated to a typographic model, but 'characteristic of the method of execution',[31] just as low-resolution bitmap fonts are significantly shaped by the available technological conditions.

On a side note, examples of the sixteenth century embroideries also open up an interesting parallel to Joseph Marie Jacquard's early nineteenth century loom invention that is regarded as a significant step in the history of computing hardware.[32] There seems to be a general awareness of a connections between textile

26 Zapf 2000, p. 31. Gudrun Zapf von Hesse revealed that she undertook most of this task, in a conversation with the author in Darmstadt, 8 March 2015.

27 Unger 1979, p. 134.

28 See Burke 2021, pp. 63–150.

29 Unger also reflects on the few available references in Unger 1990, p. 34.

30 Gerard Unger in e-mail correspondence with the author, 19 December 2015. The publication was suggested to him by his wife Marjan Unger who was a textile designer. See H. Nisbet, *Grammar of textile design,* London: Ernest Benn, 1927.

31 Lewis F. Day, *Alphabets old and new, for the use of craftsmen: with an introductory essay on Art in the Alphabet,* London: Batsford, 1906, p. xxiii.

32 In 1804 Jacquard had developed a device that was essentially controlled by replaceable perforated cards to store and retrieve sequences of weaving operations, anticipating punch-cards as a means to store data in computer programming until the 1980s. See for example James Essinger, *Jacquard's web: how a hand-loom led to the birth of the information age,* Oxford University Press, 2004.

Fig. 4.15–17 *Vijfzeven* is Petr van Blokland's graduation project, in which he explored letterforms on a 5×7 matrix for low-resolution output devices. The images on the right are screen captures by van Blokland. Reproduced from Noordzij 1983, p. 24.

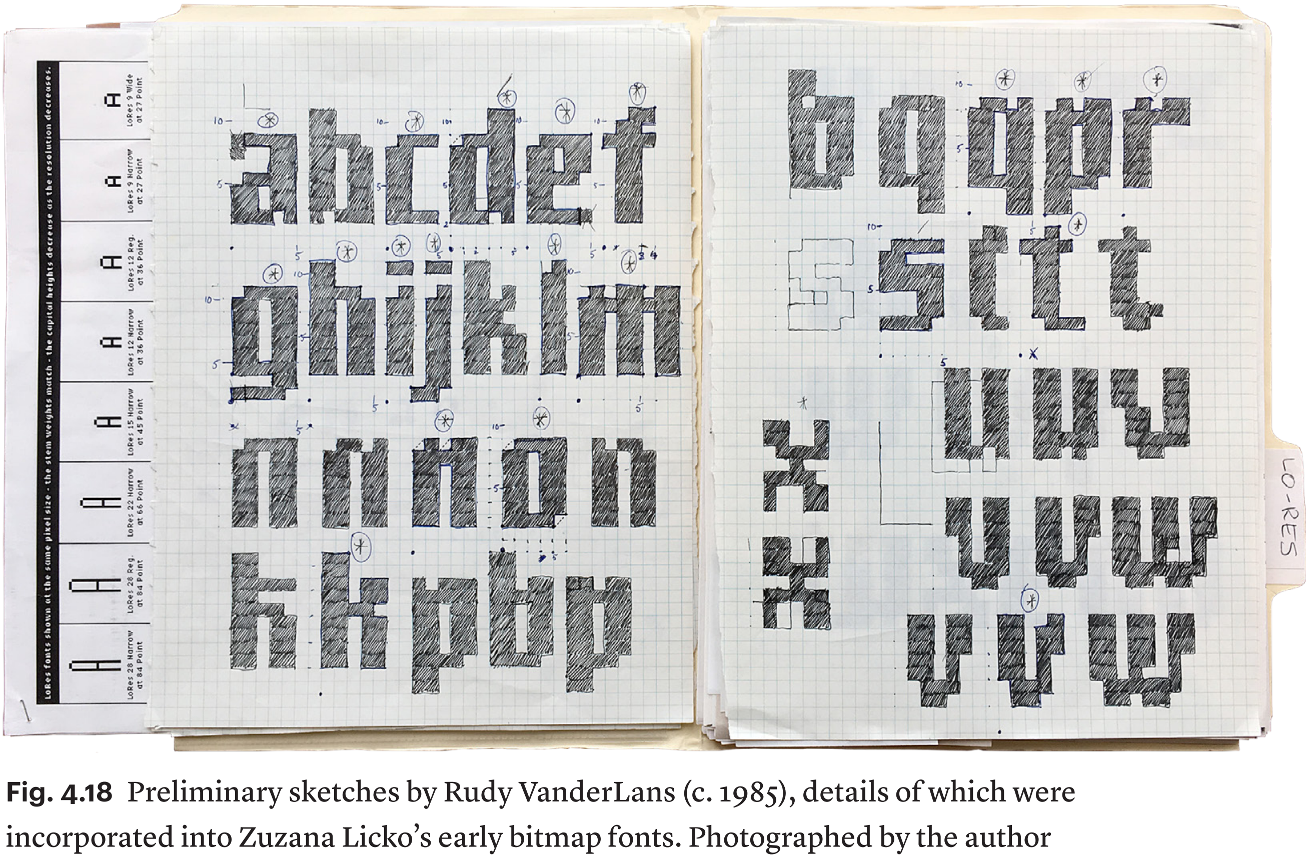


Fig. 4.18 Preliminary sketches by Rudy VanderLans (c. 1985), details of which were incorporated into Zuzana Licko's early bitmap fonts. Photographed by the author [LfA, Emigre Archive].

history and the beginnings of computing, while lettering examples in weaving and embroidery have only recently received more attention as precursors to contemporary 'pixel fonts'. Unger's clue about the connection to needle work and other references suggest the need for further research in this direction.

In the late 1970s, when low-resolution bitmap letters were still very much in the domain of engineers, two students of Gerrit Noordzij at KABK in The Hague dedicated their graduation project to 'matrix letters'.[33] In an attempt to explore the minimal requirements of a full character set for ASCII, a character encoding standard for electronic communication,[34] Petr van Blokland designed an alphabet on a 5×7 raster for low-resolution devices and dot-matrix printers, which is considered the smallest ratio with distinction between upper and lowercase (**fig. 4.15–17**). Like the sixteenth-century examples before him, he explored the effect of contrast in a limited space in order to improve legibility, following a comment by Noordzij that the absence of contrast would 'limit the restricted possibilities of a coarse matrix even further'.[35] The result of his exercise titled *Vijfzeven* (Dutch for 'five-seven') and was revisited by himself in PostScript description almost forty years later, released as Bitcount.[36]

With the arrival of font editing software on the Apple Macintosh (see 5.3) low-resolution bitmap letters were revisited for use on commercial laser printers and more frequently removed from their original intention, i.e. on magazine covers and in poster sizes (see **fig. 3.5**). Zuzana Licko's designs of Emperor, Oakland and Universal for Emigre in 1985 are some of the most prominent examples of this genre, sometimes referred to as 'pixel fonts'. Initial sketches by Licko's Emigre partner Rudy VanderLans reveal a process similar to that of van Blokland and Unger (**fig. 4.18**). Licko then assembled the bits in a 'a crude public domain software' and produced fonts for primary use on the Apple ImageWriter.[37] PostScript fonts of the same alphabets were later added for use on higher-resolution devices such as the Apple LaserWriter. In 2001 Licko revised this family of typefaces and re-relased them under the name Lo-Res. Since the late 1980s, pixel fonts have become the generic visual expression of 'digital type'.

33 The projects of Petr van Blokland and Jelle Bosma and featured in a publication on type design projects from Dutch art schools in Arnhem, Breda, Enschede and The Hague. See Noordzij 1983.

34 The American Standard Code for Information Interchange (ASCII) is a seven-bit character encoding first introduced in 1963 and updated subsequently.

35 The author's translation of the Dutch original: 'Een contrastloos schrift perkt de sterk besnoeide mogelijkheden van een grove matrix nog verder in'. Noordzij 1983, p. 24.

36 A review of Bitcount by the author includes insights into Noordzij's publication and at van Blokland's contribution. See F. Ulrich, 'Bitcount: typeface review', on <https://typographica.org/typeface-reviews/bitcount>, 18 October 2018 (last visited 22 October 2022).

37 Emigre, *Lo-Res: A synthesis of bitmap fonts,* 2011 (type specimen in PDF format, dowloaded from www.emigre.com).

4.1.2. Resolution-independent: vector outlines

Vector outline description of letterforms offers an economical improvement to storing, scaling and modifying numerical shapes regardless of their intended resolution. Outline description stores only the contour of a character, which is why it requires far less data than bitmap and run-length formats that describe the entire shape, the more so in large sizes. The description of outlines must only be stored once for any given size, it is therefore considered resolution-independent. Outlines are used primarily for storage and modification of characters, but are rasterized before they can be displayed on a computer screen or exported to a printer. In that process outlines are converted to bitmaps in a so-called raster image processor (RIP). Cutting-plotters that retrieve coordinates directly from the numerical outline description, a technique used in some early approaches to this method, are the exception to this rule. The ability to accurately fit pixels within the outline, especially at smaller sizes, became one of the great challenges of developers of digital type design systems.

The mathematical term 'vector', meaning 'carrier' in Latin, describes the connection that is carried from one point to another, creating a line segment. A closed circuit of several line segments connected by anchor points creates a shape enclosed in a vector outline. Primarily, there are two different kinds of vector outlines: polygons, comprised entirely of straight-line segments, and spline-based outlines (or curves), sub-categorized as quadratic curves and cubic curves. Quadratic curves include circular arcs, the earliest mathematical description of letterforms (that was implemented in Bitstream's Camex LIP among other systems). Cubic Curves have further sub-divisions such as Hermit cubic curves prominently embedded in URW's Ikarus or Bézier cubic curves found in Adobe's PostScript and in a revised version of Knuth's Metafont, among others. Each of these curves, often named after their discoverers, have different underlying mathematical principles, some of which date back to the nineteenth, eighteenth and seventeenth centuries. When they were first adapted to the emerging computer graphics systems of the 1960s, their different behaviours became visible in details such as points sitting *on* the outline segments, while others have additional anchor points *off* the curve — characteristics that have an effect on handling and control. A detailed overview of curves mentioned above and others as well as their mathematical origins is provided by Bigelow.[38]

In addition to improved solutions of storage and resolution, the structure of outlines also enables simpler methods of modification, such as slanting, expanding or compressing shapes by repositioning the anchor points of their outlines. The adaptation of interpolation, a mathematical concept first published in the 1870s, allowed engineers and designers to generate an infinite number of intermediate

38 See Bigelow 2020.

Image redacted

Image redacted

Fig. 4.19+20 In aviation, draughtsmen engineered stream-line shapes by constructing analogue splines that were held in place along key points of the curvature by so-called 'ducks'. Photographs by The Boeing Co. (left) and Carl de Boor (right).

shapes between two existing extremes, in technical terms: numerous 'instances' between two 'masters' (see the introduction of this terminology below). In order to create desired shapes through interpolation, it is necessary to have the same amount of points on either end. From a computing standpoint, the precondition of interpolation is defined as 'two statements in a loop, which runs for all digitized points of a contour'.[39] The integration of interpolation into digital type systems was connected to the prospects of automatically generating intermediate weights and even intermediate type sizes. The implication of these modifications for design decisions of digital type is further reflected in 5.2.3. Differences between interpolation theories are discussed when they are mentioned in the following section 4.2.

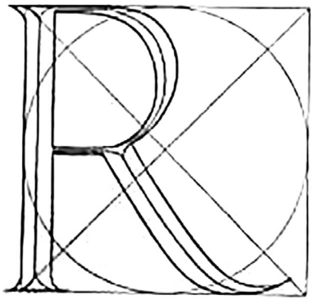
As has been established above, not all outlines are necessarily curves and there are differences between circular arcs and cubic curves. Terms used as synonyms for curves are 'contours' and 'splines'. A mid-1970s edition of the Oxford dictionary, does not associate a 'spline' with numerical curve description, but defines it as a 'flexible wood or rubber strip, e.g. used in drawing large curves'.[40] Both the term and technique described in the entry were common in railway work and in the construction of ships hulls and aircrafts. As draughtsmen worked out the curve of a spline, it was held in place by nails or by hooks attached to lead weights called 'ducks' (because of their shape), the physical predecessors of 'anchor points' between vectors on a mathematical curve (**figs. 4.19+20**).

In an attempt to explore some of the fundamentally different outline formats, this sub-section investigates the disciplines in which they were first utilized in, while also considering their mathematical origin, and eventually regards a few early approaches to outline description of letterforms. The broader discussion on the implications of the 'definitive outline' on digital type design and typography are discussed further in 5.2.2.

A search for mathematics in type quickly reveals constructed letterforms from line and arc segments on grids long before the 1960s and 1970s. Mathematicians, architects and scholars of the Renaissance made attempts to adapt classical themes, of which they did not exclude the measuring and rationalizing of Roman letters. Inspired by ancient inscriptions chiselled in stone, they referred to Euclid's plane geometry to construct mostly capital letters from ruler and compass, creating outline representations on grids. Computer scientists and type designers have repeatedly referenced these exercises as harbingers of mathematical outline

39 Karow 2013, p. 21.

40 See 'spline' in J. B. Sykes (ed.), *The concise Oxford dictionary of current English*, Oxford: Clarendon Press, 1976.



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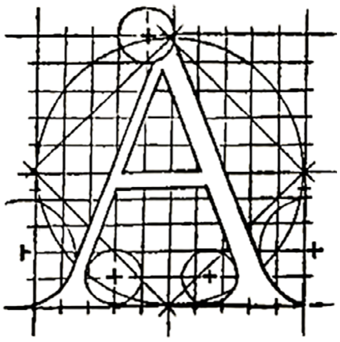

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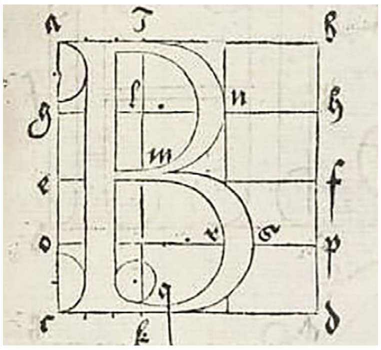
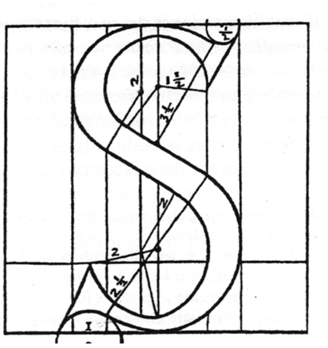
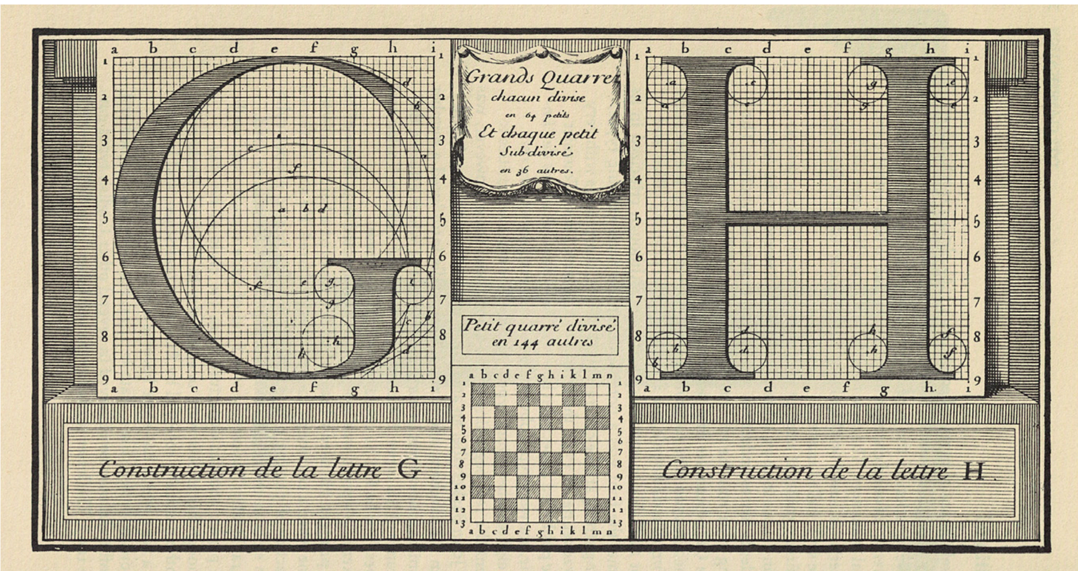


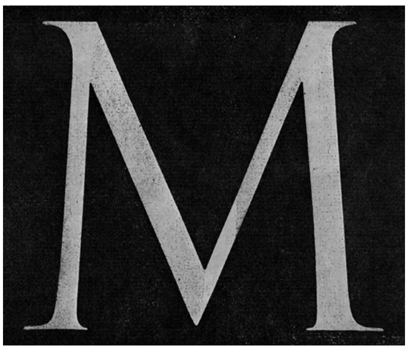
C



D



E



F

Figs. 4.21–26

Euclidian geometry in use by renaissance scholars, artists and mathematicians:

A 1463 Felice Feliciano

B 1529 Geoffroy Tory

C 1525 Albrecht Dürer

D 1527 Francesco Tornielo

E 1692 Louis Simonneau

F 1570 Giovan Cresci

description.[41] A linear connection between those artistic measurements and digital type is questionable; some of the more prominent ones are gathered here. Felice Feliciano's *Alphabetum romanum* (1463) is considered the earliest example, and although it was not published in its own time, but several centuries later, it was followed by more than a dozen similar exercises in the first half of the sixteenth century, including Luca Pacioli's *Divina proportione* (1509), Geoffroy Tory's *Champfleury* (1524) and Albrecht Dürer's *Underweysung der Messung* (1525). These artistic explorations reached a peak with the much-referenced 'romain du roi', an alphabet engraved on plates by Louis Simonneau, supervised by Philippe Grandjean (who cut the punches) on the authority of French King Louis XIV around 1695, that was also manufactured for typesetting circa five years later (**figs. 4.21–26**). There is however, a disconnect between the frequently reproduced character representations of the plates and its production in metal type: the prominently visible grid of 8×8 units offered no contribution to the established methods of sixteenth century punchcutting. In fact, none of the other examples had an impact on how type was made at the time of their creation. Kinross suggests that while the representation of these letterforms may be regarded as 'theoretical demonstrations', they are at best an 'innocent anticipation' of numerical models of letterforms explored three and a half centuries later.[42]

One exception to the examples of the early sixteenth century is the work of the Milanese scholar Giovan Francesco Cresci, who opposed the approach of his contemporaries in constructing letterforms from compass and ruler — with a wink of the eye he concluded that Euclid himself would have rejected this approach.[43] Cresci took inspiration from the inscriptions on Trajan's column (completed AD 113) and chose to follow calligraphic instead of geometric shapes,[44] an approach praised by Knuth (further explored in 4.2.2). Cresci's realization was later supported by Edward Catich who challenged the process of re-modelling ancient inscriptions from compass and ruler by demonstrating how they were initially painted with a brush before those shapes were cut in stone.[45]

Before mathematical outlines were adapted for the description of letterforms, the technique was introduced to emerging computer graphics in design and engineering of automobiles, in aviation and in shipbuilding, where 'splines' were re-invented as a digital metaphor of their previous function. In the automobile industry in France,

41 Donald Knuth devotes an entire chapter to these Renaissance alphabets in *TeX and Metafont* (1979), one of the letters is depicted on the book cover.

42 Kinross 2010, p. 26. On a side note, a character of 'romain du roi' sits on the cover of the 2004 second edition of *Modern typography* and its 2010 reprint.

43 Donald M. Anderson, 'Cresci and his capital alphabets', in *Visible Language,* vol. 5, no. 4, Cleveland/OH, 1971, p. 344.

44 Ibid., p. 331.

45 Ibid., p. 347.

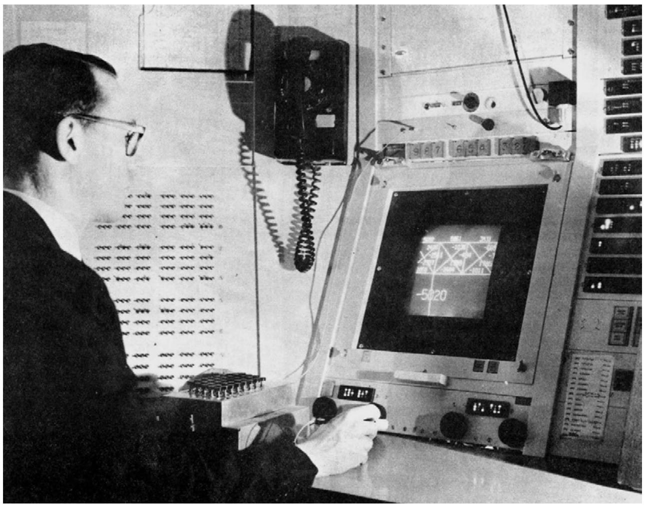


Fig. 4.27 Ivan Sutherland operates Sketchpad Photographer unknown, reproduced from Sutherland 1963, p. 11.

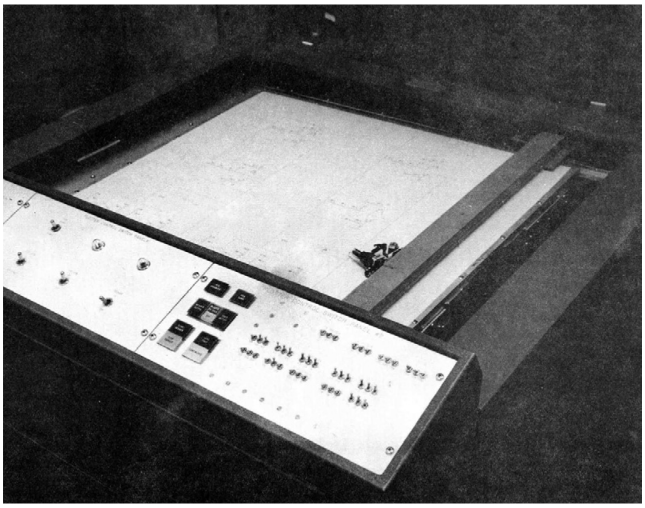


Fig. 4.28 The EAI ink-line-plotter connected to Sketchpad paved the way for output on flatbed plotters from digital type systems. Photographer unknown, reproduced from Sutherland 1963, p. 12.

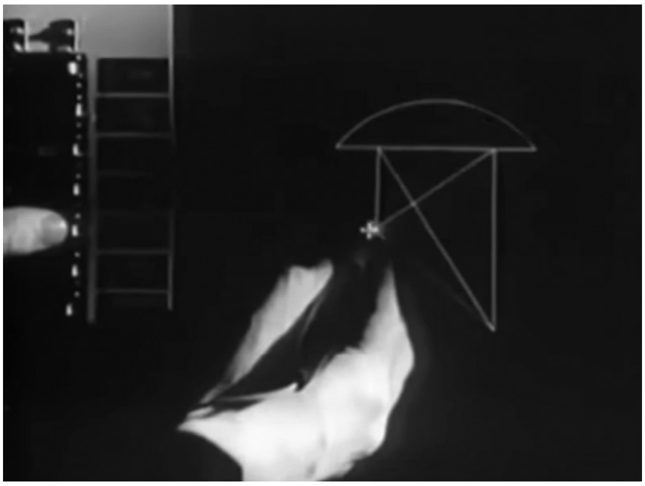


Fig. 4.29 Freehand drawing of arcs in Sketchpad. Screenshot of a taped demonstration of Sketchpad, included in Alan Kay's video documentary, <https://archive.org/details/AlanKeyD1987> (last visited 23 October 2022).

curve description was discovered almost simultaneously but independently by Paul de Faget de Casteljau at Citroën in 1959, and by Pierre Bézier at Renault shortly after.[46] For the calculation of streamlines and curves on automobiles, de Casteljau adopted mathematics published in 1912 by Sergei Bernstein, who had found practical proof of a significant theorem developed by Karl Weierstrass before him in 1885.[47] Citroën kept de Casteljau from publishing his algorithm of the Bernstein curves, while Bézier did; his name became eponymous.[48] According to Bigelow, the mathematician A. R. Forrest, who had presented a doctoral thesis on *Mathematical curves and surfaces for computer aided design* in 1968, approved Bézier's curves and proved that they too matched Bernstein's realizations.[49]

What is most intriguing about some of the early computer graphics and computer-aided design systems (CAD) are concepts, now considered familiar, that did not have visual references at the time and needed to be thought out a fresh. One of the most impressive computational applications of that era is Sketchpad, a digital drawing tool that utilizes an outline-based approach to create shapes through a graphical user interface, developed as a doctoral thesis by the electrical engineer Ivan Sutherland at MIT in 1962. The growing interest of MIT's Lincoln Laboratory in making computers 'more approachable' around 1960, sparked a conviction in Sutherland to pursue research on human-computer interaction and develop an application for 'line drawings' on the TX-2, a computer with potential in this area, utilizing what was later known as a user interface on a capable display and a light pen as input device, all of which were hardware components available at the research centre (**fig. 4.27**).[50] After just a few months, Sutherland devised a 'curve tracing' programme based on the notion of interlacing light pen and display.[51] It took him just another year to fully develop Sketchpad, his thesis was submitted in early 1963. The programme enabled the drawing of accurate, repetitive lines and shapes directly in the screen for mathematical, scientific and mechanical purposes.[52] With the integration of a EAI 'ink-line-on-paper' plotter, the system was equipped with an output format that could be supplied from punch tapes and even directly from the TX-2 (**fig. 4.28**).

Sutherland's thesis is sparsely illustrated with screen captures and contains mostly pen sketches, however, an original 1962 film recording of the system in use re-aired in a demonstration during a lecture series moderated by Alan Kay (a pioneer in graphic user interfaces associated with Xerox PARC, among others),

46 Maier 2009, p. 335.

47 Bigelow 2020, p. 20.

48 Maier 2009, p. 335.

49 Bigelow 2020, p. 21.

50 Sutherland 1963, p. 24.

51 Ibid. Sutherland acknowledges the help of Herschel H. Loomis who had performed 'some preliminary drawing work' on the TX-2.

52 Ibid., p. 2.

and is now available online.[53] The short clip demonstrates a user (probably Sutherland himself) drawing arcs and freehand shapes of unequal angles, automatically rearranged by the programme to appear fully symmetric, parallel and perpendicular (**fig. 4.29**). Sketchpad has been praised for pioneering computer graphics and for establishing the concept of an object-oriented software system.[54]

Although fonts were not of Sutherland's particular concern, Sketchpad considers alphanumeric text for legends on technical drawings, with figures 'formed from the same type face as text' from single-'line and circle segments'.[55] Sutherland's achievement in digital type should not be measured by this 'type face', but by his remarkable letter-like outline shapes. Furthermore, his procedural approach recognizes another fundamental aspect in digital type design: the notion of 'master' drawings and 'instances'.[56] Shape instances could be individually rotated, scaled and positioned, while remaining identical in appearance to a master shape, a principle that is present in contemporary applications of digital type.

Although Sutherland had presented an approach to creating arc curves in 1963, early examples of numerical outlines description of letterforms demonstrate the use of polygons, i.e. shapes that are completely composed of straight-line segments. Kathleen Carter refers to them as 'line chains'.[57] Two independent approaches, by Allen V. Hershey of the US Naval Weapons Laboratory as well as by Max V. Mathews, Carol Lochbaum and Judith A. Moss of Bell Telephone Laboratories, were both published in 1967.[58] Although they seem to have been developed independently, their procedures reveal some interesting parallels.[59] Hershey, who held a PhD in physics and worked on curve calculation of ship hulls, was concerned with a repertoire of characters that could be used to prepare mathematical reports comprised of complex formulas and that could be processed on different models of cathode ray printers available at the time. In a report with the catchy title *Calligraphy for computers,* Hershey demonstrates an extensive repertoire of digitized Latin, Cyrillic, Greek and blackletter alphabets as well as characters of Japanese scripts in a polygonal vector format for output on a Stromberg Carlson 4020 vector

53 University Video Communication presents Alan Kay, 'Doing with images makes symbols: communicating with computers', *The distinguished lecture series: industry leaders in computer science,* 1987. Available at the Internet Archive, <https://archive.org/details/AlanKeyD1987> (last visited 23 October 2022).

54 See Kay's conclusions in the video cited above.

55 Sutherland 1963, p. 80.

56 Ibid., p. 172.

57 Carter 1986, p. 15.

58 Both approaches are predated by a paper by Jack E. Bresenham of IBM, 'Algorithm for computer control of a digital plotter', *IBM Systems Journal,* vol. 4, no. 1, pp. 25–30, 1965.

59 Hershey acknowledges the work carried out at Bell Laboratories and references private communication with Mathews et al. in 1967, see Hershey 1967, pp. 2 and 28. His report was published in August, Mathews' paper in October of the same year.

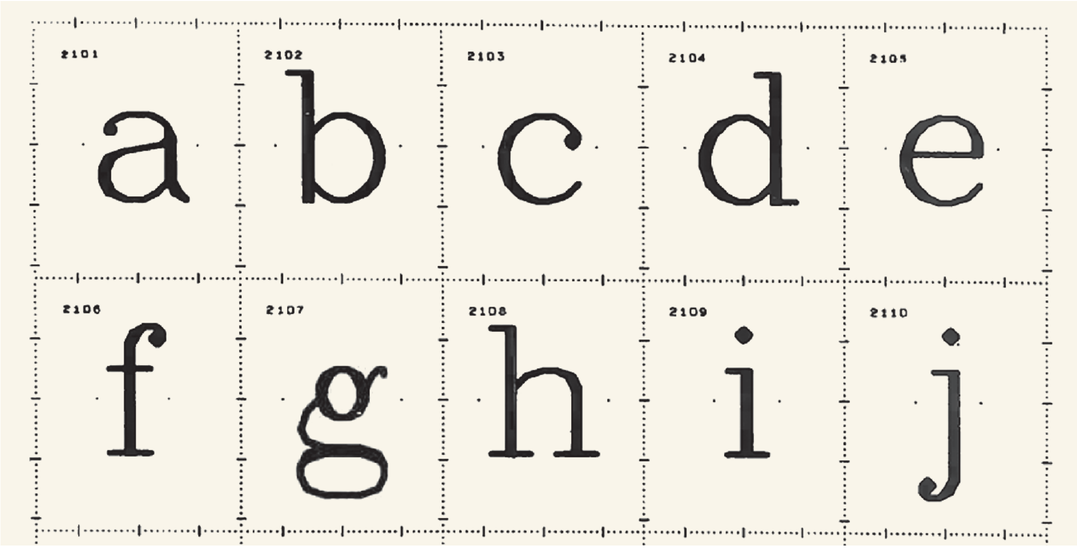


Fig. 4.30 'Calligraphy for computers': Allen V. Hershey's polygonal outline description creates 'filled' shapes through overlapping vectors in the Triplex model. Reproduced from Hershey 1967, appendix.

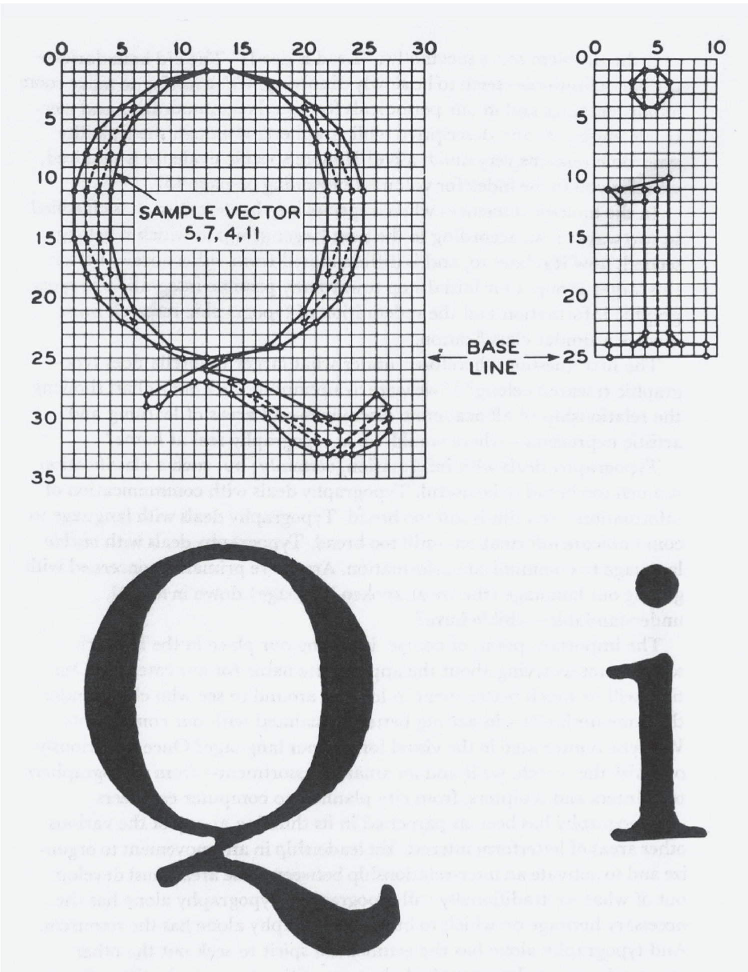


Fig. 4.31 Enlargement of polygonal letterform description reveals the straight-line segments. Reproduced from Mathews 1967, p. 347.

plotter.[60] In response to the comparably low raster of 1024 points, Hershey demonstrates an awareness of resolution-specific implications as a direct connection between character size and its design:

> A satisfactory polygonalization of a small circle is not possible for a circle of any arbitrary size. The number of sides of the polygon is related to the size of the polygon. The smallest sizes are an octagon of 4 or 6 raster units diameter and a dodecagon of 8 raster units diameter. The next two sizes are hexadecagons with 10 or 14 raster units diameter.[61]

In order to be described on the CRT, vector lines did not have to be in closed circuits. The simplest condition of a single line between two points was sustainable enough as the electron beam could represent it at a fixed stroke thickness of typically two raster units. Based on this precondition, Hershey devised three different sets of what he describes as 'line thickness', i.e. different weights in typographic terms.[62] In order to describe different stroke width, the number of vector lines is increased by one additional parallel line with each set, hence the names Simplex, Duplex and Triplex (**fig. 4.30**).

Mathews, Lochbaum and Moss, a group of mathematicians and engineers, made the same observations and came up with similar solutions: three fonts of the Baskerville style, each produced for a respective optical size range, were digitized on a 1024-point raster for output on the SP 4020 (**fig. 4.31**). Due to the limited number of raster units, the authors were also facing constraints in expressing varying stroke weight, but used the 'disarrangement of vectors' as a method to simulate stroke thickness.[63] This arrangement of parallel, touching and overlapping vector lines is also visible in Hershey's preliminary sketches.[64] Both approaches offer notable results by scientists who took on challenges that would have concerned type designers. It is noteworthy, that Hershey consulted literature by Frederic Goudy, Jan Tschichold and Emil Rudolf Weiss and references the study of type specimens in his report,[65] while Mathews et al. acknowledge 'a small amount of consultation with a type designer' who remains unnamed.[66] Despite these remarkable solution for vector encoding, Hershey's and Mathews' realizations highlight how polygonal

60 Hershey 1967, p. 4. Another, less extensive character set in a bitmap-like format (without stroke contrast) is also presented for output on a SC 4010 dot plotter of the same manufacturer, the original intention of the project, see Hershey 1967, p. 1.

61 Ibid. p. 11.

62 Ibid. p. 1 f.

63 Mathews 1967, p. 350, see figures 6A–C.

64 Reproduced in Frank Grießhammer, 'Cogitating vectors: The Hershey fonts', in *Footnotes,* issue B, Geneva: La Police, 2017, p. 79, see figure 9.5.

65 Hershey 1967, pp. 28 ff.

66 Mathews 1967, p. 352 f.

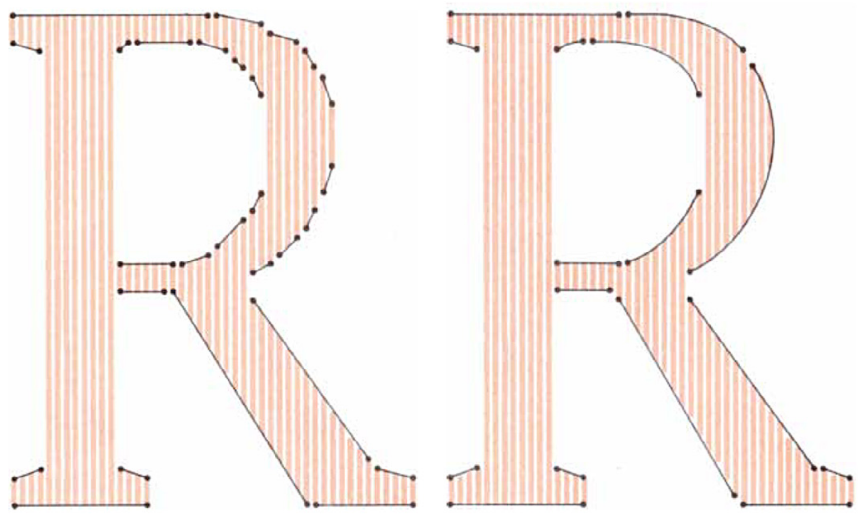


Fig. 4.32 Open-vector run-length encoding. Reproduced from Bigelow 1983, p. 118.

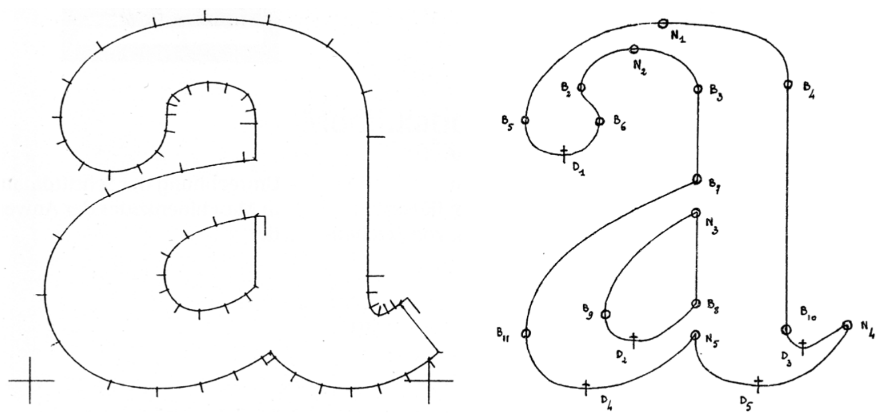


Fig. 4.33+34 Peter Karow and Philippe Coueignoux discovered solutions to spline-based outline description based on cubic splines. In both descriptions the points between vectors sit *on* the curve, although Karow's use of specifically Hermite cubic curves (left) needs far more points to connect each segment. Reproduced from URW 1983, p. 13, and from Coueignoux 1975, p. 87.

letterform description does not offer an adequate approach in achieving scalable, resolution-independent digital fonts.[67]

Purely for storage, Bigelow specifies another format that serves as a sub-variant to run-length encoding in combination with vectors: in addition to vertical run-lengths (see previous sub-section), outlines are specified at 'critical' points known as 'spline knots' (**fig. 4.32**).[68] Only when a specific letter is retrieved, the respective system interpolates either polygonal segments or circular arcs between those knots. Karow defines this technique as an 'open vector' format.[69] In May 1973, Gregory W. Evans and Robert L. Caswell of the Rockwell Corporation filed a patent for an approach that included this method of run length compression with piecewise circle segments.[70] The patent also includes the ability to vertically scale between point sizes — it is quite remarkable that a patent was granted for such a basic mathematical function.

A decade after engineers had used digital splines to describe shapes, Peter Karow and Philippe Coueignoux became probably the first to specify cubic curves for letterform outline description simultaneously, but independently in 1973 (**fig. 4.33+34**). Both of them drew on mathematical theories of interpolation and approximation published in the late nineteenth and early twentieth century.[71] While Coueignoux's discovery was presented in an MSc thesis in electrical engineering at MIT,[72] Karow's work was implemented in his digital type system Ikarus, which eventually became an industry standard, explored thoroughly in 4.2.4. Coueignoux's thesis remained unpublished and did not receive much recognition later; his achievement in parametric algorithms are discussed in the following subsection. Cubic curves and their many variants became the most widely used mathematical outline description in digital type systems developed between the 1960s and 1990s.[73]

Another intriguing technique that has roots in mathematics, was later adopted in draughting tools by engineers before it was implemented in at least one known

67 Contemporary re-digitization of the 'Hershey fonts' (as they are colloquially referred to) suggests, the polygonal nature of these typefaces is nowadays accepted as a core design characteristic, especially when they become visible in larger sizes. The description of Jean-Baptiste Levée's redrawing of one of these typefaces, released by the name Minotaur under his own label Production Type, reads: 'Minotaur offers a richness not found in most type; one that rewards viewers in new ways as they step closer to the canvas.' <https://www.productiontype.com/collection/minotaur_collection> (last visited 26 September 2022).

68 Bigelow 1983, p. 118.

69 Karow 1987, p. 77.

70 Evans et al., *Character generating method and system,* US patent no. 4,029,947, granted 14 June 1977.

71 Bigelow 2020, p. 19.

72 See Philippe Coueignoux, *Compression of type faces by contour coding,* unpublished MSc thesis, MIT, Department of Electrical Engineering, 1973.

73 Bigelow 2020, p. 19.

Image redacted

Fig. 4.35 Illustrations ('table III') of Euler's 'elastica' model. Reproduced in Levien 2009, p. 81.

Image redacted

Fig. 4.36 Euler's two-convolution, double-end spiral with odd symmetry. Reproduced from Levien 2009, p. 49.

Fig. 4.37 Examples of 'Burmester-Schablonen' (manufactured by Wichmann Bros.), more commonly known as French curves, templates made from segments of clothoid spirals for drafting. Reproduced from Otto Luegner, *Lexikon der gesamten Technik*, 1904.

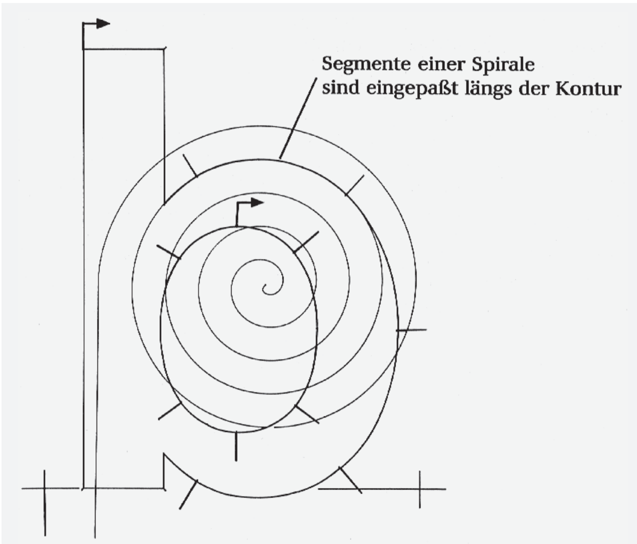


Fig. 4.38 One of the few illustrations that visualizes an uncurled digital spiral as its curve segment approximates the desired letterform component. This visualization is a bit too simplified as it inaccurately portraits the characteristics of clothoids. The annotation reads: 'spiral segments are fitted along the contour'. Reproduced from Karow 1986, p. 87.

approach to letterform description is based on logarithmic spirals. The underlying mathematical principle was first described by James Bernoulli, whose findings in 1694 have been dismissed for a lack of numerical computation and for not providing a specific construction of a spiral in his drawings.[74] Between 1744 and 1781 eighteenth-century Swiss mathematician Leonhard Euler described a linear connection between the spiral's curvature and its length: adjustment to either of these constants scales the other proportionally.[75] Euler's computations and drawings (**fig. 4.35**) consider another crucial characteristic: curvature as a signed quantity creates a two-convolution spiral with odd symmetry and a single tangent point on the straight section where the two curves meet (**fig. 4.36**). Because of its visual similarity to two spools of cotton, the double-end spiral has been described as a 'clothoide' (after Clotho, the youngest of three Fates in Greek mythology), while the common name 'Euler spiral' claims authorship.[76] A comparison of the mathematical similarities and differences between Bernoulli, Euler and others is documented in a thesis by Raphel L. Levien about spirals and splines as techniques for curve design at Berkley in 2009.[77]

Clothoids made an entrance into engineering and design disciplines as a draughting device commonly known as 'French curve', a curved ruler template composed of several different clothoid segments. The origin of the name is not clear; a set of three such templates was developed by German mathematician Ludwig Burmester, commercialized under the name *Burmester-Schablonen* that have been distributed by a variety of manufacturers (**fig. 4.37**). One hand firmly fixates the template on drawing material, while the other holds a pen or cutting device to trace and repeat complex curves that might otherwise be more difficult in a freehand movement. These templates remain in use for pattern adjustments in the fashion and textile industry to this day. With the emergence of digital outline description, the concept of clothoids was adopted in an exciting approach that 'uncurled' a digitally stored spiral until its segments approximated a desired curve (**fig. 4.38**). The concept of clothoids sparked some interest at the time, e.g. an accurately sketched-out study of the two-convolution Euler spiral was found in Unger's personal collection from the 1970s by Burke.[78] However, the only known adaptation of this approach was presented by British inventors Peter H. V. Purdy

74 Levien 2009, p. 98.

75 Euler spent thirty-eight years exploring the limits of the spiral's integral. He presented his conclusions at the Academy in Saint Petersburg, 30 April 1781. See Leonhard Euler, *On the values of integrals extended from the variable term x=0 up to x=∞,* 2007 (translation into English by Jordan Bell).

76 Another synonym is 'Cornu spiral' after French physicist Alfred M. Cornu who proposed the use of this spiral as a graphical computation technique for diffraction problems in the late nineteenth century.

77 See Levien 2009.

78 Burke 2021, p. 104 (see Unger's illustration and handwritten explanation of 'klothoïde').

and Ronald C. McIntosh in 1978, although there have been attempts to revisit this technique in recent years.[79] As mentioned in 3.4.2, a demonstration of the PM Digital Spiral was originally shortlisted by Bigelow for the 1983 ATypI working seminar, but could ultimately not be facilitated in the final programme. As a result, it was not included in the larger discussions and is also cited very little in the literature considered throughout this thesis. For these reasons the Purdy McIntosh system it is not explored in depth in the following section, but is considered for further research in 4.2.6.

79 See Levien 2009.

4.1.3. Parametric algorithms

Parametric methods in type design are explored on the premise that an alphabet is a coherent system and that each character within it or rather elements of those characters can be derived from predefined specifications. These specifications include parameters such as width, x-height, stroke contrast, essentially an infinite number of design attributes. Changing the parameters of one character would automatically precipitate those changes in all other characters as well. Although the notion for such a method existed previously, the use of computers sparked the implementation of parametric specifications through commands and algorithms. Parametric concepts do not necessarily oppose the models established in previous sections, but may challenge the static aspect of digitizing an existing design. Parametric approaches exploit existing principles of numerical description, while expanding on issues such as automation and data storage at a time when computers had very limited capacities. A recurring concept of parametric approaches to type design is centred around the idea of using a set of predefined letter-like components or even abstract shapes from which all of the characters of a script can be generated. E.g. a segment shared by four letters would only have to be stored once instead of four times, therefore reducing the amount of data stored. This method of 'element separation' has been explored in different approaches, but once again, due to the lack of common terminology, almost each approach introduces its own vocabulary to describe letter-like 'shape components'.[80] Another parametric approach is based on virtual pens that *draw* strokes. Starting from generic 'skeletal' strokes, different shapes may be generated by pre- or post-defining widths, angles, contrast as well as other parameters of the pen.[81] The notion of 'digital pen strokes' does oppose the outline method.

The idea of breaking down letterforms into reccurring shapes can be found in some of the sixteenth century measurements of letterforms explored in the previous section. In the case of Albrecht Dürer the focus is not so much on the exercises of roman letters, but on his measurements of the *gotische* blackletter style.[82] Without the need of a compass tool, Dürer used only square elements of the same size (and few triangular fractions of a square) to describe all of the strokes of those letterforms (**fig. 4.39**). When Dürer's work on blackletter faces was revisited in the mid-1930s, the absence of similar constructions of the *Fraktur* style was interpreted

80 The terms in quotes are used by Karow 2013, p. 30. Others are introduced throughout this section.

81 The term is used by S. C. Hsu et al., but has also been used before them, see Hsu, Lee, Wiseman, 'Skeletal strokes', in *Proceedings UIST '93,* Atlanta/GA, November 1993, pp. 197–206.

82 *Gotische Schrift* (Engl. 'gothic type') is a narrow blackletter style developed in the thirteenth century, not to be confused with 'gothic' as a synonym for 'grotesque' or 'sans serif'. An example of *gotische Schrift* is Textura, a style that found prominent use in the 42-line Gutenberg Bible (c. 1454).

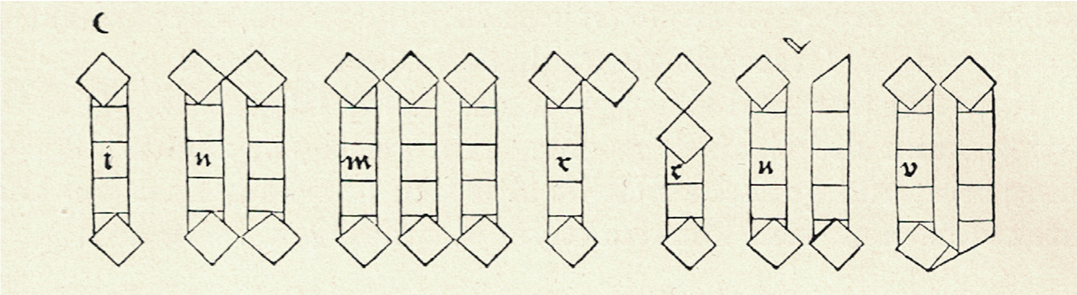


Fig. 4.39 Recurring shape components in Albrecht Dürer's construction of *gotische Schrift*. Reproduced from Klimsch 1935, p. 28 [FU].

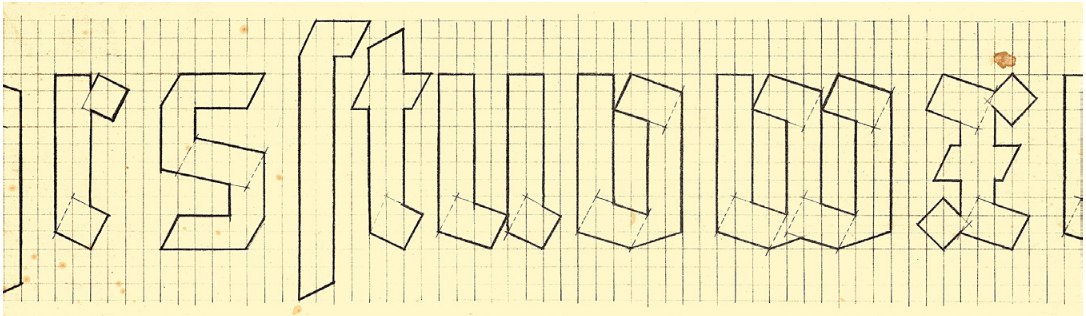


Fig. 4.40 *Reichsbahnschrift* (c. 1936) designed to re-use recurring components. From the private collection of Lars Krüger, Berlin.

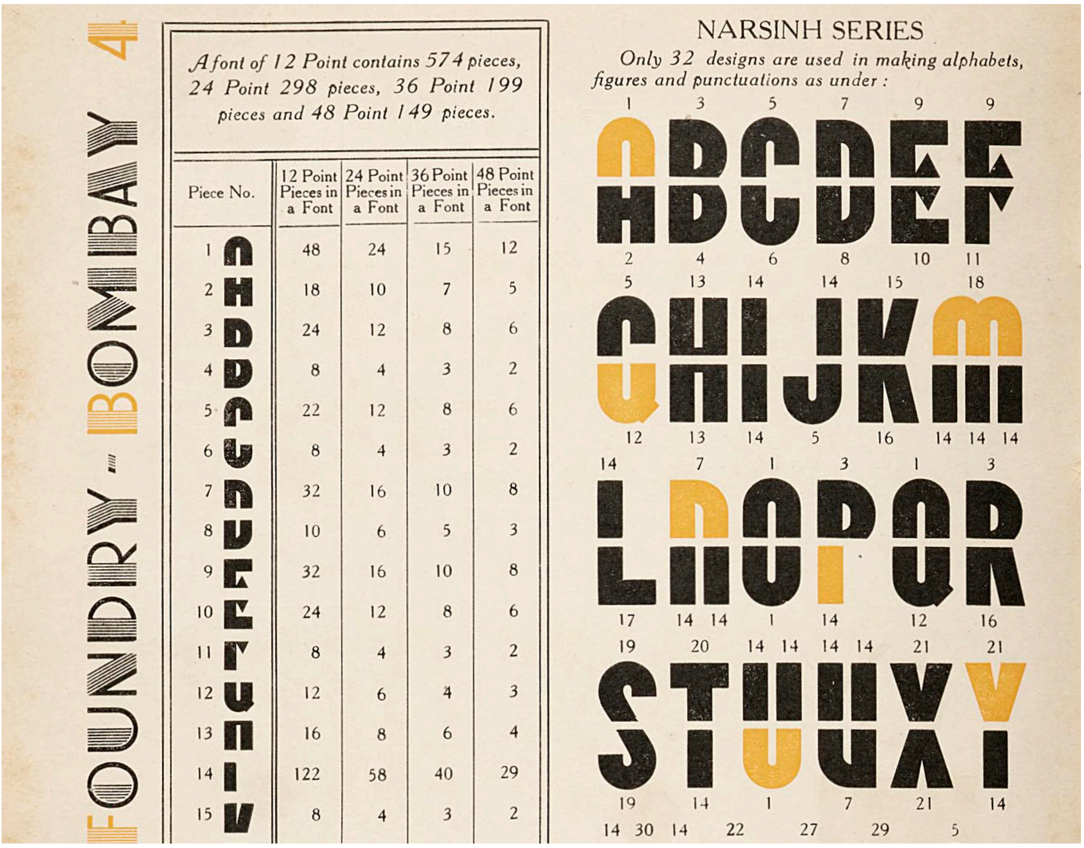


Fig. 4.41 Intermezzo (1933) by Schriftguß, Dresden, seen here as 'Narsinh series' in a detail created from a 1940s specimen page by the Gujarati Type Foundry. Reproduced with kind permission of the Letterform Archive.

as proof that not all styles were equally adequate for this method.[83] Fraktur letters are characterized by curves and swashes, adding to the complexity of letterforms not easily drafted. In the mid-1930s, contemporary reinterpretations of *gotische Schrift* were used in a lettering manual for station signs of the German Reichsbahn (national railway).[84] Executed on grids, dotted lines reveal components that were later integrated into shapes, indicated by a thick, solid outline (**fig. 4.40**). Overall, these drawings very strictly follow the grid, they lack overshoots as well as other optical corrections and were likely produced by engineers, not by trained designers. Whether they were familiar with Dürer's components has not been determined.

This example succeeds a successful period of geometric and modular approaches to type design, fuelled by a broad interest in simplifying letterforms and in constructing them from compass and ruler during the 1920s and early 1930s, eventually seized by some of Europe's largest type foundries. In the late 1920s, Giulio da Milano designed a series of modular sets for Nebiolo in Turin, including Fregio Mecano (Engl. mechanic ornaments), a set of twenty geometric elements that could be used to compose letterforms of any height and width (yet in a somewhat fixed stroke weight). A similar design called Ne-Po (short for *Negativ-Positiv*) was released by Schriftguß in Dresden. In both of these sets, modules are comprised of rather simple, geometric elements, while Intermezzo (1933) another example of element separation by Schriftguß offers much more letter-like components called *Versalhalbtypen* (Engl. 'half-capitals'). In some specimens, the components of Ne-Po and Intermezzo are declined in a simple numbering system, which then indicate the best way to assemble them in another illustration. Both typefaces from Dresden were also retailed by the Gujarati type foundry in Bombay. With the aim to market those designs as display typefaces in India, the components of Ne-Po are also used to assemble words in Gujarati and Marathi,[85] which proves that parametric concepts have the potential to expand beyond their intended alphabet in a script-specific context. In Intermezzo, selecting certain components that have different design attributes switches the overall modern geometric appearance to an art déco style, which introduces the notion of easily changing an existing design (**fig. 4.41**).

83 Konrad F. Bauer, 'Konstruktion und deutsche Schrift', in *Klimschs Jahrbuch,* vol. 28, Frankfurt/Main: Klimsch, 1935, p. 28. Bauer discusses whether blackletter styles could be constructed and uses Dürer's attempts as approval. *Fraktur,* a blackletter style of the early sixteenth century, is characterized by curves and swashes particularly in the capitals. Bauer wrote the article at a time when *gotische Schrift* was regaining popularity, accompanied by a nationalist-fueled search for the origins of 'German type', which were projected onto blackletter styles.

84 From the private collection of Lars Krüger, Berlin.

85 See Tanya George, 'How type travelled across nations and foundries', < https://letterform-archive.org/news/view/how-type-travelled-across-foundries>, 9 August 2022 (last visited 24 October 2022).

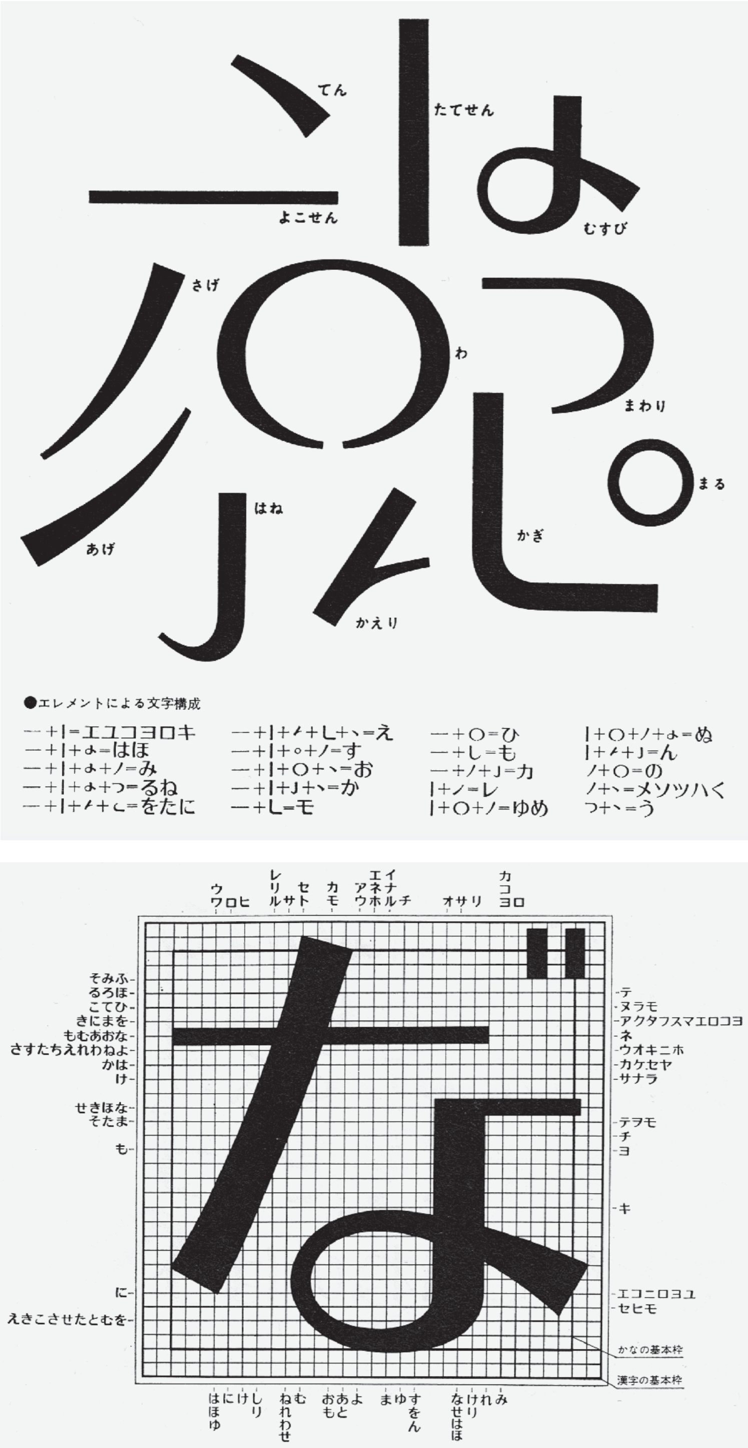


Fig. 4.42+43 Element separation for Katakana characters in Typos, a parametric approach developed by Group Typo in 1968. Reproduced from *Visible Language,* vol 5, no. 4, 1971, pp. 312, 314.

In 1968, the Tokyo-based consortium Group Typo devised a method that could be used to compose characters of the Japanese scripts from a set of separate stroke elements.[86] The design task coincided with the group's interest to reduce the use of Kanji, i.e. symbols of Chinese origin, in everyday printed communication.[87] As a result, their first typeface Typos, developed under the direction of Yasaburo Kuwayama, was initially presented as a Katakana-only character set, yet Kanji symbols were added later.[88] The original set consisted of twelve separate Katakana stroke elements that could be composed on a module grid of 32×32 units (**figs. 4.42+43**). The design of Typos must have also been considered unusual at the time, as it resembled the Japanese 'gothic' style, but instead of the typical mono-linear appearance it featured contrast between horizontal and vertical strokes, as was more common with the 'Mincho' brush styles.[89]

Element separation of an East Asian script was not an entirely new exercise in the 1960s; the members of Group Typo may have been familiar with 'composite' metal types of Chinese characters manufactured at the K. K. Hof- und Staatsdruckerei during the mid-eighteenth-century in Vienna,[90] or with those cut earlier at the Imprimerie impériale around 1830 in Paris.[91] In 1880, Carl Faulmann (who published the list of 294 components cast in Vienna) concluded that thousands of Chinese symbols and the time it took to find them in a composing room suggested the approach of composing symbols from separate components, but admits that even Staatsdruckerei's smallest results turned out too large for common use (the illustrated examples are about 36 point in size).[92] All of these early examples demonstrate the impracticality of parametric concepts for hand-setting small sizes of metal type.

86 Three different scripts are used to compose the Japanese language: up to 50,000 logographic Kanji symbols (adopted from China) and the two Kana, syllabic scripts known as Hiragana and Katakana that consist of 46 characters each. Arabic figures and occasionally Latin characters (called Romaji) for foreign proper names may be added to the Kanji and Kana.
Group Typo was formed by members of the Japan Typography Association and of phototype manufacturer Yuho Co. The group's aim was to exploit the advantages of phototype technology for Japanese scripts and is responsible for Japanese adaptations of Univers and Optima.

87 As Masaru Katsumi explains, reducing the number of Chinese characters in Japanese was a 'by-product of Japan's postwar quasi-democracy'. Group Typo 1971, p. 315.

88 Some of Group Typo's typefaces were later included in the type library of TypeBank, a subsidiary of Morisawa. In 2008 several types, including Kanji Typos, were adapted to a PostScript format and became available through Adobe Typekit in 2017. See: <https://en.morisawa.co.jp/about/news/3600> (last visited 2 October 2022).

89 In a tribute to Hermann Zapf, Yasaburo Kuwayama writes that Typos 'combines harmoniously with Optima Roman'. Dreyfus 1989, p. 203.

90 Carl Faulmann (ed.), *Das Buch der Schrift. Enthaltend die Schriftzeichen und Alphabete aller Zeiten und aller Völker des Erdkreises,* Hamburg: Nikol, 2020 (reprint of the 2nd edition, 1880), pp. 47 ff.

91 Hiroshi Komiyama, *History of Japanese metal type,* Tokyo: Seibundo Shinkosha, 2009, p. 250 f.

92 Carl Faulmann (ed.), *Das Buch der Schrift. Enthaltend die Schriftzeichen und Alphabete aller Zeiten und aller Völker des Erdkreises,* Hamburg: Nikol, 2020 (reprint of the 2nd edition, 1880), p. 49.

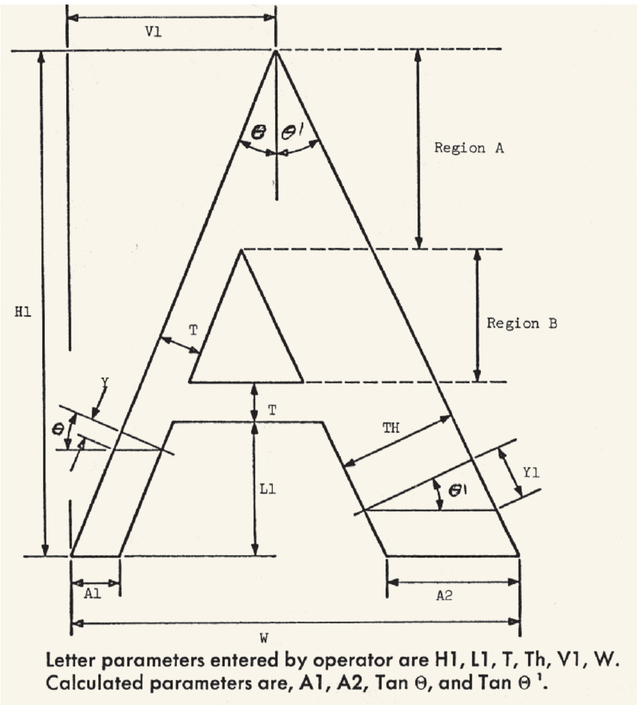


Fig. 4.44 Measurements of a character, somewhat reminiscent of the sixteenth century studies. Reproduced from Mergler 1968, p. 309.

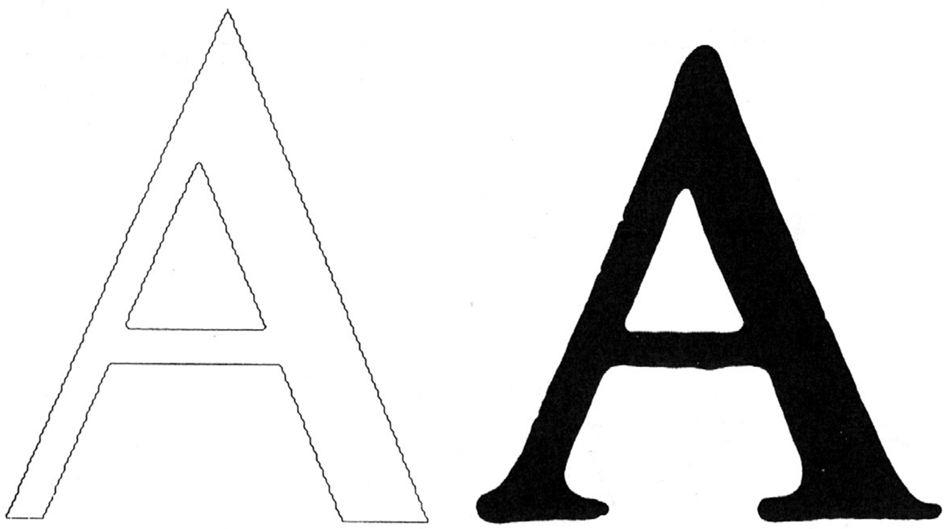


Fig. 4.45 Mergler and Vargo use the system to 'approximate' existing designs, illustrated here at the example of enlarged 18-point Times. Serifs could be added at a later stage. Reproduced from Mergler 1968, p. 316.

In addition to devising a method of shape components, Group Typo implemented a parametric algorithm to the relative proportion of vertical and horizontal stroke widths. This approach allowed the designers to develop a visual system that considered an increase in weight, while also increasing or decreasing stroke contrast — from two different axes. Typos was not encoded numerically and it took several years before the project was revisited by digital means. In 1990, Karow and his colleague Jürgen Willrodt of URW developed their own technique of element separation for Kanji and Kana on commission of the Fujitsu corporation.[93] In order to limit the storage of tens of thousands of characters, they devised a sophisticated system of 'elements' that were comprised of 'strokes' assembled from 'parts', therefore establishing components on three different levels for maximum data compression.[94]

One of the earliest known attempts to numerical letterform description underpinned by a parametric approach is the Interactive Synthesizer of Letterforms (abbreviated ITSYLF), developed by H. Mergler and P. Vargo in 1967 at the Digital Systems Laboratory of Case Western Reserve University, Cleveland/OH. Upon investigation of structures and regularities of the Latin capital alphabet, Mergler and Vargo proposed a system to study, construct and easily manipulate letterforms for output on a Calcomp drum plotter. Mergler and Vargo define letter proportions as parameters: letter height, stroke widths, distance between strokes, angles etc. The grammar they establish is not in accordance with common type terminology, some of the abbreviations are somewhat cryptic and not very intuitive (**fig. 4.44**). By denoting the left diagonal stroke of the A as a 'thin stroke' (abbreviated 'T'), the engineers seem to imply that the contrast between the letter's diagonals could not be reversed — an uncommon and unconventional yet valid design choice. After decomposing each character, Mergler and Vargo present the letters of the alphabet in five classes according to their attributes, grouping letters composed of horizontal and vertical strokes (1), of diagonal strokes (2, **fig. 4.45**), of curve segments (3), and more complex curves such as in C, G, S (4), and finally of J and Q (5), which are oddly omitted from the system due to their tail-like peculiarities.[95] Based on parametric specifications, the system provides templates (Mergler refers to them as 'models') for each letter to be used as a starting point for modification. At the heart of ITSYLF, the engineers implemented an 'automatic executive system', which enabled changing parameters on one letter (the authors demonstrate this with the example of the letter 'E', a fairly easy target) to automatically apply to all the others — the central definition of the parametric method, as established at the beginning of this subsection. Manual intervention was also possible at any time. By providing these

93 Karow 2013, p. 31.

94 Ibid., p. 32, see diagram.

95 Mergler 1968, p. 307.

Fig. 4.46 One of three alphabets generated in ITSYLF with rather underwhelming results for letters of classes 3 and 4. Reproduced from Mergler 1968, p. 321.

parametrically interconnected templates, the authors claim to relieve type designers of 'graphical bookkeeping', i.e. of the struggle to maintain consistent stroke widths, character height and so on in the drawings.[96] Although this approach comes with good intentions, it attempts to separate drawings from the design process, an observation manifested more clearly in the following statement:

> ITSYLF depends on a very basic assumption about the typographic design process. It assumes that the significant function a letter designer carries out is the making of choices — often based on unknown criteria — concerning the desirability of certain letterform shapes, heights, widths, stroke weights, and serif characteristics — to name a few. This leads to the implication that the drawing of character shapes is necessary to see the results of the design effort, but it is not inherently a part of creative letter design.[97]

It is quite remarkable that ITSYLF is based on assumptions about designer's intentions and design choices; consultation with any designers is not mentioned, their typographic bibliography is similarly limited to that of Hershey, Mathews et al. Excluding the drawing process from design decisions would have likely left Zapf and Unger sceptical at the time. The lack of acceptance among type designers is a recurring fate of these early parametric approaches, a tendency discussed more critically in 4.2.2. The poor quality in some of the results also lead to this attitude.

In order to numerically describe letterforms, Mergler and Vargo use an insufficient outline method not mentioned in the previous subsection: the superellipse. The resulting letters of classes 1, 2 and 3 are satisfactory, while the limits of the superellipses becomes visible in class 4 letters C, G and S, caused by the lack of a tangential routines, which were discovered in cubic curves only five years later (**fig. 4.46**). This proves a point made an the beginning of this subsection: some parametric concept may not be sustainable without offering a primary solution of a convincing numerical letterform description. Although Mergler and Vargo propose remarkable ideas for the abilities of a parametric font design system, it lacks considerations and a general understanding of type design processes and what it is that designers need in such a tool.

Philippe Coueignoux has been introduced as an unannounced speaker of the 1983 ATypI working seminar in 3.4.2. In addition to his unpublished MSc thesis on cubic curves in 1973, Philippe Coueignoux's 1975 doctoral dissertation not only improves his previous work on outline description, but also provides a highly significant contribution to parametric algorithms at the example of a 'generative' programme

96 Mergler 1968, p. 301.
97 Ibid., p. 303.

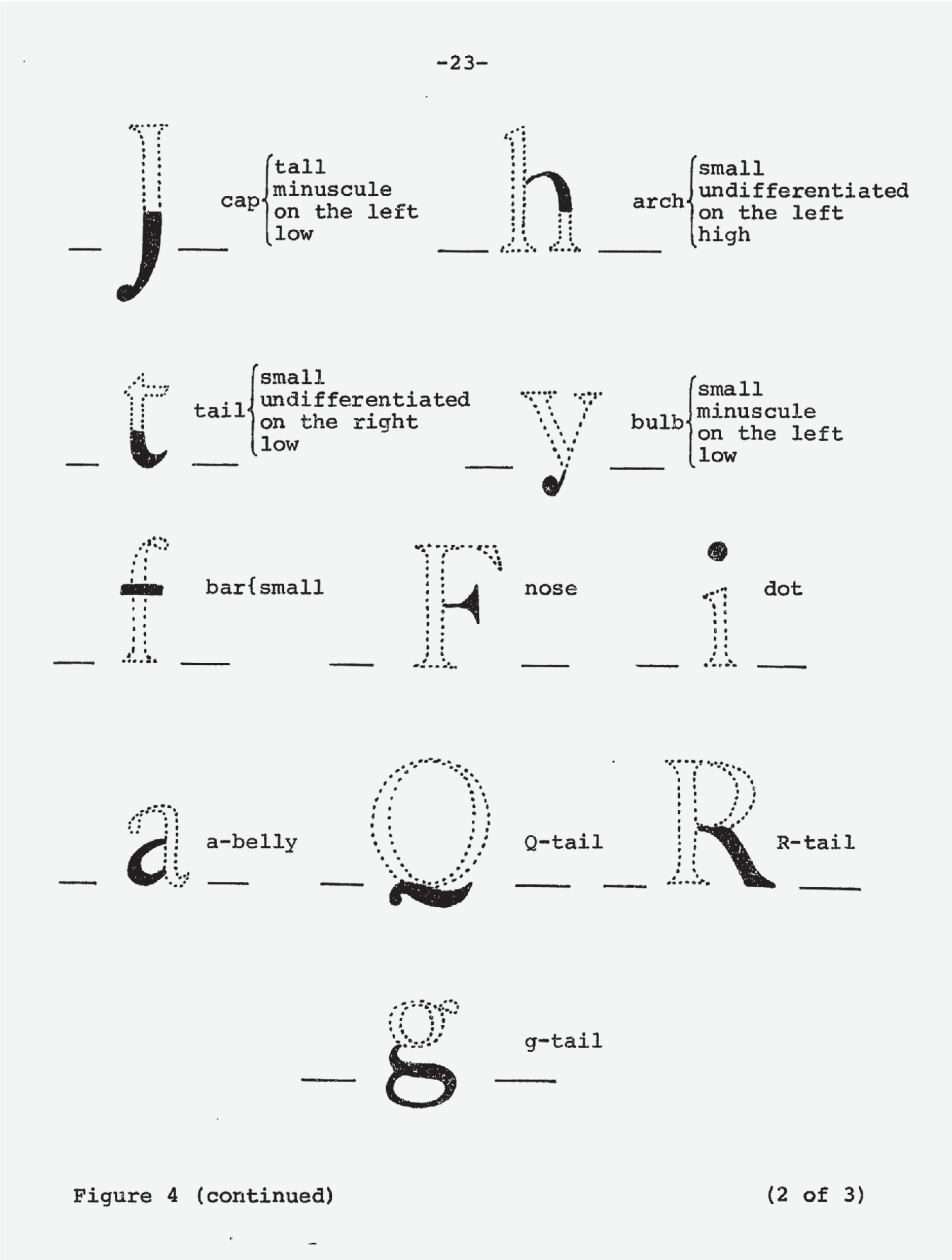


Fig. 4.47 'Illustrating the grammar' by the example of Caslon. Reproduced from Coueignoux 1975, p. 321.

called Character Simulated Design (CSD).[98] Karow refers to Coueignoux's achievement as the first use of digital shape elements,[99] thus overlooking some of the previous work introduced above. Ruggles oddly implies that Coueignoux was not familiar with ITSYLF while working on his dissertation.[100] In fact, Mergler's parametric approach is referenced in the thesis, Coueignoux draws comparisons between the two systems, emphasizing that despite key similarities they were developed independently.[101]

Based on the premise that 'type has fallen in the engineer's hands' while trying to solve optical character recognition (OCR) through 'descriptive grammars', Coueignoux attempted to reverse-engineer those techniques.[102] Previously, descriptive grammars of OCR had captured attributes assigned to certain shapes in order to differentiate between them.[103] Following an intensive study of the structure and consistency of roman letters and typefaces from a generative position, Coueignoux presents an approach of decomposing characters into what he refers to as 'primitives' that can each be specified by a set of parameters. He devises a comprehensive grammar that is nested in a complex framework of the occurrences of parameters and primitives in letters (**fig. 4.47**). In order to improve data storage even further, additional compression is achieved by gathering parameters in 'families'.[104] Four fonts were generated using CSD, illustrated in the unpublished thesis: numerical description for Baskerville, Bodoni, Cheltenham and Times New Roman (**fig. 4.48**).[105]

The grammar is coherent in itself, but appears to be inconsistent in details with some of the typography literature at the time.[106] At the heart of his descriptive grammar of parameters, Coueignoux implements a series of observations and rules: the 'rule of proportion' and the 'rule of disposition'; they consider the relationships

98 In total, Coueignoux's dissertation is comprised of an underlying descriptive model (his written thesis), a prototype of CSD and another prototype called FRANCE for setting type and solving issues of letter-fitting.

99 Karow 2013, p. 30.

100 Ruggles 1983, p. 8.

101 Coueignoux 1975, p. 47.

102 Coueignoux 1975, p. 11 f. Coueignoux adds that type designers were also reluctant to define 'complete sets of compelling rules' for their work, thus allowing engineers to take on the discipline.

103 Coueignoux cites a parametric approach to OCR in which parameters are referred to as 'embellishments': C. Cox et al., 'The application of type font analysis to automatic character recognition' in *Proceedings of 2nd international joint conference on pattern recognition,* Copenhagen, 1974, pp. 226–232.

104 Coueignoux 1975, p. 2.

105 Coueignoux based his replications on specimens found in J. I. Biegeleisen, *Art director's book of typefaces,* New York City: Arco Publishers, 1967.

106 The lower portion of the 'g' is called *tail* in Coueignoux's grammar, just like the tail of the 'Q' and the diagonal stroke in 'R'. Typography literature refers to the descending part of 'g' as *bowl* or *loop*, see Lawson 1971, p. 25.

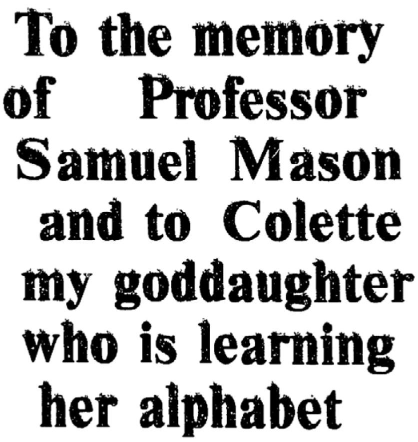


Fig. 4.48 One of the results presented in Coueignoux's thesis: a rendition of Times New Roman bold. Reproduced from Coueignoux 1975, p. 6.

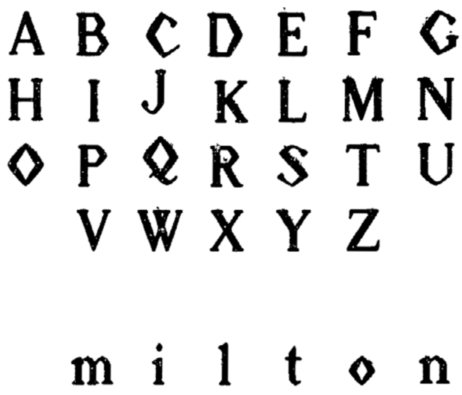


Fig. 4.49 An intriguing design result from Coueignoux's thesis. Reproduced from Coueignoux 1975, p. 6.

between all letters in a font as well as between each letter of different fonts. Similar to the attitude of Mergler and Vargo before him, Coueignoux readily assumes that type designers would 'likely' follow the rules he established.[107] Despite the complexity of a framework of primitives, parameters, observations and rules one cannot help but wonder why Coueignoux focuses on the replication of existing typefaces. The benefits do not seem obvious in comparison to the comprehensive work of a much simpler system such as Hershey's (see 4.1.1). An intriguing example of Coueignoux's applied research is found on one of the opening pages: a polygonal set of letterforms left uncommented (**fig. 4.49**). What appears to be an original design may be the result of the author's parametric approach.

The few secondary sources that mention Coueignoux's work, discuss the method and his approach, rather than the results it produced. His CSD system was not adopted by the industry — Bigelow suggests that computers of digital typesetters were not powerful enough to raster cubic curves in 1973.[108] It is precisely the results of parametric approaches that often trigger criticism and explain why the underlying systems gained little acceptance. It has also been questioned whether intuition and the 'whole creative process' were under threat by such an approach.[109] Discussions on automation quickly assume a compromise of elements of surprise and intentional inconsistencies in a typeface. Expectations of type designers were high, but the standards put forward by engineers could not yet meet them. According to Karow, flawless element separation is a matter of artificial intelligence.[110] Of the five systems examined in section 4.2, Knuth's Metafont is the only one developed from parametric algorithms. Its conception, development and critical responses are much better documented than the examples in this section; it serves as case study to address the concerns expressed here.

107 Coueignoux 1975, p. 13.
108 Bigelow 2020, p. 20.
109 Carter 1986, p. 18.
110 Karow 2013, p. 31.

Conclusion

The methods and their approaches of numerical description of letters and letter-like shapes represent a remarkable range of techniques and considerations. They coincide with the emergence of computers that no longer occupied entire rooms and provided early user interfaces to unveil and visualize the computational processes hidden behind nuts and bolts in the early 1960s. As a result, the people behind the developments of computer graphics were almost exclusively at home in the domains of electrical engineering and computer science. The purpose of their computed shapes was to improve calculation for transportation disciplines: railway tracks, hulls, streamlines, much bigger shapes (and industries) than letters. There appears to be a distinct disconnect between the disciplines; the community described in chapter 3 is not at all present in these early steps of establishing the groundwork for mathematical letterform description. However, although a direct concern for fonts is absent in Sutherland's Sketchpad (apart from a generic set of single-line letters), the outline shapes presented there are just a few steps away from becoming readable.

In the second half of the 1960s, engineers and computer scientists demonstrate a curiosity in their natural allies: type and typography — not least to express their own scientific reports and mathematical formulas (e.g. Hershey). Some of the earliest approaches indicate consideration not only of technical issues such as storage, resolution and output, but also for aesthetic criteria and letterform modification. One of the very few windows between the disciplines is the *Journal of Typographic Research/Visible Language,* a role that has been discussed in chapter 3 and that is acknowledged in many of the citations and references throughout this section. The journal's launch in 1967 coincides with the emergence of several digital letterform systems. It established itself as a significant platform of the convergence of engineers and the typographic community. With few exceptions, type designers had little presence in those developments; some of the scientific papers show inaccurate use of typographic terminology. While most of the systems and the people behind them were never heard of again in the typographic community, Hell decided to collaborate with designers early on, built long-lasting relationships with Caflisch, Unger and Zapf, and eventually established itself as a key industry member in type manufacturing during the following three decades.[111]

Bitmaps, vector outlines and their technical implications on aesthetics laid the groundwork for almost all the digital type design systems discussed in the following

111 In 1976, Hell reached out to the ATypI community, when the annual congress was hosted in Kiel, Germany. A little more than two decades after introducing the Digiset, Hell went from inventor of teleprinters, scanners, fax machines and other products of the telecommunication sector to merging with Linotype, one of the leading manufacturers of type, in 1989. They operated under the name Linotype-Hell before being acquired by Heidelberg in 1997.

section. While a look back in history reveals remarkably relevant examples of embroideries that pose reasonable references to designers of digital bitmaps, the link between outline representation of the Renaissance era and outline description of the 1960s should not be overestimated and may simply be proof of people wanting to explore, measure, calculate things to fully understand them — letters included. Resolution-specific bitmaps are praised for the accuracy in the appearance of specific sizes; Southall compares the freedom in bitmap editing to manual punchcutting, in that it makes this technique particularly attractive for designers who have control over the definition of letters in every size at the final steps of the manufacturing process.[112] At the same time, the commercial disadvantages of a technique that is both resolution-specific as well as device-specific, is quite obvious. The merits of scalable outline description lie not only in the improvement of resolution, but in offering better solutions to storage and letterform modification.

With the introduction of parametric algorithms, desires to simplify letters and certain aspects of type design was revitalized, primarily by utilizing the abilities of computers. Although many of the early results are not convincing typographically, they break with the traditional notion of typefaces and fonts as static models, an aspect that concerned designers at the time.

Having explored the available methods to numerical description of letter-like shapes by the early 1980s, the following section investigates specific approaches to digital type manufacturing through the examples of the five type design systems that were presented and demonstrated at the 1983 ATypI working seminar.

112 Southall 1993, p. 95.

4.2. Approaches to numerical description of letterforms

The previous section established methods of numerical description for letter-like shapes available in the 1970s and early 1980s, which allows us to investigate specific approaches that are based on one or more of those methods to design typefaces and produce digital fonts. This section explores the five digital type design systems that were presented and demonstrated at the 1983 ATypI working seminar. In addition, it sheds light on other systems that fall outside the scope of this section, but are considered for further research.

Although some systems have been under more observation than others, the secondary literature on them is generally thin. The aforementioned report by Ruggles on 'letterform design systems' briefly mentions the five systems selected for investigation, among a dozen others. Kathleen Carter includes short overviews of Elf, Ikarus and Metafont in her thesis, but like Ruggles, focuses mostly on technical details and largely overlooks the circumstances. Ruggles was of course associated with Knuth and Metafont, and Carter was the PhD student of Elf-developer Neil Wiseman — biases to keep in mind when assessing the literature. Southall's papers on digital type systems are also influenced by his work on Metafont and close collaboration with Knuth.

When examining the systems, two fundamentally different approaches can be assumed: translating printed or drawn representations of existing designs into numerical descriptions, therefore *digitizing* them, or using a system to create new original designs from the start. In some cases, the developers may claim their system can do one thing, but it performs the other. Each approach is different in terms of the equipment that is necessary to run it and in the way it is operated, although the hardware conditions were somewhat dictated by the state of technology at the time. According to Ruggles, at least three components make up a 'letterform design system': (1) an input mechanism, (2) means of interaction with the system, (3) techniques of displaying the final result.[113]

(1) Some common input mechanisms were introduced in the previous section, e.g. punch tapes, optical scanning, the light pen. The obvious input mechanism for alphanumeric encoding is the keyboard, a device that the typesetting domain had been familiar with in every generation of phototype and in mechanical metal typesetting before that (and in typewriters, too). Four of the five systems use some sort of a hand-held device for pointing, selecting and for input. Although the light pen (utilized in Sketchpad) was still in use, it was also being reconsidered in the 1970s in favour of the 'mouse',[114] a tool further developed at Xerox PARC, where

113 Ruggles 1983, p. 1.

114 The mouse was first presented in a demonstration by Douglas Engelbart in December 1968. Two months earlier the German company AEG-Telefunken presented the first rolling-ball mouse *(Rollkugelsteuerung)*. The mouse was further developed at Xerox PARC in the 1970s.

it first appeared commercially in 1981.[115] (2) 'Means of interaction' refers to the dialogue between the system and those who use it, a relationship also known as human-computer-interaction (HCI). The graphic user interfaces (GUI) were generally not as advanced at the time, but the notion of 'what-you-see-is-what-you-get' (WYSIWYG) was in the air and under development at PARC.[116] (3) Output techniques include rasterized bitmaps for display on a graphic screen, early dot-matrix printers, including predecessors of the laser printer and a variety of plotters for masking film.

Chapter 3 established the environment in which these systems were discussed; this chapter explores the environments in which they were conceived. It identifies Elf and Metafont as results of academic research, Fred as an example of industry research at Xerox PARC, and Ikarus and Camex LIP as commercial products competing in the open market. The systems are therefore discussed in this order, not chronologically. The following subsections shed light on the different approaches, consider the circumstances and the people involved in devising the respective systems. Another aim is to unveil the hidden figures and the contributions of those who have previously been overlooked. The role of type designers in these environments is under special observation. In Chapter 5 these different approaches are cross-examined under considerations of their implications on the greater discourse.

115 Myers 1998, p. 47.
116 Ibid.

4.2.1. ELF: a prototype of applied academic research

Since the mid-1970s a cohort of computer scientists at the University of Cambridge, unofficially known as the Rainbow Group led by Neil Wiseman, engaged in applied academic research on 'computer-designed letters' for more than a decade, which resulted in prototypical digital type design systems, one of which became known as ELF. In the earliest conference presentations and papers Elf was presented as a tool with a high degree of interaction that would make it intuitive especially for designers. As is typical of academic research, a decent amount of published work is available from the group (of changing authors) in periodicals of computer science and information design, but not in typography-specific journals. Wiseman frequently corresponded with Bigelow, Knuth, Unger and others and informed them of updates to his research, attaching articles and department reports called *Rainbow Memo*. This material is available at Rochester and Stanford as well as in private collections. By comparison to these primary sources, there are almost no secondary accounts or reviews worth mentioning. Apart from a brief summary in Ruggles' report, the research of Wiseman et al. is not discussed by Karow, Rubinstein or Southall. The lack of coverage raises some doubts about the system's level of sustainability and realization. Study of the archival records of Wiseman's 1983 ATypI presentation and unpublished paper at RIT support this scepticism.[117]

The development of digital type systems at Cambridge is preceded by explorations into computer graphics and numerical page composition as a result of Wiseman's involvement with a computer-aided book composition system for Cambridge University Press in the early 1970s.[118] This early work, as well as several projects that followed at the university's Computer Laboratory, were based on BCPL, a programming language conceived my Martin Richards at Cambridge in 1969.[119] A paper by Wiseman and fellow researchers Colin Campbell and John Harradine submitted to *The Computer Journal* in the summer of 1977 (published in 1978) is concerned with different formats of 'high quality images' that could be generated on computers for production on a Laser Scan HRD-1 Display Plotter.[120] This device is comprised of a storage display and a high-precision plotter that uses a numerically

117 See Wiseman's paper of the 1983 working seminar presentation and the correspondence with Stanford that followed it [CC, CSC 030, box 5, folder 4].

118 See Neil Wiseman, 'A computer based graphics system written in BCPL', in *IRIA Journées Graphiques,* 1973, pp. 77–86.

119 A manual of BCPL is being continuously updated by Cambridge, see M. Richards, *The BCPL Cintsys and Cintpos user guide,* Computer Laboratory, University of Cambridge, 2022, <https://www.cl.cam.ac.uk/~mr10/bcplman.pdf> (last visited 21 July 2022).

120 See Wiseman 1978.

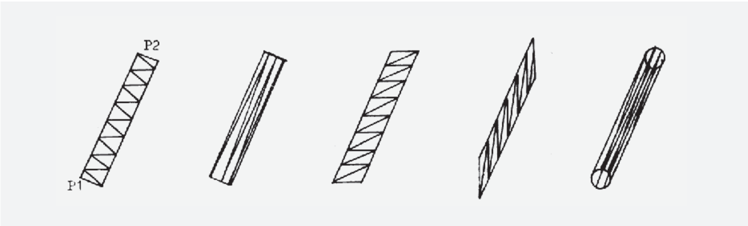


Fig. 4.50 Experiments with strokes at an early stage: geometric shapes are spun between two points, then filled with a 'zigzag' movement of a laser beam for output on a laserscan display plotter. Reproduced from Wiseman 1978, p. 3.

Fig. 4.51 'Stroke spacing': trapezoidal movement of varying density simulates levels of 'image quality'. Reproduced from Wiseman 1978, p. 4.

controlled laser beam on Diazo film, and was available at the university.[121] The authors explore the production of halftones and introduce a method that allows them to draw strokes of various thicknesses by spanning rectangles, centred on a line between two points, and then filling that rectangle with a 'zigzag' movement of the laser beam (**fig. 4.50**). In order to easily connect multiple line segments, Wiseman et al. suggest replacing rectangles with 'trapezoidal areas', precisely not parallelograms.[122] This approach is better illustrated by the example of three different stages of trapezoidal density of the same specimen word 'High', an effect the authors refer to as 'stroke spacing' (**fig. 4.51**), a rather confusing term.[123] The resulting, visually appealing effect manifests the interrelation of drawing speed and 'image quality' — the equivalent might be found in insufficient amounts of ink in letterpress printing or in inadequate levels of exposure in photocomposition. The authors defend their typeface choice:

> It did not seem to us wise to couple any significant change in form with a switch of technology and therefore we have adopted faces closely similar to well known metal types. There is a sense in which we have taken certain liberties with the design of a format but we have had expert advice and guidance and believe that the traditions are being properly upheld and honoured.[124]

The 'closely similar' type is clearly a slight modification of Monotype Bembo, a typeface based on a late fifteenth century Venetian style; 'expert advice and guidance' came from David Kindersley and his partner Lida Lopes Cardozo. Kindersley was a stonecutter, known for his inscriptions on public buildings all over the United Kingdom, who had established a workshop in Cambridge where he was later joined by Dutch stonecutter Lopes Cardozo.[125] Kindersley was also specialized in uppercase lettering in public spaces: in 1951, he designed an all-caps alphabet for street signs of the British Ministry of Transport, later another one for British road signs.[126] His expertise in the design of typefaces is comprised of Octavian, a narrow

121 The plotter was initially developed by Laser-Scan Laboratories in Cambridge, UK, in cooperation with the university's Computer Laboratory where the first device became available in 1973, see P. Woodsford, *The HRD-1 laser display system, Laser-Scan Laboratories,* Cambridge, undated <https://dl.acm.org/doi/pdf/10.1145/563274.563289> (last visited 21 July 2022).

122 Wiseman 1978, p. 3.

123 Ibid., p. 4.

124 Ibid.

125 The lettering on the entrance gate of the British Library is a prominent example of the collaboration between Kindersley and Lopes Cardozo.

126 The street sign alphabet is referred to as MOT Kindersley or Kindersley Street and can still be found throughout England. It is available in digital format as Grand Arcade from Kindersley's workshop via Lida Lopes Cardozo, <http://www.kindersleyworkshop.co.uk/type-design/> (last visited 22 July 2022). The road sign alphabet known as MOT Serif was discarded in favour of the typeface Transport, created in 1963.

Image redacted

Image redacted

Image redacted

Fig. 4.52+53 The first of a series of small publications by Fendragon Ltd., formed by John Harradine, David Kindersley and Neil Wiseman in 1977. According to Kindersley, it is typeset in an early digital version of Bembo. The spacing, much too tight in the sub-headings, is done with Kindersley's letter-spacing system LOGOS. Photographed by the author [GU].

serif face he co-designed with Will Carter,[127] released by Monotype in 1961, and of another, lesser-known type for film-setting in 1976, Itek Bookface.

Within the type community, Kindersley was primarily known for his theories on letter-spacing,[128] which he had written about since the late 1960s and presented at various events including the 1976 ATypI working seminar at Reading, where he described his method as 'entirely derived from the "eye"'.[129] His conclusions were published the same year.[130] Eventually, Kindersley teamed up with Wiseman to further develop this method into a system called LOGOS that could be applied to computer programmes, for which they filed a patent in 1977.[131] The same year, Harradine joined them to form Fendragon Ltd., a firm dedicated to computed type and typography.[132] The first booklet of a small series of *Fendragon* publications is typeset in an unnamed face credited in the colophon as 'under development by Lida Lopes Cardozo', though in a newsletter sent to Gerard Unger, Kindersley admits it is Bembo 'digitised some years ago in rather a primitive fashion' (**figs. 4.52+53**).[133] Unfortunately it remains unclear how it was digitized. Unger responds that the computer-spaced words 'do somehow look natural', but expresses regret over the use of a digital Bembo due to his unconscious comparison with the metal type original.[134] This dialogue is an example of the ongoing debate on what kind of typefaces should be used for new technologies — Unger's position on this has been recorded in 3.4.3. The booklet gives no further clues as to how the typeface was digitised at all, but the authors offer a general, yet vague description of how they envisioned digital type design:

> Computer assistance with the design of letters would put many facilities at the disposal of the designer, supplementing if not replacing the pencil and sketchpad. The designer would sit at a screen attached to a computer and use an electronic pencil, the lines he sketches appearing on the screen. The computer would smooth curves which are uneven, or generate families of

127 Will Carter was the founder of the Rampant Lions Press in Cambridge, continued by his son Sebastian until 2008. Previously to Octavian, Carter designed Klang for Monotype in 1955. Will and Sebastian Carter are not related to Harry and Matthew Carter who are also mentioned in this thesis.

128 See D. Kindersley, 'Optical letter spacing', in *Penrose Annual,* vol. 62, 1969.

129 See *Summary report of the second working seminar on the teaching of letterforms,* University of Reading, July 1976, pp. 17–20.

130 See D. Kindersley, *Optical letter spacing for new printing systems,* Wynkyn de Worde Society, 1976.

131 Submitted under the British Patent Application no. 27266/77 for 'Letter spacing', granted in 1982, filed as GB2004502A 'Determining the spacing of character'. Meanwhile the patent has expired.

132 From a 1977 letterhead of Fendragon. A 1978 letterhead lists two more partners: Peter Robinson and Michael Jordan [GU].

133 In an undated newsletter (1977) by Kindersley to Unger alongside an attached copy of the *Fendragon* booklet for evaluation of the page 'texture' [GU].

134 Undated hand-written draft of Unger's response to Kindersley [GU].

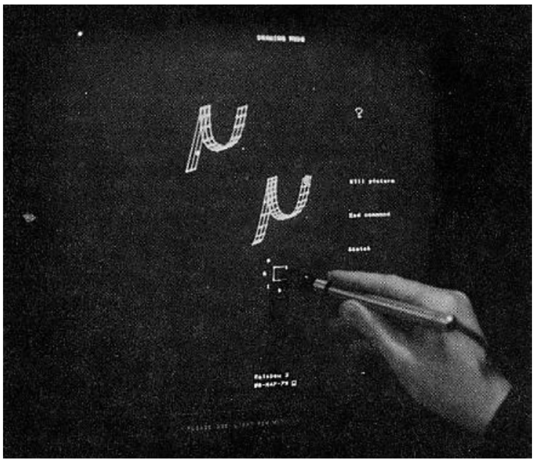


Fig. 4.54 Photograph of the Elf interface on a monitor. Photographer unknown, reproduced from Pringle 1979, p. 68.

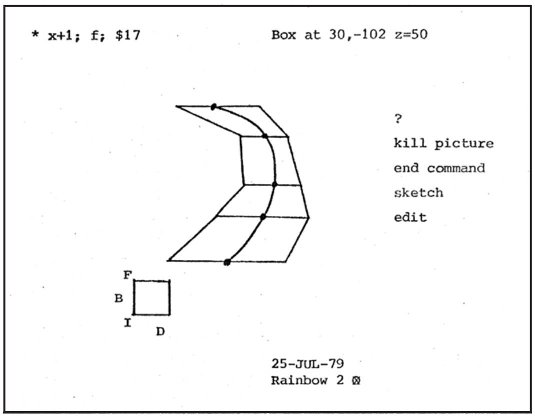


Fig. 4.55 Mock-up of the Elf interface, reproduced from Pringle 1979 [SUA, CS 0097, box 14, folder 3.5].

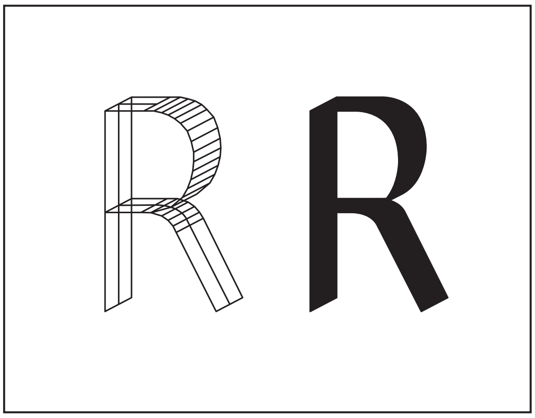


Fig. 4.56 Illustration from Kindersley 1979, p. 17, redrawn by the author due to the poor quality of the reproduction.

Image redacted

Fig. 4.57 A string of trapezoidal strokes results in a polygonal outline. Reproduced from Carter 1986, p. 22.

> curves for him to choose from. While he is working he could display the centre and computed width of the character, and alongside the one on which he is working he could display other characters from the same or different alphabets. Once the fount is designed the computer would store it for future use.[135]

Some of the hypotheticals described here as well as the earlier explorations into trapezoidal strokes eventually culminated in the development of Elf in early 1978. Wiseman and his PhD students Alison Pringle and Peter Robinson first presented the system as one of three Rainbow projects that relate to 'aspects of quality in the design and production of text' at the 1979 SigGraph conference in Chicago.[136] In the published paper, the authors introduce two themes, which were further developed in later articles: the issue of 'quality', described as the similarity between the designer's intention and its realization in digital form, and the attempt to address those qualities with a 'typographer's or printer's eye' by collaborating with practitioners from those fields. A closer look at the system's functions and its results is necessary to determine whether it meets these objectives.

The light pen was adopted as the user's primary device to draw directly on the vector display, leaving a sequence of connected points that generate shapes (**fig. 4.54+55**). As Wiseman admits, this set-up resembles 'an interactive graphics system for handling simple geometric objects',[137] — immediately Sutherland's Sketchpad comes to mind. However, the laser plotter and light pen were likely 'pressed into service' because they were simply available at the Computer Laboratory.[138] Trapezium shapes were constructed around each of the points with the option to define width and angles, which enabled the emulation of pen strokes (**fig. 4.56**). A complete string of trapezia resulted in a 'line chain outline', i.e. in a polygonal outline (**fig. 4.57**).[139] The resulting polygonal digital letterforms would have been unfavourable at large sizes unless they were comprised of an unreasonable amount of points, i.e. trapezia.

Ruggles describes Elf as a system that assists its users through all stages of designing a typeface from early sketches to the final step of 'encoding the finished form' and storing it in a digital format.[140] During this process, 30 commands were at disposal to change the style of a selected line segment, to delete, insert or change the coordinates of points, etc.[141] In addition to one active letterform, the display mechanism allowed simultaneous comparison of three passive characters, surely an

135 Harradine 1977, p. 3.

136 The other two projects deal with high-quality text for television transmission and with computer-based typesetting of tabular text. See Pringle 1979.

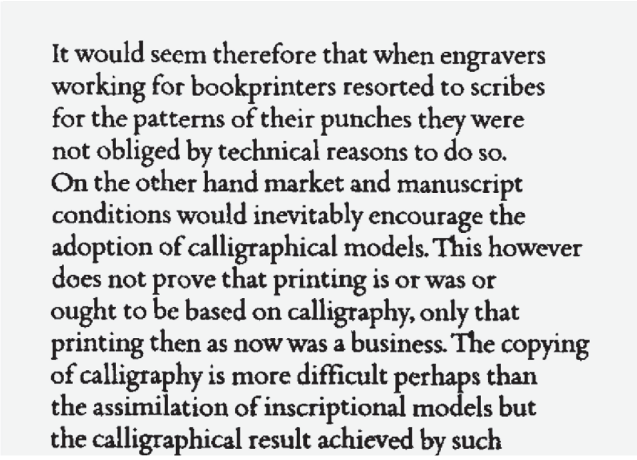
137 Wiseman 1980, p. 220.

138 Pringle 1979, p. 64.

139 Wiseman 1980, p. 221.

140 Ruggles 1983, p. 9.

141 Ibid., p. 10.



It would seem therefore that when engravers working for bookprinters resorted to scribes for the patterns of their punches they were not obliged by technical reasons to do so. On the other hand market and manuscript conditions would inevitably encourage the adoption of calligraphical models. This however does not prove that printing is or was or ought to be based on calligraphy, only that printing then as now was a business. The copying of calligraphy is more difficult perhaps than the assimilation of inscriptional models but the calligraphical result achieved by such

Fig. 4.58 Reproduced from Pringle 1979, p. 68.

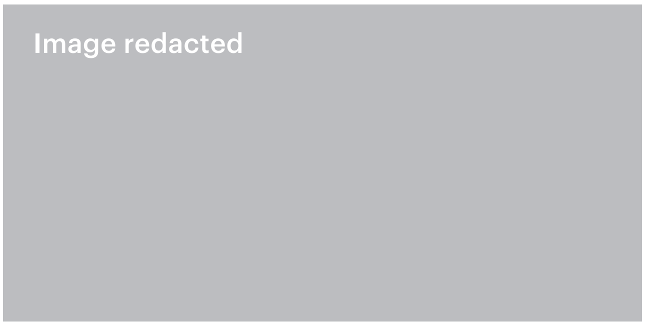


Fig. 4.59 This illustration in K. Carter's thesis of a trapezoidal description of a five letters of Bembo offer a clue, but no proof that a complete font may have been produced in Elf. Reproduced from Carter 1986, p. 22.

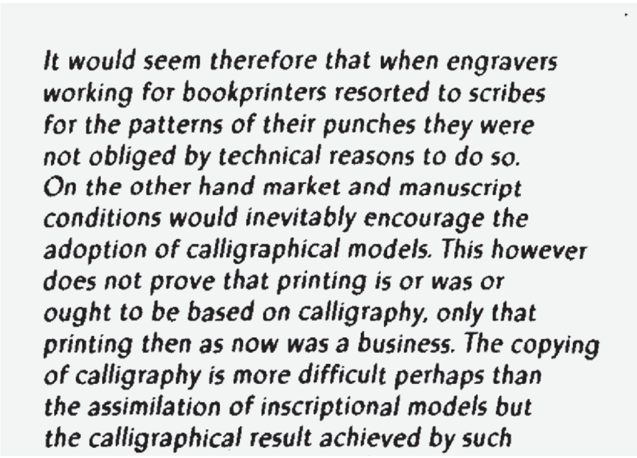


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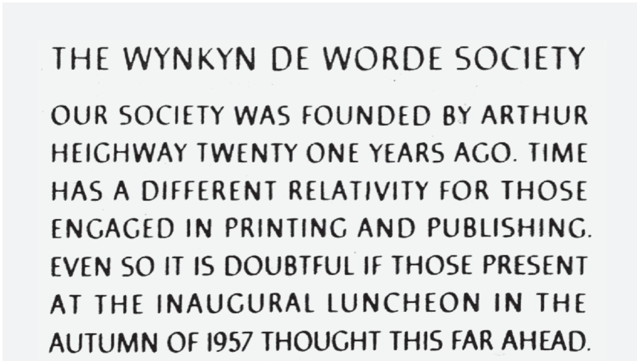
Fig. 4.60 'A new face'. Reproduced from Kindersley 1979, p. 17.



THE WYNKYN DE WORDE SOCIETY

OUR SOCIETY WAS FOUNDED BY ARTHUR HEIGHWAY TWENTY ONE YEARS AGO. TIME HAS A DIFFERENT RELATIVITY FOR THOSE ENGAGED IN PRINTING AND PUBLISHING. EVEN SO IT IS DOUBTFUL IF THOSE PRESENT AT THE INAUGURAL LUNCHEON IN THE AUTUMN OF 1957 THOUGHT THIS FAR AHEAD.

Fig. 4.61 An 'experimental face'. Reproduced from Wiseman 1980, p. 222.

Fig. 4.62 24 point Klang by Will Carter (1955). Alphabet printed at The Stellar Press, Barnet.

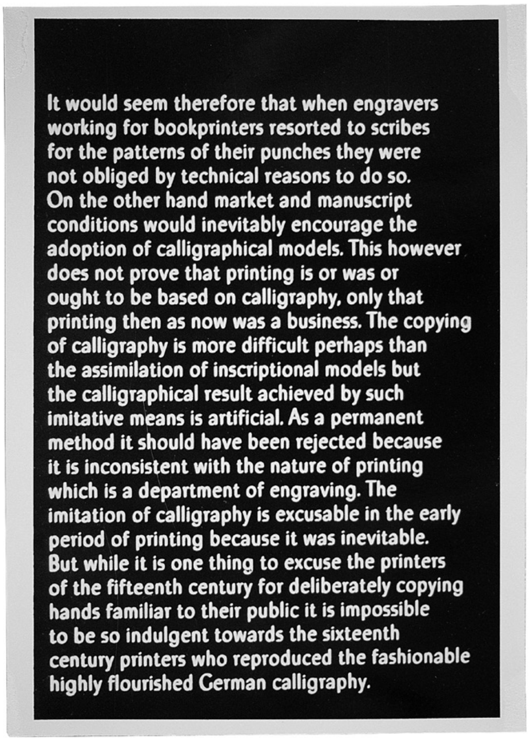
indication of an advanced user interface. Apparently, it was also possible to adjust the sensitivity of the light pen by applying parameters such as handshake tolerance and sample rate in order to suit users' drawing styles.[142] Without further evidence it is difficult to verify these features.

With the exception of one photograph (**fig. 4.54**), all published images of the Elf interface in Wiseman's papers seem to be mock-ups (like **fig. 4.55**). Two papers published in 1979 reproduce a page of the *Fendragon* booklet (**fig. 4.58**), typeset in the face 'similar to Bembo' — it remains unclear if this is the version 'digitized some years ago' when Elf did not yet exist or whether another version was created later using Elf (**fig. 4.59**). Despite the lack of published results, the team behind Elf was convinced that the system would find acceptance:

> Given the appeal which [Elf] seems to have for designers one could envisage systems being accepted in professional design studios. [...] A new face, not yet fully developed, was used for the examples of Fig. 6. [...] It suggests, in fact, that something like the standards of calligraphy might be achieved given a rich repertoire of letterforms.[143]

These excerpts of a closing paragraph are full of assumptions about the underlying principles of Elf and its applications, about things that 'seem', that 'could' or 'might' happen. Readers are provided with little evidence of other interested designers in addition to Kindersley and Lopes Cardozo, and what it is particularly that speaks to them in Elf. It is difficult to make conslusions based on the few examples 'not yet fully developed'. The mentioned 'new face', referred to as an 'experimental face' in one of the captions, can be found in two articles by Wiseman et al.: a serifless Roman with attributes of a broad-nib in the stroke endings, italic in one illustration (1979, **fig. 4.60**), upright and all-caps in another (1980, **fig. 4.61**). These unnamed examples bear considerable resemblance to Monotype Klang (**fig. 4.62**), a contrasted sans serif typeface designed by Will Carter, who was also a co-designer of Kindersley's Monotype Octavian. The system's underlying trapezoidal technique would suggest that this is *the* prototypical alphabet designed with Elf. However, a flaw lies precisely in the attempt to achieve 'standards of calligraphy'; building an approach to type design on a calligraphic model would result in a rather limited repertoire. As Wiseman's PhD student Kathleen Carter admits, letterform definition from pen strokes was helpful for sketching an initial idea, but less so at later design stages: 'Some type faces are calligraphic in form, but very many are not [...].'[144] Like lettering, calligraphy is a domain of its own, characterized by a composition of letterforms that make sense in a singular context, while type refers to a concept of arranging (typesetting), disassembling and rearranging characters.

142 Wiseman 1980, p. 221.
143 Kindersley 1979, p. 17.
144 Carter 1986, p. 21.



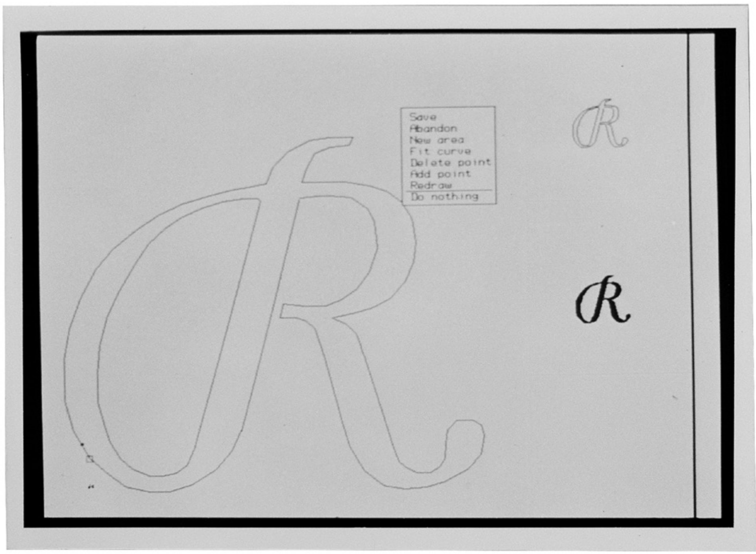


Fig. 4.63+64. Archival findings: illustrations of an unpublished paper by Wiseman (1983/84) show traces of Elf (left), the paragraph seen in **fig. 4.60** of the same typeface, but upright, and screenshots of another system (right) that uses polygonal outlines in an interface of 'windows'. Photographer unknown, reproduced by Norman Posselt [CC, CSC 030, box 5, folder 4].

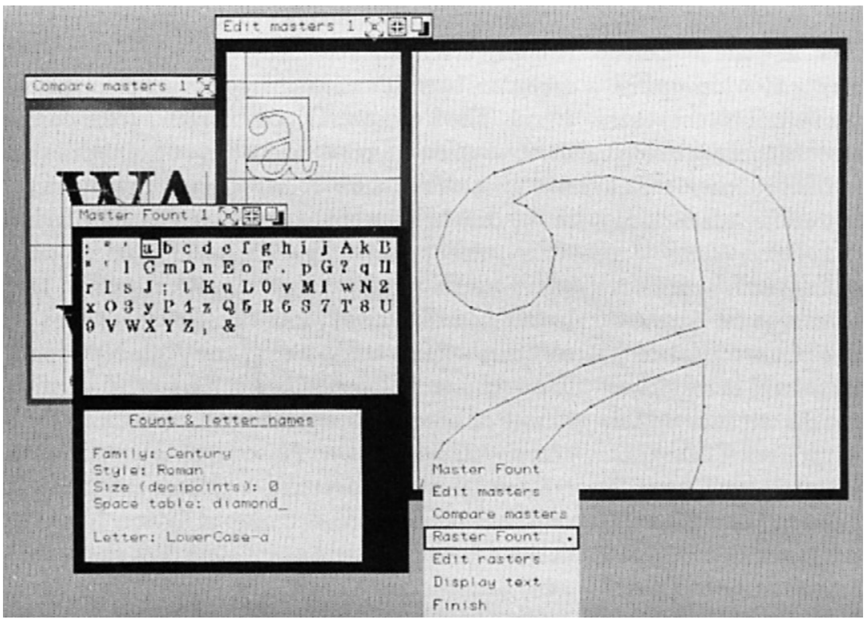


Fig. 4.65 Catherine Carter's applied research thesis is concerned with the development of the digital type design system Imp and follows the concept of 'managing windows on screen'. Reproduced from Carter 1987, p. 164.

Although Wiseman was announced to introduce the Elf system at Stanford in 1983, it remains uncertain as to what he actually presented. A reviewer of the seminar remembers a presentation of Elf, but without an actual hands-on demonstration.[145] As Bigelow recalls, the organising team offered Wiseman a computer to demonstrate his system, but could ultimately not provide a corresponding interpreter, after he revealed it was written in BCPL.[146] With over a year of planning ahead of the seminar, it seems odd that this challenge could not be overcome, especially at Stanford. When Wiseman submitted his paper to Bigelow and Ruggles half a year later, he explains it was based on 'what I think I said'.[147] The name 'Elf' is not mentioned once in the submitted paper; none of the ten slides found in the archives show characteristics of the system (e.g. trapezium shapes, light-pen, etc.). Instead archival research revealed screenshots of outlined letters (**fig. 4.64**), of anti-aliased letterforms and of the same old paragraph of the 'experimental face' (**fig. 4.63**).[148] A manuscript of the unpublished paper, titled *Computer-aided typographical design,* describes a new Rainbow workstation, built on the concept of 'managing windows on screen'.[149]

It must be assumed that Wiseman had no intention to publish another article on the merits of Elf. He may have abandoned the system in early 1984 after he had moved on with another project: the new digital type design system that captured his attention was IMP, developed as part of Carter's applied doctoral thesis.[150] Work on Elf may have also been suspended for hardware reasons. In her thesis, Carter mentions Elf in past tense and implies that one of its key components, the vector display, had become obsolete.[151] Imp ran on the new Rainbow workstation, made full use of an interactive principle of overlapping 'windows' environment (**fig. 4.65**) and utilized a mouse for interaction, similar to the concepts brought forward by Xerox PARC and Apple in the 1980s. Oddly, the outline description in Imp could not calculate curves and continued to rely on polygons, a technique that seems almost antiquated in the mid-1980s. The user manual for Imp is credited to Lynn Ruggles, who collaborated with Carter on the project during a research visit to Cambridge in 1985, and is available as part of the thesis.[152] Carter and Wiseman continued to publish on the greater concept of a 'window management programme' that includes Imp as an application.[153] An investigation of the transition from Elf to Imp goes

145 Pankow 1984, p. 8.

146 Charles Bigelow in an interview with the author, 8 September 2017 [audio file 01, 13:20].

147 Letter by Wiseman to Bigelow, 8 February 1984 [CC, CSC 030, box 5, folder 4].

148 It is difficult to assess whether these are photographs of a display screen or whether they are analogue mock-ups [CC, CSC 030, box 5, folder 4].

149 Wiseman 1984, p. 1.

150 Carter 1986, pp. 72–141.

151 Ibid., p. 21.

152 Ibid., p. i and appendix 1, 'Imp user manual', pp. 1–27.

153 See Carter 1987.

beyond the scope of this thesis, but should be considered for further research elsewhere.

Taking everything into account, it must be concluded that Elf was a system in use at a prototypical stage, under development between 1978 and 1983, before it was discontinued in favour of a new approach. The academic environment of such a project allowed the group to pursue research over this time span without presenting a fully sustainable outcome. Digitally drawing trapezium-shaped letterforms that have adjustable angles to mimic pen strokes offers an intriguing approach and a unique technique to polygonal outline description.[154] However, the absence of a proper demonstration at the 1983 working seminar suggests that it was not ready to be put to the test by an inquisitive audience, side-by-side with competing systems. Unfortunately, this also means that no secondary accounts of seminar participants is available. In terms of the merits and features of Elf we would have to take the authors at their word — much of the claims are frankly not visible in the published material that is reviewed and considered here. Hopefully private collections of former members of the Rainbow Group and their collaborators become available for further research so that more evidence can be revealed.[155]

154 Towards the early 1990s, Wiseman became more interested in Knuth's Metafont approach and co-wrote a paper on 'skeletal strokes', see S. C. Hsu, I. H. H. Lee & N. Wiseman, 'Skeletal strokes', in *UIST '93: Proceedings of the 6th annual ACM symposium on user interface software and technology,* December 1993, pp. 197–206.

155 An inquiry in 2017 revealed that archival material of the project was not available at Cambridge. Unfortunately, Kathleen Carter could not be contacted for an interview.

4.2.2. METAFONT: a specific typographic brief

Donald Knuth's initial concern was the development of a 'system for technical text' called TEX, before he began to work on METAFONT in 1978, a 'system for alphabet design'. It is also the name of its programming language that could generate fonts for TeX.[156] As a computer scientist and in his capacity as professor at Stanford University since 1969, Knuth had been concerned with the analysis of algorithms for several years; the epitome of this work is published in what can be considered his life's work, *The art of computer programming;* initially planned as six, then seven volumes.[157] The concept of Metafont changed significantly between 1979 and 1984, hence the distinction between two versions called 'Metafont 79' and 'Metafont 84'. During this time, its development benefitted from the academic framework it was rooted in, through the formation of a graduate programme with Charles Bigelow, with frequently visiting scholar Richard Southall and a cohort of students who formed the Digital Typography Group (see 3.2). Their contributions to Metafont are considered in this section, as are Knuth's collaborations with visiting type designers. Different aspects of Metafont are well documented, including in Knuth's extensive literature, in published papers by Bigelow and Southall and in several Masters and PhD theses. There is however, far less critical secondary literature by authors who were not in some way involved.[158] The Stanford University Archives hold Knuth's material related to Metafont such as printed source code and output material, related correspondence, course material, reports, and a vast collection of 'digital type incunabula'. Southall's papers are also archived at SUA, while some of his Metafont material is held at DTGC. Interviews with Knuth and Bigelow follow the methodology as discussed in 2.3.1.

Although Knuth identifies the order of developing TeX and Metafont as a 'chicken and egg problem',[159] it is very much in line with a recurring pattern: improvements of text composition systems are followed by the production of fonts that optimize the representation of type with the new technique.[160] Work on TeX began in 1977, upon examining proofs of the phototypeset second edition of *The art of computer programming,* volume two. Knuth's frustration with line-breaks and

156 These definitions of the two systems follow Knuth's chapter headings in the official manual of TeX and Metafont, see Knuth 1979. According to Knuth, the 'X' in TeX is pronounced like a German 'ch' in *ach,* Knuth 1979, chapter 1, p. 4. Knuth typesets $\TeX$ throughout his publication, while the common spelling of the system's name is used here: TeX.

157 Volumes 1 (1968), 2 (1969), 3 (1973) and instalments of 4 (2005–2015) have been published, while others are in planning or remain to be announced. Work on volume 4 was suspended in 1977 as a result of the development of TeX.

158 See Hofstadter 1982 (although a fierce critic, Knuth credits Hofstadter as a consultant on the design of Computer Modern) and Leonidas 2000.

159 Donald Knuth in an interview with the author, 22 October 2018 [audio file 01, 13:50].

160 Southall 1986, p. 17.

particularly with the representation of mathematic formulas conflicted with the quality he had experienced in the first edition typeset and printed from hot-metal Monotype.[161] In an attempt to preserve those standards, Knuth envisioned a system that would be a 'big paste-up job': all graphic elements of a document are metaphorically categorized as either 'boxes' or stretchable 'glue'.[162] Boxes describe all movable, printed elements such as characters, words, lines of type and entire paragraphs, while glue represents the white space that binds them, spacing between characters, words and lines. In the early 1980s, TeX was already popular and used by scientist worldwide. Twenty years later, the typesetting of Knuth's book *Digital typography* (1999) was reviewed as a 'subtle benchmark' and praised for its superiority of line-breaking algorithms, even over PostScript-based alternatives, until it was apparently matched with the introduction of Adobe InDesign in 1999.[163]

The urge to provide fonts for TeX began with unsuccessful attempts in creating letterforms directly in the typesetting system,[164] but as it would in any such technology, eventually this proved to miss the point.[165] Knuth recalls witnessing letterform exercises on monitors during a visit to Xerox PARC, probably in 1978, which may have given another impetus.[166] In any case, the conception of Metafont seems to follow a specific typographic brief that Knuth gave himself. One motivation is expressed in the discussion around the design of the 1983 ATypI logotype (see 3.4.3), during which Knuth claims, 'simply' tracing the outline of pre-existing drawings (as Sumner Stone did using Ikarus), would not provide any 'insights' and instead proposes to capture the 'principles' of the design and then use their specifications to generate the remaining letters. This idea of recording the 'intelligence' behind a design is an aspect that is repeated in Knuth's work:

> I believe that this aspect of Metafont — its ability to capture the designer's intentions rather than just the drawings that result from those intentions — will prove to be much more important than anything else.[167]

Whether it is at all possible to capture 'intentions' of designers or the 'intelligence' of typefaces is a central question of parametric design methods that has been raised in 4.1.3. Before taking a closer look at Knuth's approach, it is necessary to clarify the

161 These standards are documented in Monotype type specimens of that era (e.g. Times 4-line mathematics 569) and in more detail in *Monotype Recorder,* vol. 40, no. 4, 1956.

162 Knuth 1979, part 2, p. 41.

163 Leonidas 2000, p. 112.

164 Donald Knuth in an interview with the author, 22 October 2018 [audio file 01, 14:00].

165 As mentioned in 4.1.3, even in metal type technology, it was possible to create new letterforms from modular components, but this was time consuming and not a very sustainable technique.

166 Donald Knuth in an interview with the author, 22 October 2018 [audio file 01, 14:30]. Knuth was a consultant to Xerox PARC at the time and came to meet John Warnock. As he recalls, all the office doors were open; he may likely have seen the Xerox Alto Font Design System in use.

167 Knuth 1985, p. 38.

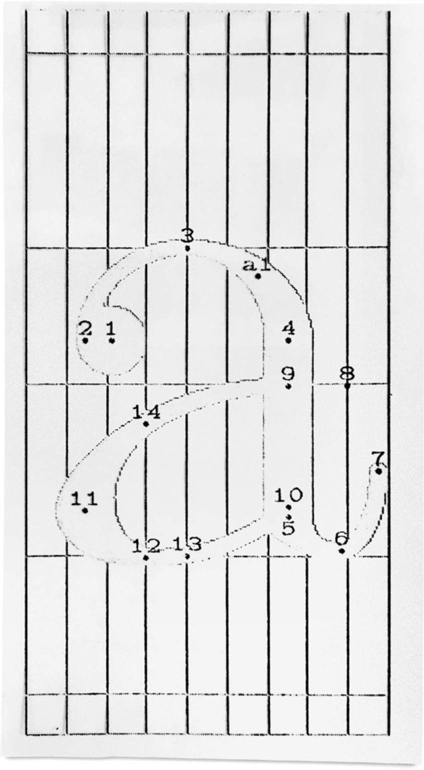


Fig. 4.66 Letter proof of Donald Knuth's Computer Modern, plotted on a translucent foil: points sit on the spine of the stroke. Photographed by the author [SUA, SC 1002, box 1, folder 5].

Fig. 4.67 Transformation of pen parameters. Photographed by the author [SUA, SC 0097, box 21, folder 10.9].

use of the term 'metafont'. As has already been established, Metafont is the name of the system and of the language that is used to write code in the Metafont interpreter. The result of the system is 'a meta-font' (typically spelled with a hyphen), which does not refer to *one* specific font, but offers a 'schematic description' of several instances within a larger design space,[168] all of which would be identified as equal members of a family by their visual attributes, regardless of style and function. Southall uses the phrase 'ways of doing meta-design', and refers to degrees of 'meta-ness'.[169]

The original Metafont 79 was developed in less than a year,[170] and follows Knuths paradigm of 'the three P's of Metafont — drawing with pens and parameters via programs'.[171] Similar to his introduction of 'boxes' and 'glue' in TeX, Knuth continues this metaphorical approach in Metafont: the hardware setup does not actually include a physical pen device for input (like in Elf), instead coordinates and parameters of a virtual 'pen' are programmed in order to 'draw' strokes that leave behind a trail of pixels, while 'erasers' can be used to 'clean off the ink'.[172] These digital strokes are described by spline paths, their points sit primarily on the spine of the stroke, not on the contour (**fig. 4.66**). Users of Metafont can change coordinates to adjust the overall proportions, width and height of a letterform or modify the pen parameters to transform its weight, stroke contrast, pen angle, pen pressure, and others (**fig. 4.67**). Early on, Knuth included specifications for scale and type size to determine the desired resolution for the output bitmap format, which offered a promising take on optical sizes (further discussed in 5.2.3).

The parallels between Knuth's approach of digital strokes and Gerrit Noordzij's theory on pen strokes are quite intriguing. Noordzij's thesis is based on the observation that characteristics of every writing tool are captured in the strokes they produce. According to his model, all western letterforms are derived from two categories of pen strokes: 'translation' describes those derived from broad nib pens, 'expansion' is represented by pointed nib pens.[173] These terms are understood mathematically, comparing 'translation' to a vector that carries points, while its length and direction defines stroke width and angle respectively (**fig. 4.68**). In the

168 Knuth 1982, p. 4.

169 From an unpublished report by Richard Southall, dated 8 December 1983 [SUA, SC 0097, box 21, folder 10.13]. Interestingly, the well-known Berlin-based design firm MetaDesign was founded in 1979. According to one if its founding partners Florian Fischer, the name means *'design für design'* (design for design). From an unpublished essay by Fischer, November 2003.

170 First drafts of the Metafont interpreter and its syntax were ready by mid-December 1978, Knuth added the first successful drawing routines by April 1979. The first complete version of Metafont 79 was presented by early July and was officially 'released' for use on 25 October 1979 [SUA, SC 0097, box 21, folders 9.1–5].

171 Knuth 1985, p. 39.

172 Knuth 1979, part 3, p. 24.

173 Noordzij 1982, p. 7 f.

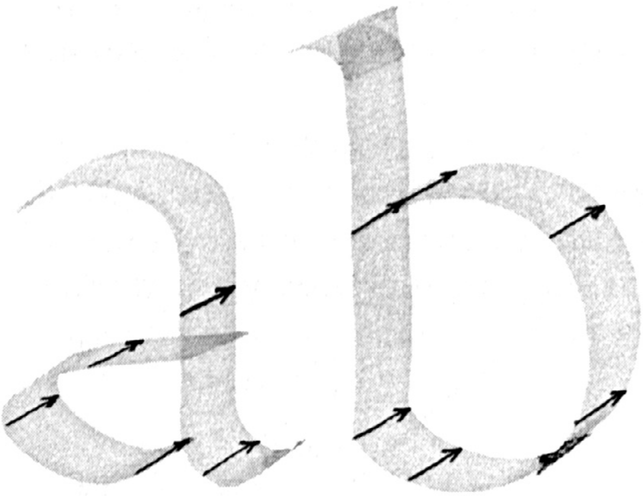


Fig. 4.68 Translation model: the arrows indicate vectors that carry points. Reproduced from Noordzij 1982, p. 9.

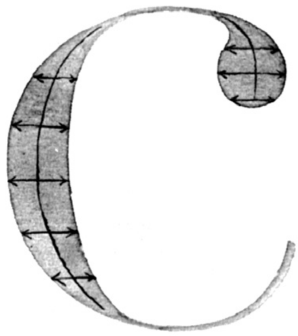


Fig. 4.69 Expansion model: vectors expand from the spine of the stroke to both sides. Reproduced from Noordzij 1982, p. 10.

Image redacted

Fig. 4.70 Display of a letter in the Metafont programme. Reproduced from a dia slide [DTGC, Richard Southall collection, ‘old Metafont’].

'expansion' model, points sit on the spine of the stroke, vectors of the flexible nib expand to both sides (**fig. 4.69**) — an analogy also found in Metafont. Some of these early ideas first appeared in the 1973 ATypI congress publication (see 3.4.1) and in Dutch in 1978,[174] but by the time they were first published in more detail in English in 1982, Knuth had long established the basic concepts of Metafont 79.[175]

Knuth claims, in order to capture the 'designer's intentions' he tried to study 'as much as possible about what was in that person's mind' in order to 'incorporate that knowledge into a computer'.[176] According to Noordzij, by choosing a pen, attributes of the resulting letterform are defined before making a single stroke. In offering more than a handful of different nibs, Knuth considers that choice, however, many more aspects need to be taken into account. It is reasonable to assume that a type designer brings several intentions to the table before Metafont is put into use: ideas of a range of weights and widths, possibly a clear project brief that would suggest legibility in smaller sizes or optimization for use in a signage system. The ability to assess the design at any stage, to make proofs and adjustments, to try out alternatives etc. are part of a design process. In any case, all of the steps would have to be translated in Metafont using the appropriate language to code parameters in the Metafont syntax. The GUI of Metafont 79 was not very responsive and offered very little interaction, coded letterforms appeared on the monitor with quite some delay (**fig. 4.70**) and designers had no visible reference to fall back on. For someone with a visual image in their mind, this method must have appeared counter-intuitive.

When Knuth and Bigelow started the Digital Typography programme at Stanford in 1982, Knuth assumed that their students had not yet specialized their left or right brain and that through the programme they could have 'a foot in each world';[177] he later concluded this did not happen and called the idea naïve.[178] Perhaps his proposal that computer scientists should 'team up' with type designers stems from this realization. Knuth invited Gerard Unger to Stanford in August of 1980,[179] Matthew Carter (sponsored by Mergenthaler) and Hermann Zapf (on a grant of the National Science Foundation) had visited earlier that year (see below). Richard Southall, once described as a person 'at the meeting point of type design

174 See Gerrit Noordzij, 'Haag's ABC', in *Compres,* no. 3, 1978, pp. 13–19.

175 No correspondence between Noordzij and Knuth was found in the collections at SUA that would suggest an exchange. Charles Bigelow does not recall Knuth ever citing Noordzij's writings or work. Correspondence between Bigelow and the author, 16 October 2022.

176 Knuth 1985, p. 39.

177 Following the lateralization of brain function, according to which the left brain is concerned with mathematics and logic and the right brain with imagination and arts, and the widespread notion that people tend to lean towards one of the halves.

178 Donald Knuth in an interview with the author, 22 October 2018 [audio file 01, 28:15].

179 Unger worked on trial characters of his typeface Flora with the help of Scott Kim, see Burke 2021, p. 105.

Image redacted

Fig. 4.71 Members of the Digital Typography Group c. 1983/84, identified with the help of Charles Bigelow. Standing: [?], Donald Knuth, John Hobby, Lynn Ruggles, Nazneen 'Neenie' Billawala. Kneeling: David Siegel, Charles Bigelow, Dikran Karagueuzian, David Fuchs, Richard Southall. Photographer unknown, reproduced from a dia slide [DTGC, Richard Southall collection, 'new CMR 2'].

Image redacted

Fig. 4.72 Sketches and notes by Richard Southall during his first visit to Stanford, 1981/82. Photographed by the author [SUA, SC 1002, box 1, folder 2].

and computer science',[180] therefore the ideal collaborator for Knuth, first visited the department in 1982 and returned frequently as a full member of the Digital Typography Group during the academic year of 1983/84 and in the Spring and Summer of 1985 (**fig. 4.71**). During this time, he took many notes, made observations and sporadic attempts at designing letters and alphabets, and used Metafont as a 'drafting system' (**fig. 4.72**).[181] While at Stanford, Southall wrote several papers on the development of Metafont, calling out its problems and weaknesses and making proposals for improvement; his unpublished reports appear to be more critical though,[182] while most of his published accounts of Metafont are rather descriptive.[183]

Knuth and Bigelow established the 'Metafont lunch bunch', during which students and teachers shared their experience with the system. Knuth's collection at the Stanford archives contains countless memos from those session; feedback ranges from technical difficulties and missing functions to lack of programming skills and the ability to abstract far enough.[184] One memo captures a main challenge in working with a design tool that lacks a tangible input mechanism and an interface for an immediate visual reference:

> Can't see what I'm doing. Can't do what I'm seeing (in my mind).[185]

The Digital Typography programme became the backbone of research on Metafont during the 1980s: the exchange of feedback and criticism turned into a crucial factor in its development, while the students formed a close-knit community that became concerned with various aspects of Metafont that Knuth had not explored himself. E.g. Nazneen Billawala explored the basic components of letterforms as 'families of shapes' and declined a collection of 'meta-marks' (**fig. 4.73**), after which she embarked on the design of her own 'family of typefaces' called Pandora. Billawala, who went to an art school before attending Digital Typography, reflects on learning an algebraic language:

> Put in perspective, it takes a long time to learn how to draw type by hand or to use the broad edged pen for calligraphy, so people shouldn't expect computers to be any easier. Two-person teams (designer and programmer) may prove to be a productive combination in many instances, or perhaps the combination of designer and programmer in one person will become more common in the generation that is growing up with computers.[186]

180 André 2015, p. 100.
181 Southall 2005, p. 222.
182 E.g. Southall 1985.
183 E.g. Southall 2005, pp. 185–203.
184 See collection of notes in SUA, SC 0097, box 21, folder 10.13.
185 Ibid.
186 Billawala 1989, p. vi.

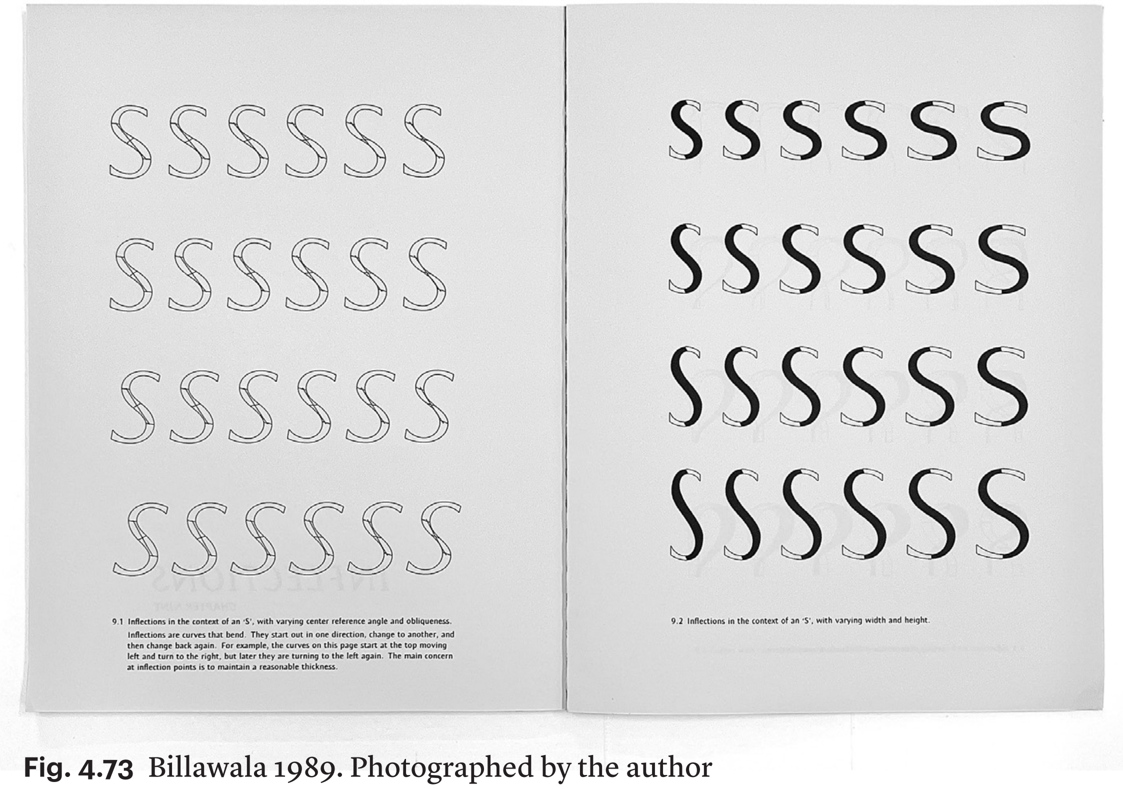


Fig. 4.73 Billawala 1989. Photographed by the author [DTGC, Richard Southall collection, box 14].

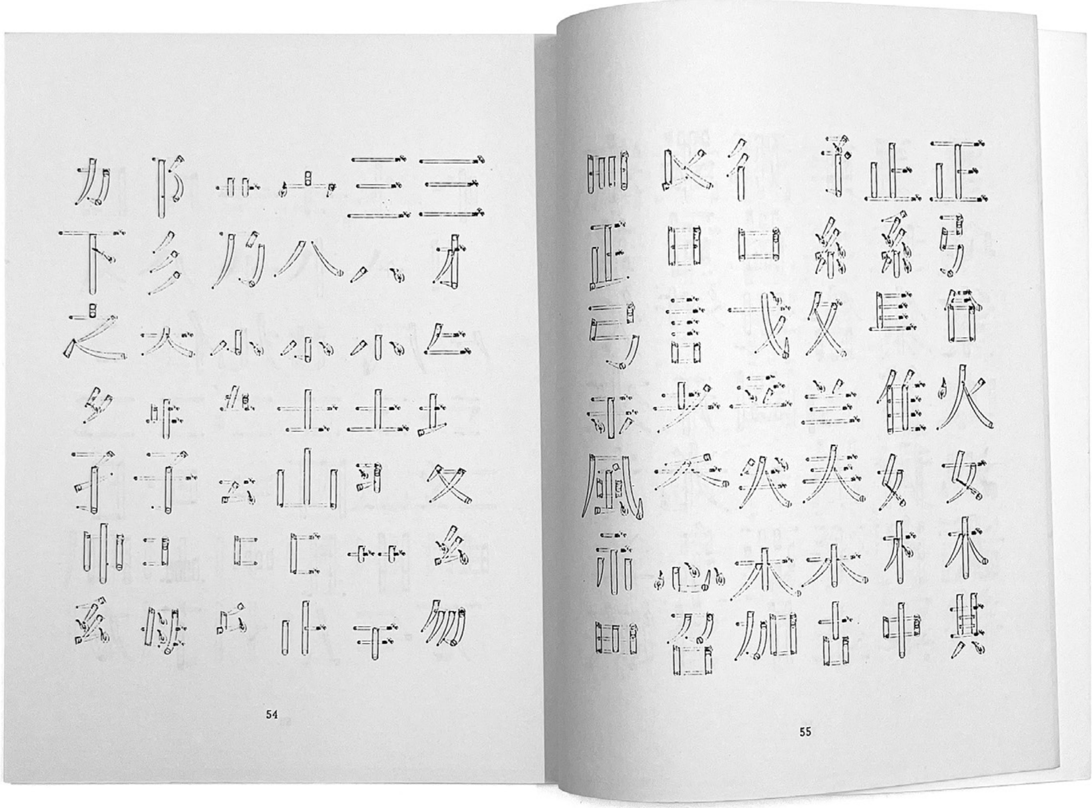


Fig. 4.74 Mei 1980. Photographed by the author [ibid.].

Even before the programme emerged, Tung Yun Mei published a paper on an experimental system for Chinese character design in October 1980. Based on experience with the parametric approach in Metafont, Mei developed a 'character font compiler' called LCCD (Language for Chinese Character Design) which describes characters from basic strokes and so-called 'radicals' similar to the approach in designing with components, as explored in 4.1.3. (**fig. 4.74**).[187] A rich repertoire of reports and papers by Digital Typography students were published in *Tugboat,* the official organ of the TeX Users Group, where they remain digitally accessible.

The most prominent example of a meta-font is Knuth's own Computer Modern Roman (CMR, **fig. 4.75**), developed almost simultaneously while devising Metafont 79, in an attempt to 'capture the spirit' of Monotype Modern Extended 8A, the typeface used in the first edition of *The art of computer programming.*[188] This attempt earned criticism from prominent typographers, not least because to some CMR represented an inaccurate rendition of the original Monotype Modern. Over the years, Knuth constantly changed and improved CMR and was not shy of using it for publications early on — in some cases prematurely. For the first edition of *TeX and Metafont* (1979), Knuth admits to having developed the typeface 'rather hastily' and referred to himself as 'a rank amateur at such things'.[189] Although his 1982 article about 'the concept of a meta-font' (in the aforementioned issue of *Visible Language*) caused quite a controversy, it must be regarded not only as a manifesto of the meta-font concept, but as an ode to CMR: the entire article functions as a type specimen filled with different type sizes and a remarkable repertoire of instances created by Metafont, changing with almost every page.

In a follow-up issue, Stanford alumnus Douglas Hofstadter offered a fair response of Knuth's concept that went far beyond a formal criticism and suggested a counter proposal,[190] followed by fifteen letters to the editor by prominent type designers and typographers.[191] Although Knuth received some encouraging words (by Bigelow and Zapf) the majority of responses paint the picture of a typographic community that is unforgiving about the odd appearance of a familiar typeface, while overlooking the potential of a new technology if it laid in the hands of experienced designers. Perhaps the greatest misinterpretation of its critics is the notion that CMR is simply a digital revival of a classic, when it is actually a numer-

187 Mei 1980, p. 3.

188 Knuth 1982, p. 7.

189 Knuth 1979, chapter 3, p. 1.

190 See Hofstadter 1982.

191 See Wrolstad 1982. The medley is comprised of comments by Baudin, Bigelow, Henri-Paul Bronsard, Ed Fischer, David Ford, Gary Gore, Karow, W. P. Jaspert, Albert Kapr, Alexander Nesbit, Edward Rondthaler, John Schappler, Walter Tracy, Unger and Zapf.

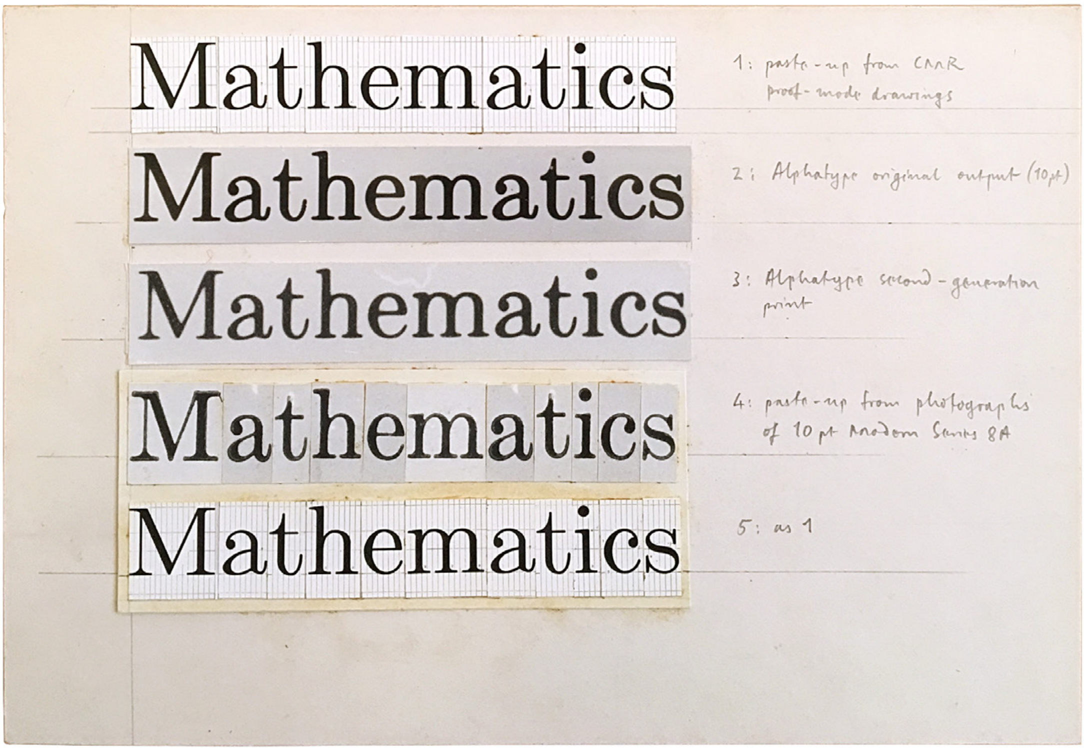


Fig. 4.75 Paste-ups of different states of 'Modern', from top to bottom:
(1) proof-mode drawings of Computer Modern Roman
(2) original 10-point output from an Alphatype machine
(3) output from second-generation Alphatype machine
(4) original photographs of 10-point Monotype Modern 8A
(5) proof-mode drawings of Computer Modern Roman
Photographed by the author [SUA, SC 1002, box 1, folder 5].

ical reinterpretation. Hofstadter was not concerned with the appearance of a meta-font, but questioned the concept behind it:

> I am making the nontrivial claim that nobody can possess the “secret recipe” from which all the (infinitely many) members of a category such as “A” can in theory be generated. In fact, my claim is that no such recipe exists.[192]

While Knuth welcomed all of the criticism (see 3.3),[193] he and Hofstadter continued their own scientific dialogue and eventually agreed to disagree. Their fascinating debate is explored in more detail by Huot-Marchand.[194] Perhaps the essence of the debate, a misunderstanding between design and computer science, is strikingly captured by Unger:

> In the beginning of his article, Knuth gives the impression that the parameters of a design are more important than the design itself — that is: than the idea behind the design and how the face looks and reads.[195]

In the same way that Coueignoux stated that his thesis was ‘not concerned with characters per se’, but with fonts,[196] one could conclude that Knuth was less concerned with typeface and fonts than with parameters and design spaces, and with the ability to specify any desired instance from that space.

The second most prominent typeface that sprung from Metafont, Euler for the American Mathematical Society (AMS), shows few signs of such ‘meta-ness’. Its development put Metafont firmly to the test, in the setting of a semi-commercial project and in the proposed constellation between type designer and computer scientist. Revisiting Euler here does not significantly add to the information provided by Southall (who was sporadically involved in the project),[197] but as it considers previously unpublished sources it sheds light on the circumstances that eventually led to a fundamental reconsideration of the Metafont concept. McCarthy also writes about the Euler project, but mainly considers its implications for the Group, not for Metafont as a whole.[198]

Like Knuth before them, the AMS in Providence/RI became dissatisfied with the quality of their printed publications after the transition from metal to phototype during the late 1970s, and formed a ‘font committee’ to address the issue of

192 Hofstadter 1982, p. 310.

193 Wrolstadt p. 358 f.

194 See the lecture by Thomas Huot-Marchand, ‘Knuth vs. Hofstadter’, ISType conference, 10 June 2017.

195 Wrolstad 1982, p. 354.

196 Coueignoux 1973, p. 55.

197 See Southall 2005, pp. 185–203.

198 See McCarthy 2020.

Image redacted

Fig. 4.76 Knuth and Zapf at Stanford in February 1982. Photograph by Charles Painter, Stanford News Services.

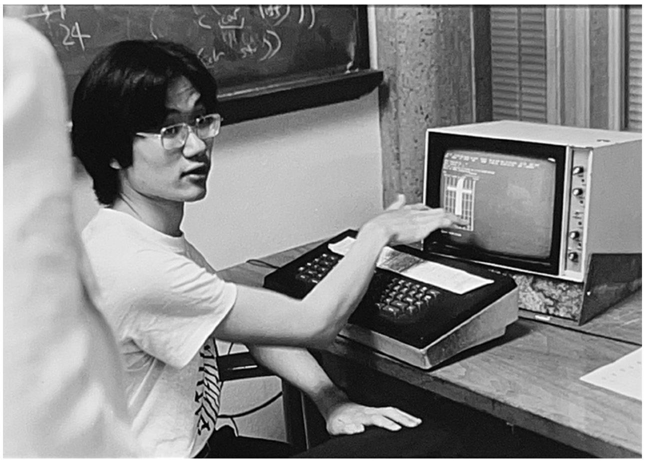


Fig. 4.77 Scott Kim demonstrates the description for Euler letter ‘f’ in Metafont. Photographer unknown, reproduced from a dia slide [DTGC, Richard Southall, ‘Euler/Kim’].

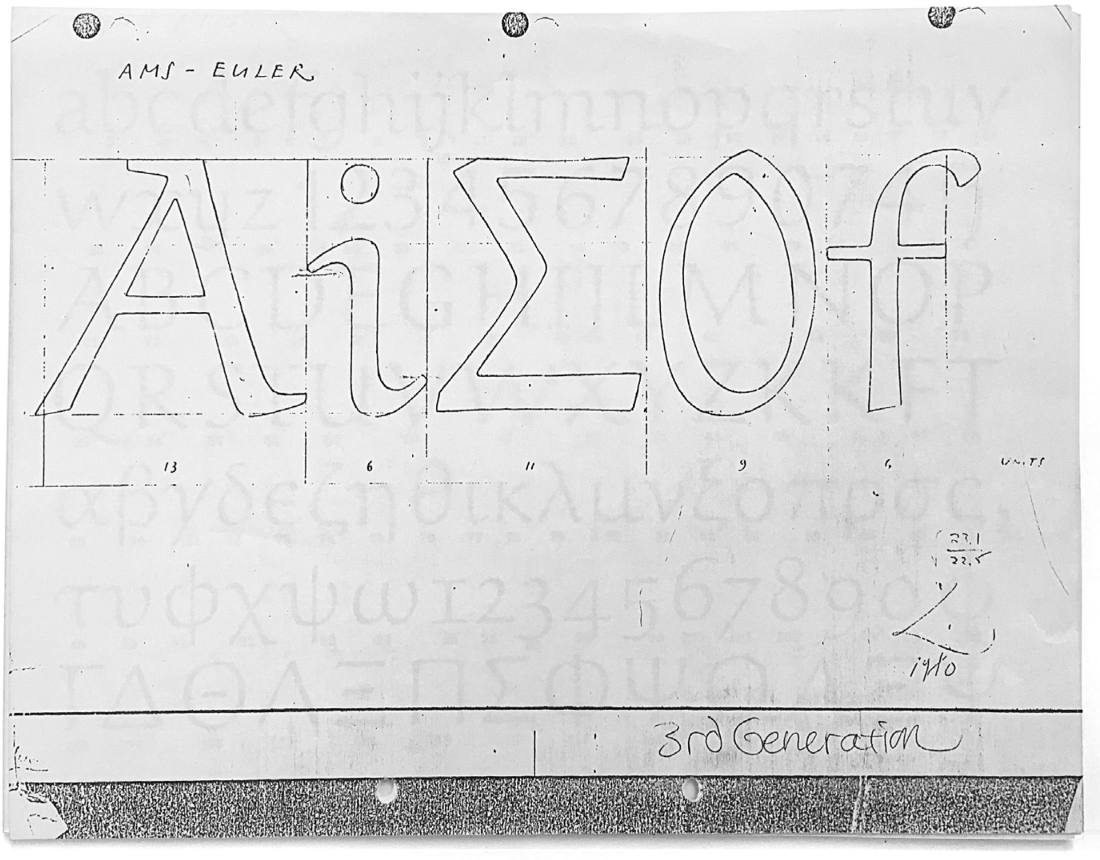


Fig. 4.78 Original copy of Zapf’s preliminary outline drawings of Euler. Photographed by the author [SUA, SC 1002, box 1, folder 3].

designing a new typeface for Latin, Greek, and blackletter characters.[199] With Knuth as committee member, it was clear that an exclusive typeface for the AMS would follow the typesetting requirements established in TeX and that Metafont would be used to produce the fonts. The introduction of Hermann Zapf by another AMS member as typographic advisor, suggested him as Knuth's counterpart in the project.[200] Correspondence between them began in early October of 1979 and led to Zapf's two-week stint at Stanford in February the following year to discuss their collaboration on the new typeface (**fig. 4.76**). As they discovered their shared interest in calligraphy (Knuth's wife Jill is a calligrapher), Zapf encouraged Knuth to add a parameter for varying pen pressure.[201]

It is noteworthy that is was Knuth who initially proposed that an existing design by Zapf such as Optima could be digitally remastered — Zapf remained sceptical due to his previous experience of compromising old designs for new technologies and they eventually agreed on a new design.[202] Knuth introduced his graduate student Scott Kim to the project as a 'digital punch cutter',[203] of whom Knuth later implied 'he was closest of having one equal foot in each side' (**fig. 4.77**).[204] Such a partnership with an 'interpreter' of his drawings was familiar to Zapf. According to the original concept of a meta-font, however, Zapf would only have had to design a few letters, Kim would then specify parameters from their attributes via programmes. Initially, Zapf did send just five letters for specifications (**fig. 4.78**) — interestingly, prepared as enlarged outline drawings (about 7 cm in height). Per font committee's request, however, Zapf had to deliver complete alphabets for Greek and Latin, for evaluation by each member.[205]

Thus, Kim eventually received outlines drawings for every character and began to remodel them from virtual pen strokes like a 'digital punch cutter' (**fig. 4.79**). Every single character posed a programming challenge of its own: evidently, the centre lines of the strokes were offset from the original outlines, and Zapf disliked the results.[206] At some point, Knuth asked Zapf, 'if there is something nearly like your drawing that is easy for Metafont and that looks OK to us, may we deliberately change your design to what is most natural for Metafont?'[207] The team caught up

199 Knuth 1989, p. 171. Members of the committee were Richard Palais, mathematics professor at Brandeis University; AMS editor Barbara Beeton, editor Peter Renz, Knuth and later Zapf.

200 Zapf was introduced to the AMS by Arnold Pizer. They were both colleagues at Rochester Institute of Technology, where Zapf held a visiting professorship since 1977.

201 Knuth 1985, p. 47.

202 Knuth 1989, p. 133.

203 Charles Bigelow referred to Kim and his successors in the project as 'digital punch cutters', see Bigelow 1983 II, p. 12.

204 Donald Knuth in an interview with the author, 22 October 2018 [audio file 01, 33:20].

205 Knuth 1989, p. 144 f.

206 Southall 1985, p. 10.

207 Knuth 1989b, p. 151.

Image redacted

Fig. 4.79 Programmed Euler letters by Scott Kim slowly ‘building up’ on the monitor. Reproduced from dia slides [DTGC, Richard Southall collection, ‘Euler/Kim’].

with the challenge of a double-translation: Zapf translated his ideas to paper, Kim used them as a reference to translate them through code. Metafont was being utilized in a way not intended by Knuth, but it did not succeed in accurately replicating an existing design either.

By the Spring of 1982 the project was in deadlock. As the AMS got impatient, Bigelow (who was still based in Providence at the time) was consulted to deliver a report on the feasibility of the project and to evaluate whether Metafont was still the right tool for the task.[208] Although his evaluation led the AMS to conclude that the estimates of time and expenses were too high, it was Bigelow who 'saved' the project, according to the narrative of the Group.[209] With his appointment as a professor at Stanford in the autumn of 1982, two of his former students from RISD, Carol Twombly and Dan Mills, enrolled in Digital Typography, inaugurating the first cohort of the programme.[210] Bigelow knew Knuth, he had experience with Metafont and had previously met Zapf, too.[211] After Kim withdrew from the project, it was primarily continued by Twombly and Mills with Bigelow's supervision. One year after his involvement in the Euler project, he offered an honest assessment of the situation:

> In this project we see a slow rate of progress, a high rate of attrition of "digitizers" (digital punch cutters), a high level of impatience from the client and from the designer, and a good deal of confusion and vagueness about what is going on. In the commercial design world, this project would be seen as having all the ingredients for a disaster. The only thing that would probably save it is a degree of perseverance and forebearance far beyond what any of the principals could have predicted or prepared for. It is fortunate that this seems to be the case.[212]

Bigelow diagnosed a misinterpretation of metaphors as the primary problem based on his own grammar (see 3.3): outline representations and carved letterforms (e.g. in steel) follow the 'glyptal' metaphor,[213] while written letterforms are considered 'ductal'.[214] According to his metaphoric approach, Metafont descriptions were

208 The report was titled *Evaluation of Metafont as a production tool* (1981). From the 'Timeline for the development of the Euler typeface', a chronologic overview of events available via <https://www.tug.org/pubs/annals-18-19/> (last visited 18 Oct 2022).

209 Siegel 1985, p. 6.

210 Twombly and Mills both joined Adobe after graduating from Digital Typography, Mills as typographic director. Cleo Huggins is another student who received a BA at RISD, joined Digital Typography in 1982 and later went to Adobe.

211 Bigelow and Holmes took a calligraphy course with Zapf at RIT in 1979, see Dreyfus 1989, p. 196.

212 Bigelow 1983 III, p. 13.

213 Ibid., p. 2. Derived from Greek *glyphein,* to carve; related to English *glyph,* a carved image.

214 Ibid. Derived from Latin *ducere,* to lead; used by Bigelow in the sense of a 'temporal sequence of movements' that define a script written manually.

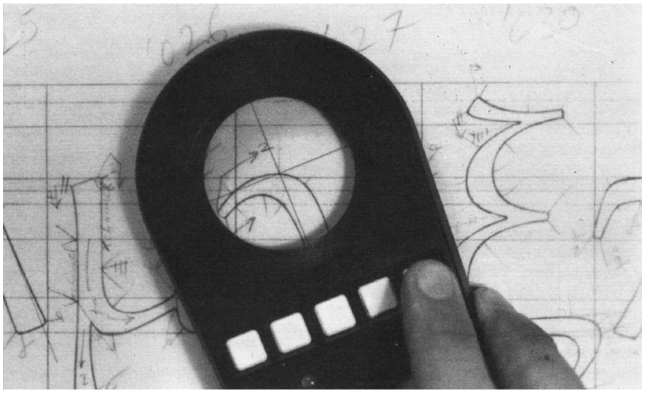


Fig. 4.80 Digitization of Euler characters by utilizing a crosshair sensor and tablet. Photographer unknown, reproduced from Siegel 1985, p. 12.

'ductal', yet Zapf had prepared outline drawings for a 'glyptal' production process that supplied 'only the faintest clues of how to create ductal representations of themselves'.[215] In other words, Bigelow tried to convince the group that 'glyptal' drawings had to be met with an approach of a digital outline description. At his suggestion, Twombly and Mills experimented with one-pixel wide boundaries, two for each stroke, while completely disregarding Kim's previous 'meta-features'.[216] After Twombly and Mills initially specified coordinates of 'critical points' along the contours of the letter drawings, Digital Typography student David Siegel wrote a programme that could read commands through a digitizing tablet, captured by positioning the crosshairs of a 'puck' on points marked along outlines of Zapf's original drawings (**fig. 4.80**). The data was then converted into a Metafont input format. This procedure and its implementation (at the rate of up to fifteen characters per day[217]) became Siegel's MA thesis and is published in a small-format project documentation.[218] In the autumn of 1983, proofs of the complete Euler character set were sent to Zapf for corrections, after another cycle and final approval the fonts were delivered to the AMS in 1985. Bigelow calls this development of Knuth's original approach 'the ikarusation of Metafont'.[219]

Bigelow made a judgement call that signalled a paradigm shift. The original approach of Metafont 79 was still valid, but proven inappropriate for certain tasks. The Euler project must be regarded as a high point in the short history of the Digital Typography Group (the programme was terminated in 1986) as a project that received some attention for a high-profile client, but it was also a turning point in the development of Metafont as Knuth intended it.

Knuth came to terms with the changes made to his system for the greater good of the project; at the 1983 ATypI working seminar both Metafont versions were demonstrated. The title of Knuth's talk suggests reflection: 'Lessons learned from Metafont'. The Euler project was not mentioned (perhaps bound to confidentiality), but Knuth admitted to 'paying a great deal of attention to the edges',[220] i.e. to character outlines. However, his remarks of Stone's design approach to the ATypI logotype suggest he was still convinced of the original idea. At the same time, Metafont became subject to a fundamental reconsideration. In the spring of 1984, when Knuth completed the first draft of Metafont 84, the pen metaphor was still present as 'the correct "first order" insights about how letters are drawn', while outlines offered 'second order' details of the refined design.[221]

215 Ibid., p. 13.

216 Siegel 1985, p. 7.

217 See 'Timeline for the development of the Euler typeface', a chronologic overview of events available via <https://www.tug.org/pubs/annals-18-19/> (last visited 18 Oct 2022).

218 See Siegel 1985.

219 Charles Bigelow in an interview with the author, 8 September 2017 [audio file 02, 01:08:00].

220 Knuth 1985, p. 46 f.

221 Knuth 1985, p. 47.

Metafont received little attention from commercial type manufacturers, however, as a vivid advocate of Open Source, Knuth never intended to gain financially from TeX and Metafont. He made them available for free from the start, a decision that has earned both systems widespread use in the academic world. After his time at Stanford, Southall continued to spread his knowledge of and experience with Metafont across Europe. The course that he co-taught with Bigelow and Knuth in the Spring of 1984 (as the new Metafont 84 was under development[222]) became a model for future workshops and courses with the system.[223] When Southall collaborated with French mathematician Jacques André on a Metafont workshop at the Institut National de Recherche en Informatique et en Automatique (INRIA) in Rennes during the winter of 1984/85, they concluded that while none of the other existing digital type design systems appeared 'usable' in the context of a course, Metafont, 'like TeX, belongs more or less to the research community'.[224] In addition to hands-on type design sessions with Southall in Metafont 84, the one-week seminar included lectures on other systems and copyright issues,[225] and overall built on a previous symposium on digital document systems hosted at INRIA in 1983, which has been alluded to in the conclusion to chapter 3. André became a central figure in the discourse in digital type.[226] He continued to co-organize events such as the INRIA Workshop on Font Design Systems at Sophia-Antipolis in May 1987 and an international conference on Raster Imaging and Digital Typography at EPF Lausanne in October 1989.[227] This chapter of Metafont would be worth exploring further, under particular consideration of activities organized by André, Southall (who went on to teach at the Université Louis-Pasteur in Strasbourg) and others. While Metafont's following remains comparably small, but not insignificant, TeX continues to provide a standard in scientifc typesetting and publishing, in use by thousands of computer scientists, physicists and engineers world-wide.[228]

222 A hand-out on *Low-level Metafont* reads 'Beware: These specifications change daily' (dated 28 May 1984) [SUA, SC 0079, box 21, folder 10.4].

223 For course material of 'CS 279' and student work see SUA, SC 0079, box 21, and SC 1002, box 2.

224 André 1985, p. 143.

225 Speakers include André, Patrick Baudelaire, Nicole Croix, Ladislas Mandel, Southall et al.

226 André received a PhD in mathematics at Nancy in 1965, then became engaged in industry research before he began teaching at INRIA in 1975. For a short biography see Jean-Marie Pinon, 'Avant-propos' in *Document numérique,* vol. 10, no. 1, 2007, p. 7.

227 See André 1989.

228 TeX User Group (TUG) in the US, *Groupe francophone des Utilisateurs de TeX* (GUT) in France and *Deutschsprachige Anwendervereinigung TeX e.V.* (DANTE) in Germany count thousands of members and publish monthly journals that are typeset in TeX.

4.2.3. FRED: industry research for internal use

In 1973, a team of researchers at Xerox PARC led by Robert C. Sproull devised the first networked computer workstation called Xerox Alto as a digital publishing platform that included a series of services and applications. One of these applications was the Xerox Alto Font Design System, essentially a two-step process comprised of the interactive outline description programme FRED, designed and implemented by Patrick Baudelaire in 1974, and the rasterizing application PREPRESS, developed by Sproull himself. A multi-disciplinary group of PARC's Computer Science Laboratory made improvements and adjusted the programmes primarily for in-house use.[229] PARC, the Palo Alto Research Center, was founded as a division of the Xerox Corporation in 1970 and has become known for some of its contributions to early personal computers, office printing, GUIs, ethernet, and for the convergence of all of these components in 'the office of the future', several of which were first implemented in the Alto (**fig. 4.81+82**).[230]

Like many of the other Alto publishing applications, Fred and PrePress were considered prototypes for research purpose.[231] Only a few 'experimental installations' of the Alto became available at a handful of privileged spaces including Stanford.[232] As a result, the Xerox Alto Font Design System remained largely absent from the digital type discourse until Baudelaire presented it at Stanford in 1983. Although the merits of the Alto workstation and specific applications are acknowledged in computer history literature, mentions of Fred are often missing. Apart from short passages in Ruggles' report[233] and Bigelow's recent paper[234], none of the literature consulted in this chapter discusses it either. Baudelaire's own paper on the type design system was published only thirty years after the Stanford seminar, in the aforementioned anniversary issue of *Visible Language*.[235] Despite the significant lack of secondary accounts, user manuals of the Alto and its utilities are accessible online in addition to digital documents available in a particular primary online source: in 2014, with permission of PARC, the Computer History Museum in Mountainview/CA released digital resources related to the Alto through an open

229 Baudelaire credits Ron Gechman, Charles Hains, Paul Lam, Joe Maleson, Ron Pellar and Kerry LaPrada. Pellar gave the demonstrations of the system at the 1983 ATypI working seminar at Stanford and helped Baudelaire in preparing the paper alongside Judy Kaye, published in 2016, Baudelaire 2016, p. 24.

230 In 2002 PARC became an independent subsidiary of Xerox. See overview on <https://www.parc.com/about-parc/parc-history/> (last visited 17 July 2022).

231 Sproull 2018, p. 38.

232 Seybold, 1984, p. 365.

233 See Ruggles 1983, p. 19.

234 See Bigelow 2020, p. 20.

235 See Baudelaire 2016.

Fig. 4.81 The Xerox Alto workstation. Photographer unknown, reproduced from Thacker 1979, p. 2.

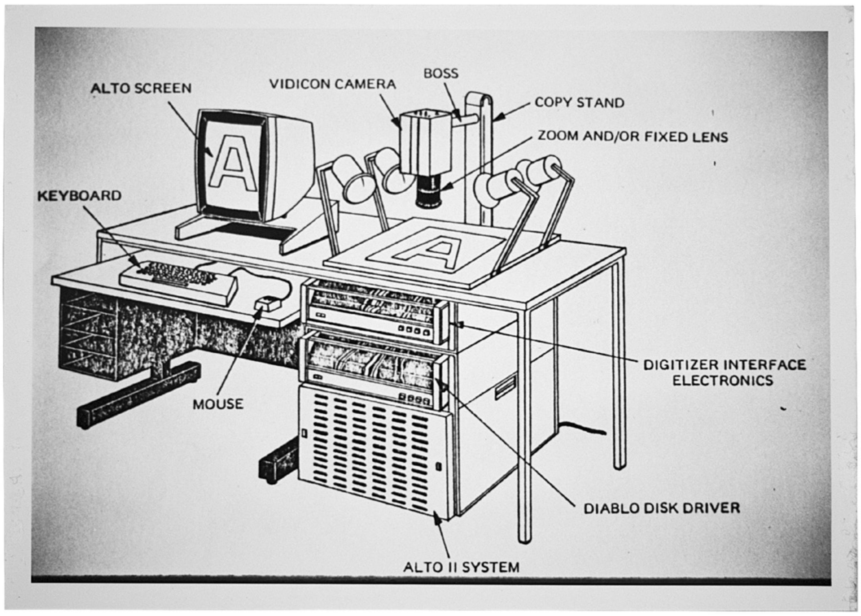


Fig. 4.82 Set-up of the Xerox Alto Font Design System. Reproduced by Norman Posselt [CC, CSC 030, box 1, folder 1].

source online archive, accessible for non-commercial use.[236] Organised on the original server on which the Alto files resided at PARC, the collection includes source code of the workstation and its applications, font files, manuals and links to related oral histories and excerpts of correspondence. Photographs of Fred's GUI while in use have been obtained in correspondence with Baudelaire, as well as from archival research at RIT.[237]

To fully comprehend the impact of Fred and its sister application PrePress it is necessary to take a look at the larger integral system developed in an environment that pursued industry research with the purpose to build prototypes expected to become commercial products within a decade or more, or not at all. When Sproull and his colleague William Newman began to envision a publishing platform that could be used to create documents, specifying text, graphics and photographic images on the same page, they established the notion of what is commonly referred to as a page-description language.[238] By integrating previously established ideas of computer graphics, image processing and digital typography, Sproull and Newman eventually developed the relatively device-independent description scheme PRESS.[239] Sproull's typesetting experience on a Ludlow line-caster during his student days may have sparked his interest in type.[240] In anticipation of an office environment in which personal computers 'sent' documents to printers, Press functioned as the mediator between the devices and allowed files to be exported, communicated, published and printed. It is not at all farfetched to consider Press a forerunner of comprehensive page-description languages such as Adobe's PostScript.

Press files found most use in xerographic printers connected through the ethernet network, many models of which were being developed in prototypical stages at PARC, some of them with functions of copy machines. At the end of the 1970s Xerox released the 9700 electronic xerographic printer.[241] It became clear to Sproull and Newman that in order to display text in the publishing applications and on the printed output, it was necessary to devise the principle of distinct, interchangeable fonts:

236 See <xeroxalto.computerhistory.org> (last visited 17 July 2022).

237 See CC, CSC 030, box 1, folder 1. All of these images have also been published in Baudelaire 2016.

238 Sproull 2018, p. 38.

239 See the report on the *Press file format* by R. Sproull et al., last updated in December 1979: <https://xeroxalto.computerhistory.org/_cd8_/printingdocs/frommaxc/.pressformat.press!1.pdf> (last visited 31 October 2022).

240 Sproull 2018, p. 52.

241 Seybold 1984, p. 365.

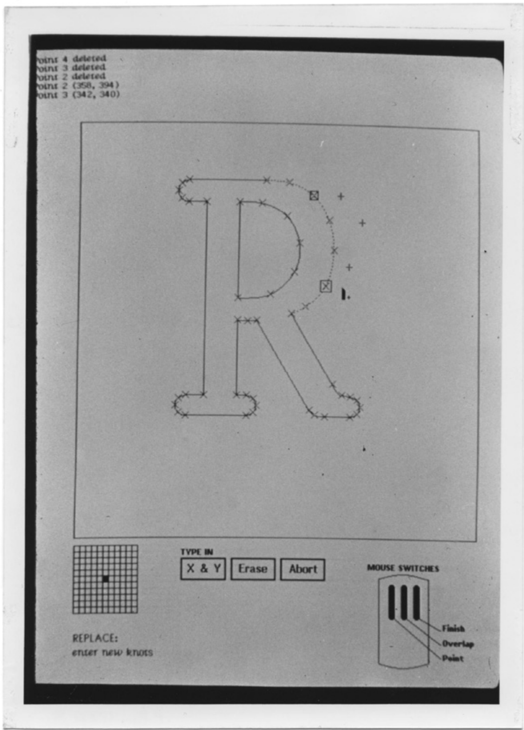


Fig. 4.83 Fred spline routine, photographed off the Alto screen. [CC, CSC 030, box 1, folder 1].

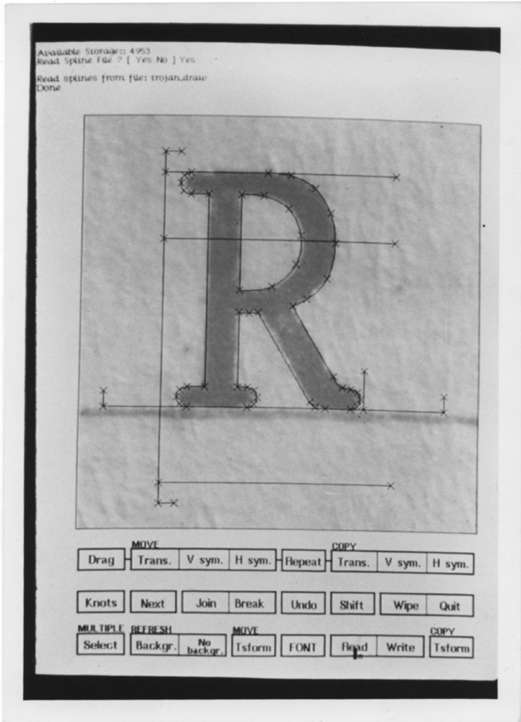


Fig. 4.84 'Television image' method, photographed off the Alto screen [ibid.].

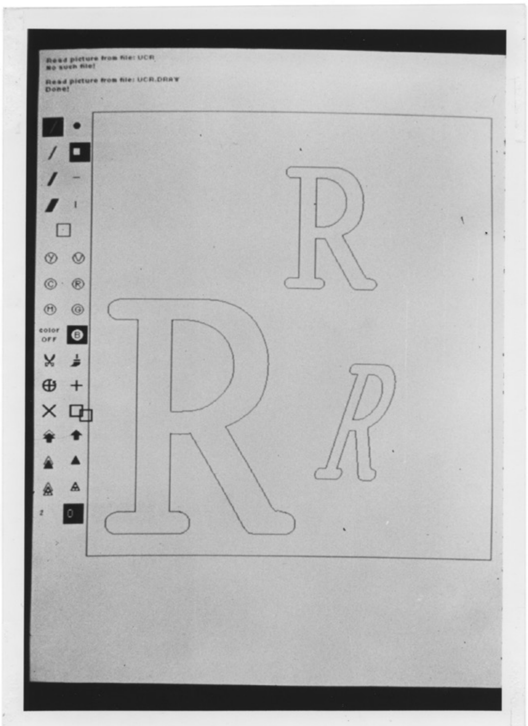


Fig. 4.85 Character modification in Draw, photographed off the Alto screen [ibid.].

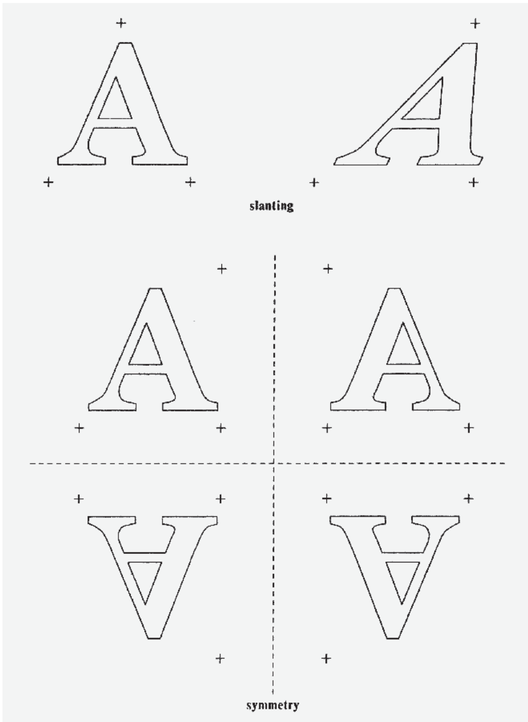


Fig. 4.86 Reproduced from the *Alto user's handbook,* 1979, p. 118.

> We took a pragmatic approach to creating fonts; our objective was to construct a sufficient collection of characters, font styles, and sizes to make our experimental publishing tools realistic.[242]

This statement regards fonts as means to an end, which is perfectly reasonable with a greater objective in mind. Baudelaire developed a programme that could be used to create and modify digital outline description of characters so they could be rasterized at a later stage at any given resolution for in-house xerographic printers. The team at PARC had decided to work with a mathematical outline description of cubic curves based on the familiarity that some of its members had with the method and because it was deemed intuitive for 'nonmathematical' users.[243] The 600×800 portrait-format display screen gave the Alto its iconic appearance, a 'mouse' as a pointing input device was still a rare sight at the time (see 4.2.).[244] It was these features and what Baudelaire called the Alto's 'friendly user interface' that enabled graphical interactions and visual feedback as preconditions in the usability of Fred.[245] Of the five systems presented at Stanford in 1983, Fred was the only one that fully demonstrated the principle of the much quoted acronym WYSIWYG, 'what you see is what you get'. Manual movement of the mouse across the screen, while selecting one end of a spline and then pointing to the other end creates a closed shape of straight-line and curve segments connected by 'knots' (**fig. 4.83**). The GUI of Fred reveals a couple of remarkable features: at the centre of attention is a 'drawing area' of 500×500 pixels framed by a character's 'bounding box'. The box is guided by a set of horizontal and vertical grid lines that specify cap height, x-height, baseline, descenders, with extra space for overshoots on both extremes, and side-bearings. A particular feature that stands out it is the 'television image' method: a Vidicon camera installed on the workstation could capture a digital image of an (enlarged) existing letterform representation (**fig. 4.82**).[246] With the image displayed in the background on a separate layer, a superimposed outline could be traced along the contour of the letterform (**fig. 4.84**) — an ideal technique for accurate digitizations of existing designs.

Despite its striking appearance, the editing options of the closed outlines were rather limited. In order to modify one control point on a curve, the complete set of segments had to be replaced; Baudelaire himself did not find the editing functions of Fred to be specialised enough.[247] He later suggested a technique that would allow the mouse to grab knots and move their position — which would have been

242 Sproull 2018, p. 40.
243 Ibid., p. 47.
244 Seybold 1984, p. 365.
245 Baudelaire 2016, p. 15.
246 Ibid., p. 16.
247 Ibid., p. 17.

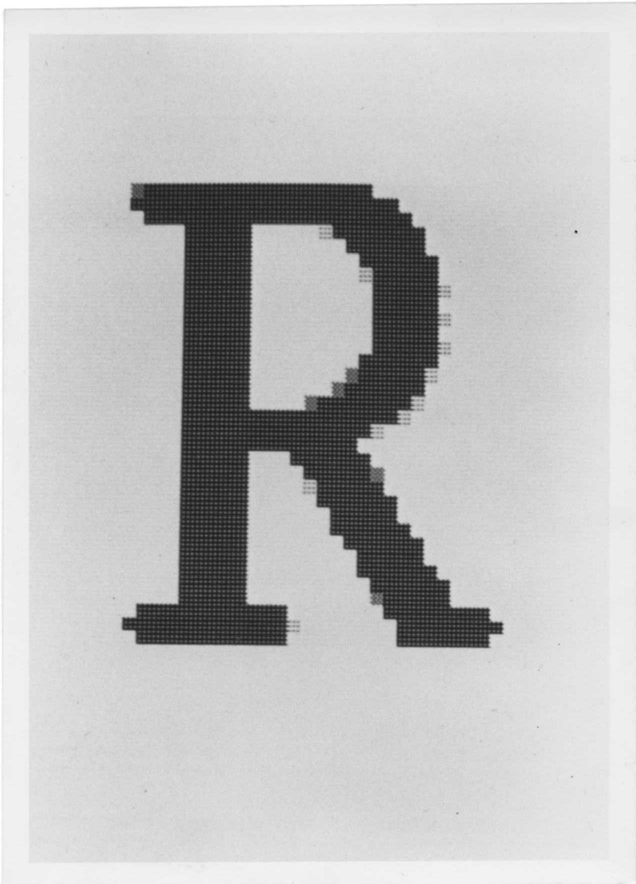


Fig. 4.87 Rasterizing in PrePress with a hint at greyscaling, photographed off the Alto screen. Reproduced by Norman Posselt [CC, CSC 030, box 1, folder 1].

a ground-breaking feature then, and was found in digital type design tools a decade later.

It was also not possible to perform simple automated modifications such as slanting, expanding or even scaling in Fred. To carry out these steps, Baudelaire developed a sub-programme within the Xerox Alto Font Design System as a 'freehand' drawing companion called DRAW that enabled open curves and the use of different brushes, including a set of commands and simple geometric shapes to choose from a tool bar (**fig. 4.85+86**). Again, this interface predates similar applications that became available in the mid-1980s. At second glance one cannot help but recognize a certain resemblance between the appearance of Fred and Draw, particularly in details such as the 'knots', and Sutherland's drawing routines in Sketchpad (see 4.1.2). The connection that is not at all implausible, given that Sproull acknowledges an undergraduate seminar taught by Sutherland at Harvard in 1967 as an experience that sparked his primary interest in computer graphics (in 1980, they formed the joint consulting firm Sutherland, Sproull and Associates).[248]

The raster conversion from outlines to bitmaps was an automated process in PrePress and was calculated based on three conditions: the point size of a character, the resolution needed for an intended output device and the scanning direction of that output device (horizontal or vertical run-length).[249] Although Sproull writes that the Alto screen could not reproduce greyscale images,[250] a screen capture of PrePress shows signs of levels of grey in the manual editing process of characters (**fig. 4.87**). Either way, at 72 lines-per-inch, the resolution of the Alto screen was considered 'very low'.[251] However, there were no objectives to devise a large library of fonts for external use. The team at PARC was aware of the technical constraints and was perhaps willing to accept compromise. In hindsight Sproull concludes, 'in view of these limitations, we did not embark on a strategy to create superb character shapes.'[252]

Although the system of Fred, Draw and PrePress is labelled a 'font design system', Baudelaire refers to it as a 'font production system' in his paper several times, a description that is probably more accurate. All known fonts that have been manufactured in Fred and PrePress are based on existing typeface designs; the Alto user manual lists five designs, each available in fonts of different sizes: Times Roman, Helvetica, Hippo (a Greek serif face that barely matches Times), Gacha (a monospaced face) and a set of mathematical characters (**fig. 4.88**).[253] According

248 Sproull 2018, p. 52.
249 Baudelaire 2016, p. 18 f.
250 Sproull 2018, p. 40.
251 Bigelow 1982, p. 9.
252 Sproull 2018, p. 40.
253 See the *Alto user's handbook,* dated September 1979, p. 68, available at <http://www.bitsavers.org/pdf/xerox/alto/Alto_Users_Handbook_Sep79.pdf> (last visited 31 October 2022).


Fonts

Times Roman

Font 0 = 10pt., Font 1 = 8pt., Font 5 = 12pt.
Available in 6, 7, 8, 10, and 12pt in Reg., **Bold**, *Italic*, and ***Bold Italic***.
Available in 18pt. in Reg. and **Bold**.
↑O = Em Quad; ↑Y = En Quad & Fig. Space.
Space Bar = 1/4 Em Quad.

Helvetica

Font 6 = 10pt., Font 7 = 8pt., Font 9 = 18pt.
Available in 6, 7, 8, 10, and 12pt. in Reg., Bold, Italic, and Bold Italic.
Available in 18pt. in Reg. and Bold.
↑O = Em Quad; ↑\ = En Quad; ↑Y = Fig. Space
Space Bar = 1/4 Em Quad.

Math

Font 3 = 10pt.
Available in 8 and 10pt. in Reg. only.
↑D = 1 pt. space

Hippo

Font 4 = 10pt.
Available in 8 and 10pt. in Reg. only.
↑O = Em Quad; ↑Y = En Quad & Fig. Space.
Space Bar = 1/4 Em Quad.

Logo

Font 2 = 24pt.

XEROX

Gacha

Font 8 = 10pt.
Available in 8 and 10pt. Reg. only.

NOTES:

1. In Times Roman, Helvetica, and Hippo;
↑N = ↑X = Minus sign,
↑V = En Dash,
↑S = Em Dash.
2. The Bold Italic characters on this page represent the keys on the keyboard.
3. Three lines of characters below the keys are Control, Upper Case, and Lower Case respectively.
4. Two lines of characters represent Upper Case and Lower Case respectively.
5. Blank lines are not blank but contain spacing characters.

Fig. 4.88 Font selection available on the Alto. Reproduced from the *Alto user's handbook,* 1979, p. 68.

to Baudelaire, using Fred to create new original designs had not been taken into consideration.[254]

By the time Baudelaire presented the Xerox Alto Font Design System at Stanford in 1983, some of its performance aspects in software and hardware appeared to show 'signs of obsolescence'.[255] As a result of years of research on the Alto, Xerox had officially introduced its successor in 1981, the professional workstation 8010 commonly referred to as 'Xerox Star'. Although the new model did not sell well, it paved the way for the 'user-friendliness' of its era, featuring a digital desktop with icons for files and programmes (**fig. 4.89**), by commercially introducing the mouse and by foreshadowing the 'convergence of word processing and type setting'.[256] Fred demonstrated the most advanced GUI of the five systems presented at Stanford, however, by the standards of the time, as represented by the Xerox Star and Apple LISA, it was considered 'conventional'. Baudelaire calls the system's transition 'from laboratory to production site' unforeseen; however, re-modeling its capabilities to the new standards of the Star was regarded as an unscheduled 'cost-effective redesign' and therefore was not attempted.[257] One cannot help but wonder what kind of advance in digital type design would have been possible in the unity of the Font Design System on the Xerox Star. It seems, there was no intention to turn the type design system into a commercial product line, although digital type remained an area of research for internal purposes. According to Bigelow, Xerox continued to utilize Fred as well as modifications of it in the production of bitmap fonts for its commercial laser printer.[258]

As mentioned in the introduction to this subsection, despite acknowledgement of the merits of the Alto, Fred remains hidden in most of computer history. E.g., according to a 1998 paper on *A brief history of human-computer interaction technology* by computer scientist Brad A. Myers, Newman's application Markup was supposedly the first drawing programme on the Alto computer in 1975, 'followed shortly' by Baudelaire's Draw, therefore overlooking that Markup is actually predated by Baudelaire's Fred, a programme that could trace and draw letterforms.[259] In fact, Myers does not specifically touch upon any issues relating to digital letterforms, but brings forward several examples of programmes that can

254 Baudelaire 2016, p. 24.

255 Ibid., p. 14.

256 Seybold 1984, p. 364 f.

257 Baudelaire 2016, p. 20.

258 Bigelow, 2020, p. 20. On a side note, the year Baudelaire gave his presentation at Stanford, Michael Plass and Maureen Stone developed spline-fitting algorithms with piecewise parametric cubic curves at the Imaging Science Laboratory of Xerox PARC, which demonstrates the institution's broader interest in spline technology at the time, see Ruggles 1983, p. 19.

259 Myers 1998, p. 48.

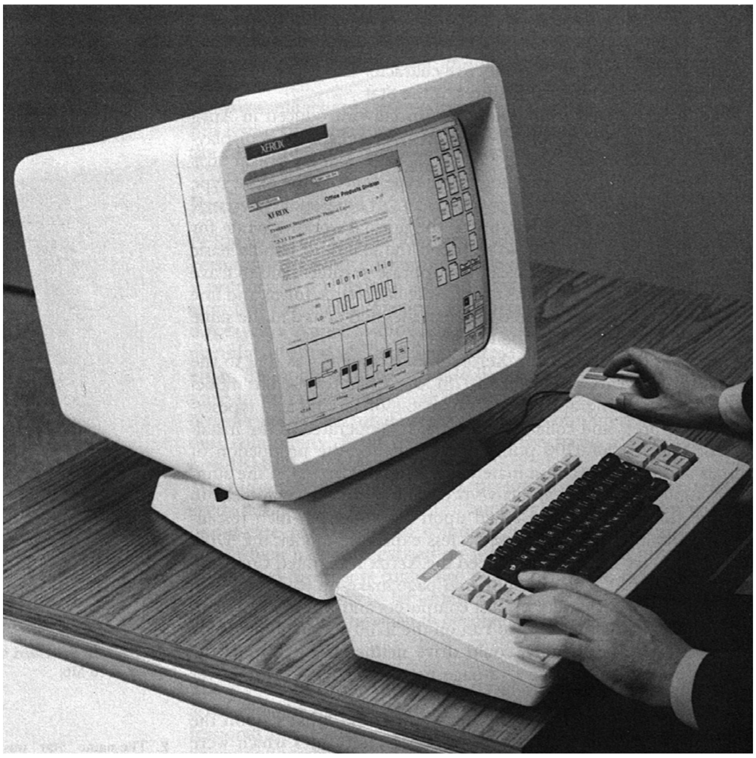


Fig. 4.89 Xerox 8010 ‘Star’, the first commercial desktop workstation with a GUI of frames and icons. Reproduced from Seybold 1984, p. 366.

draw shapes. Baudelaire himself considers Draw to be merely an 'afterthought' of the Font Design System and marginal to the overall process.[260]

Robert Sproull left Xerox PARC in 1978 to accept a professorship in computer science at Carnegie Mellon University. According to his former PhD student Brian Reid[261], Sproull returned to PARC during a sabbatical in 1982, to revisit his work on the page-image-description scheme Press with John Warnock who had joined a team formed by Charles Geschke at PARC in 1978 and developed the graphics model JaM with Marti Newell.[262] The convergence of Sproull and Warnock (who had previosly led Ivan Sutherland's research office in Mountain View/CA) led to the creation of the page description language InterPress; during the 1982 SigGraph conference, Warnock presented a model that utlized Bézier curves for the description of shape countours.[263] Geschke and Warnock left in December 1982 to co-found Adobe, where they released their own page description language PostScript in 1984 and utilized Bézier curves as the method for a corresponding font format (see 5.3).[264] This narrative does not only suggest a connection from Sutherland via Warnock to Adobe, it also portrays Xerox PARC as an environment of missed opportunities in the developments of the personal computer and digital type. In 1984, the year Apple introduced the Macintosh and Adobe released PostScript, John W. Seybold called the Alto 'the most important unknown computer product of the 1970s'.[265] The Xerox Alto Font Design System shares this fate.

260 Baudelaire 2016, p. 18.

261 Reid was a speaker at the 1983 symposium on Document Preparation Systems at INRIA Rennes.

262 Reid's essay 'PostScript and Interpress: a comparison' was sent by e-mail to the 'laser-lovers' distribution list, 2 March 1985. It is digitally archived on the Xerox Alto server: <https://xeroxalto.computerhistory.org/xerox_alto_file_system_archive.html> (last visited 31 October 2022).

263 Bigelow 2020, p. 21. Bigelow cites John Warnock, Douglas K. Wyatt, 'A device independent graphics imaging model for use with raster devices', in *ACM SIGGRAPH Computer Graphics,* vol. 16, no. 3, 1982, pp. 313–319.

264 Ibid.

265 Seybold, 1984, p. 365.

4.2.4. IKARUS: digital punch-cutting

In the early 1970s, a team of physicists and computer scientists led by Peter Karow at the Hamburg-based firm URW (Unternehmensberatung Rubow Weber)[266] developed the system called IKARUS based on an approach to digital outline description. Of all the systems available until 1983, Ikarus was in use as a commercial product and as a service by most type manufacturers and became the de facto standard of that era.[267] As a result, several documented accounts of the system's integration in typeface digitization processes exist by established type foundries with a history in hot metal, by phototype manufacturers that emerged in the 1960s and 1970s, and by a handful of type design studios that began to work independently in the 1980s. As a developer of products that competed in the open market, URW issued promotional material, regularly presented and demonstrated Ikarus at conferences, while Karow himself gave interviews and wrote several articles and books, most notably the aforementioned *Digital formats for typefaces* (1987). More recently, the successors of URW published a company chronicle written by Karow, *Pioneering years: history of URW*.[268] This source provides detailed descriptions of technical and economic aspects, lists employee numbers, and gives insight into the company's annual turnover, underpinned by numerous personal anecdotes from Karow's memory. While most of the information lacks proper references, it was considered carefully in the preparation for an interview with Karow in 2019.[269] Because of its widespread success for almost two decades, Ikarus was in use by several prominent and lesser-known figures of the type design industry; key persons have been consulted by the author in preparation of the thesis.[270]

266 URW went bankrupt in 1995, was re-established by Peter Rosenfeld et al. the following year as URW++, acquired by Global Graphics PLC in 2016, renamed URW Type Foundry in 2018, acquired by Monotype Imaging Holdings Inc. in 2020, followed by the closing of the Hamburg office.

267 A published client list of URW counts 26 major manufacturers of typesetting devices who used Ikarus to digitize their font libraries, including Autologic, Compugraphic, Berthold, Hell, Linotype, Letraset, etc. Karow 1987, p. 101 (fold-out pages).

268 The first German edition of *Die Pionierjahre: Geschichte der URW* was published by URW Verlag in 2018, followed by the English edition in 2019 with translation by Julia and Paul Daugherty.

269 Conducted at Karow's home in Hamburg, 20 May 2019.

270 These consultations include: Interviews and follow-up correspondence with Charles Bigelow and Gerard Unger who used Ikarus in their work; an interview and follow-up correspondence with Petr van Blokland who developed a Macintosh-compatible version of Ikarus between 1984 and 1989; informal conversations and formal correspondence with Martin Majoor who was a type design intern at URW; with Albert-Jan Pool who headed the type department of URW from 1991 to 1995.

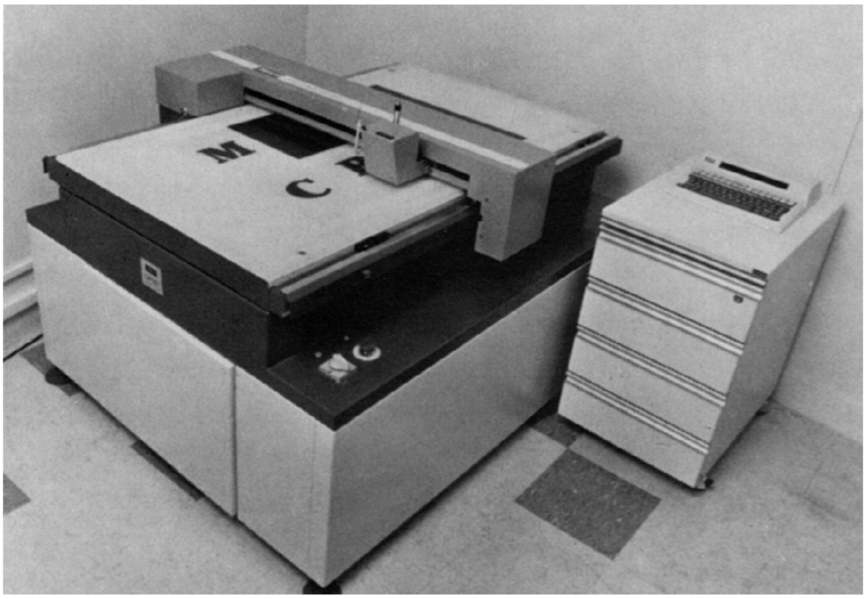


Fig. 4.90 Aristomat 201 M. Photographer unknown, reproduced from URW 1983, p. 4.

Image redacted

Fig. 4.91 The Aristomat cuts shapes on masking film with numerical continuous path control. Photographer unknown, reproduced by Norman Posselt [CC, CSC 030, box 2, folder 8].

The physicist Jürgen Weber and the economist Gerhard Rubow founded URW as a 'business consultancy' in 1971, yet quickly established the firm as a software company.[271] Programming experience in COBOL and FORTRAN led them to develop applications mainly for business administration and for clients in science and technology. Karow, who had graduated in physics alongside Weber at DESY in Hamburg,[272] joined the firm shortly after to pursue image processing and became a partner in 1972. URW's entry into the type manufacturing industry was recently described by Karow as 'coincidental', initiated by a business relationship with Aristo in the summer of 1972, a Hamburg-based manufacturer of slide rules, drawing devices and plotters.[273] In 1959 Aristo had introduced the first generation of flatbed plotters that became known as Aristomat (**fig. 4.90**).[274] From a set of predefined coordinates the technology made use of numerical continuous path control to draw, engrave or cut shapes on different material (**fig. 4.91**). One particular material that already had the attention of some type manufacturers was red translucent masking film (backed by a polyester bottom sheet), best known by the brand Rubylith of the Ulano Corp. Skilled manufacturers used scalpels to cut shapes into the Rubylith material by hand or by using curved rulers.[275] The resulting positive shape could then be 'stripped' off the backing sheet, leaving a negative shape that served as a frisket for the production of phototype-setting matrices of different manufacturers. In 1972, Walter Brendel, a client of Aristo inquired whether Aristomat plotters could be used to cut masking film from numerical data.

Brendel was an owner of Brendel & Pabst, a photo-typesetting studio equipped with Unitype machines, founded in Düsseldorf in the late 1960s with several branches across Germany and neighbouring countries.[276] Alongside Hamburg, Düsseldorf was a hub for advertising agencies in Germany in the 1970s and Brendel & Pabst supplied them with type styles in vogue during that era. The source material on Brendel and his studio is thin, neither are mentioned in the literature consulted in this thesis apart from Karow's writings and some unreferenced statements of former URW employees found online.[277] Elsner suggests that it was Brendel's

271 Translated from the original name *Unternehmensberatung*.

272 *Deutsches Elektronen-Synchroton* (DESY) is a public research center in Hamburg founded in 1959.

273 Karow in an interview with the author, 20 May 2019 [audio file 1, 03:54].

274 The company Aristo exists to this day, see: *Company profile, precision since 1862*, <https://www.aristo.de/company/> (last visited 6 September 2022).

275 As Erik Spiekermann recalls, this procedure was executed at Berthold type studio before the introduction of numerical path control. He heard manufacturers in England refer to those curved rulers as 'railway curves'. From correspondence with the author, 5 September 2022.

276 These studios were also part of a larger network called Type Shop.

277 Former URW employees Veronika Elsner and Albert-Jan Pool frequently leave unverified trails of information on various online platforms such as Flickr, Typophiles or on their own websites. See following footnote.

Image redacted

Fig. 4.92 Aristo digitizer. Photographer unknown, reproduced by Norman Posselt [CC, CSC 030, box 2, folder 8].

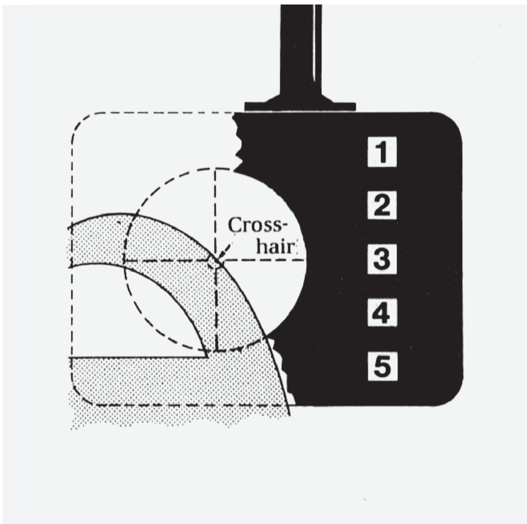


Fig. 4.93 A crosshair captures the coordinates of points on the outlines, one of five buttons selects the appropriate description for that point. Reproduced from Karow 1987, p. 382.

Image redacted

Fig. 4.94 A wooden spline. Drawing by Pearson Scott Foresman.

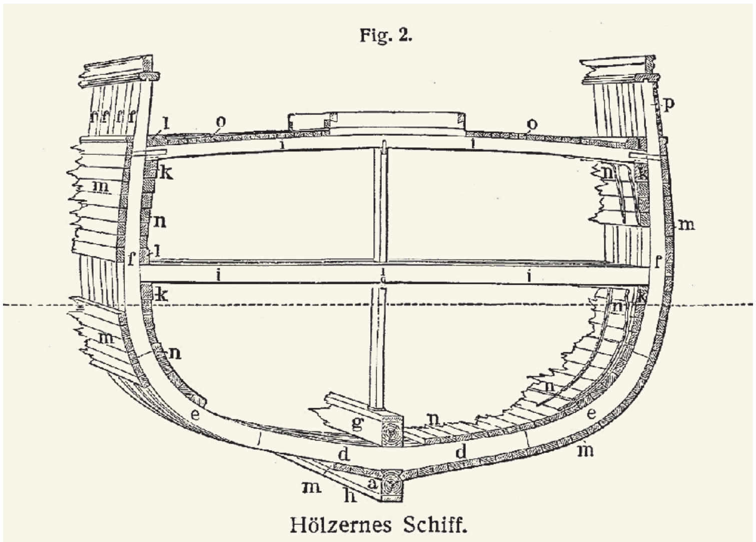


Fig. 4.95 Reproduced from *Meyers Konversationslexikon,* Leipzig, vol. 4, 1892.

impetus that led to the creation of a digital outline description language,[278] and Karow confirms that URW was commissioned and paid for this task by Brendel,[279] while all the components were co-developed in partnership with Aristo.

In addition to providing Aristomat plotters as the primary output device, Aristo also contributed hardware components to capture the coordinates of existing letterforms. This hardware comprised a small input device with a cross-hair sensor (referred to as 'digitiser' or 'puck' in most literature) that could be used to trace the outline of two-dimensional shapes on an Aristo 'tablet', essentially using X and Y coordinates to translate the physical representation of a letterform into numerical description (**fig. 4.92+93**).[280] However, in its early stage, this outline description was polygonal and could not reproduce smooth curves.

According to a repeated narrative of URW, Karow and his team took inspiration from methods in shipbuilding or 'yacht design' while developing the underlying algorithm of a digital outline description language between December 1972 and May 1973.[281] This connection refers to the origin of 'splines' as described in 4.1.2.; to determine the outer skin of ships, engineers created curves from thin wooden laths stretched between sets of nails (**fig. 4.94+95**). Karow identified this method as the interpolation of curvature between two points and considered using this principle for computer-generated curves, while claiming, 'what is correct for the shape of ship hulls is equally correct for the shape of letterforms'.[282] Surely this narrative also served as a connecting piece between Hamburg's Hanseatic traditions in engineering during the transition to digital technologies in the second half of the twentieth century.

In another account of the origins of the Ikarus system, Karow explains the search for spline algorithms, while experimenting on full circle shapes followed by a contrasted letter 'O' and then realising that these shapes would have to be composed of several segments each.[283] By this account, it was Gerhard Rubow who discovered an example of 'curve fitting' in an unreferenced book, which Karow 'simply copied' and then implemented in what he considered 'the heart of the later Ikarus system'.[284] Karow does not reference the adopted spline algorithm in this source, but Bigelow has identified it as a publication by Helmuth Späth, which built on a paper on interpolation theory by Charles Hermite from 1877.[285] Späth wrote a

278 In a portrait of Type Shop on Elsner's business website, <https://www.fonts4ever.com/portrait_library.php?id=3#familyName> (last visited 7 September 2022).

279 According to Karow, officially commissioned 12 December 1972. Karow 2019, p. 17.

280 For the original set-up provided by Aristo see Karow 2013, p. 16.

281 URW 1983, p. 10.

282 Ibid.

283 Karow 2019, p. 20.

284 Ibid., p. 20 f.

285 Bigelow 2020, p. 20.

Image redacted

Fig. 4.96 Set-up of an Ikarus workstation at the Berthold drawing office in Taufkirchen, Germany, c. 1983. Photographer unknown, reproduced by Norman Posselt [CC, CSC 030, box 2, folder 8].

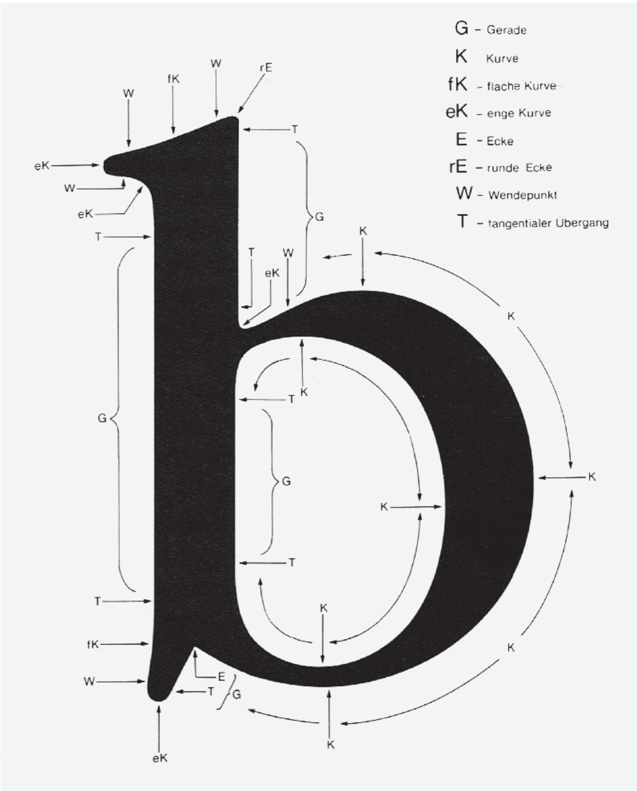


Fig. 4.98 Letterform description with information embedded in each point: straight line (G), curve (K), flat curve (fK), narrow curve (eK), corner (E), round corner (rE), turning point (W), tangential point (T). Reproduced from URW 1983, p. 13.

Image redacted

Fig. 4.97 An Aristo 'puck' used for hand-digitisation of a letterform at the Berthold drawing office. Reproduced from Berthold 1981, p. 41. Photograph likely by Uwe Rau for the slide collection of H. Berthold held at Deutsches Technikmuseum Berlin.

Image redacted

Fig. 4.99 Ikarus description of a letterform photographed on screen. Photographer unknown, reproduced by Norman Posselt [CC, CSC 030, box 2, folder 8].

book about spline algorithms for the construction of flat curves and shapes, published in 1973 — perhaps early enough in the year for Rubow and Karow to discover it.[286] The French scientist of the nineteenth century became the eponym of so-called 'Hermite cubic curves', the underlying mathematical method of Ikarus that later enabled the interpolation of letterforms and shape transformation. As discussed in 4.1.2. (and in the following sub-section) Philippe Coueignoux had developed his own method of creating digital letterforms from cubic curves and even began his research in early 1972,[287] but there is no knowledge of contact between him and Karow at the time, therefore one must assume that both applied cubic curves to letterforms independently.[288]

Although an automated scanning technique was developed later to digitize existing character representations, a manual and very tangible process known as 'hand-digitization' became the system's iconic feature. For initial preparation enlargements of original prints or letterform drawings are carefully traced, turned into clean outline drawings and can then be registered on an Aristo tablet. In addition to a pre-set baseline and side-bearings left and right of the letterform, the outline drawings are marked along its most characteristic points, e.g. in corners and curve extremes. The Aristo digitiser (a sensor device equipped with a magnifying crosshair and at least five keys[289]) is manually moved from mark to mark along the outline, producing a sequence of numerically stored points and therefore 'digitizing' the letterform (**fig. 4.96+97**). Each point carries information of the curve definition, selected from five buttons on the puck: starting point, corner point, curve point (flat or narrow), and tangent, where curves transition into straights and vice versa (**fig. 4.98**). During his early computations Karow realised that each circle segment between two points could be described by single path controls of tangents.[290] Due to the specification of Hermite cubic curves, no additional points (or 'handles') sit off an Ikarus spline — unlike Bézier curves. As a result, shapes described in Ikarus curves are typically composed of several on-curve points: while a mathematically perfect circle can be displayed using four points (one on each extreme), any deviation such as the letter 'O' requires two or three additional points between extreme points that sit 90° apart.[291] This principle does indeed draw a parallel to traditional shipbuilding: analogous to the example outlined above, more nails at shorter sequence create greater tension and provide better control of the spline.

286 See Helmuth Späth, *Spline-Algorithmen zur Konstruktion glatter Kurven und Flächen,* München: R. Oldernbourg-Verlag, 1973.

287 Bigelow 2020, p. 19.

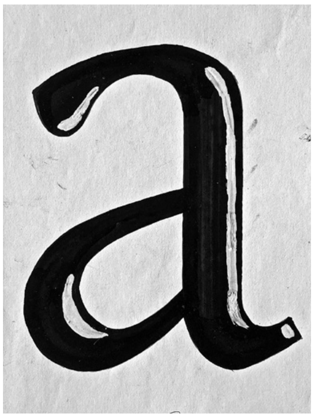
288 URW acknowledge the work of Coueignoux in a 1983 Ikarus brochure and briefly explain why their system 'remains unique', see URW 1983, p. 12.

289 Over time, different digitizer models developed by Aristo and different models in use by URW's clients show evolution in shape, changing number of buttons and different crosshair designs.

290 Karow 2019, p. 21 (see the diagram that illustrates Karow's Ikarus algorithm).

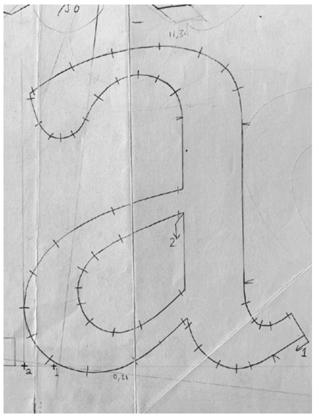
291 Karow 1987, p. 377.

A

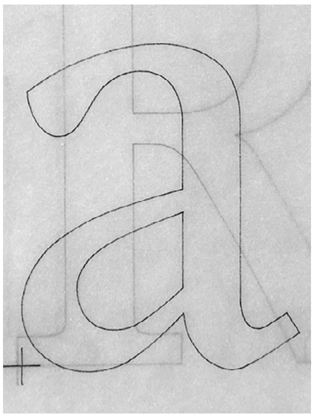


B

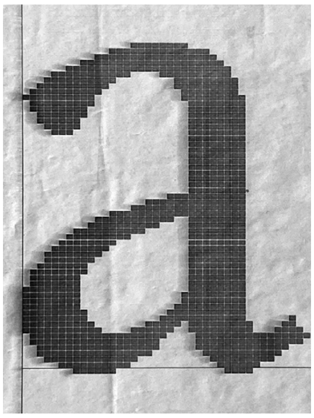
C



D



E



F

G

H

I

Fig. 4.100 All photographs by MM.

A Early sketch from Febraury 1983, later rejected

B Final design with a ‘glow’ exercise using white-out

C Fine-tuned drawings with marks

D Outline representation with marks for digitization

E Plotted output of a digitized outline description

F Rasterized letterfform

G Shape cut in Rubilyth from outline coordinates

H There is generally no use for the positive shape in production; Majoor used it for the presentation of Serré at the university

I Template of a character set for exposure on output material

The digital outlines were stored at a resolution of 15,000 × 15,000 units per em (comparably high at the time) in URW's own Ikarus format (IK) that also included a description of metrics and kerning data. It is important to recognize that in its early version, the set-up of the Ikarus system was almost a decade away from commercial desktop computers with GUIs; during the digitizing process the image of a character appeared in staggered fashion on available monitors (**fig. 4.99**).[292] The numerical data was stored on punch tapes, later on floppy discs, and then fed to an Aristomat for plotting and cutting on masking film. Only after this stage was it possible to receive a reliable, high-resolution output in a laborious and time-consuming process. The digitization and production process is visualized here at the example of the typeface Serré, an unreleased student project by Martin Majoor, realized on an Ikarus workstation during his internship at URW in 1984 (**figs. 4.100**).[293]

In late February of 1973, Karow and his team began implementing a repertoire of modification programmes that enabled automatic letterform distortion on screen such as slanting or rotating of single characters as well as rounding off, 'contouring' and 'shadowing' of the outlines (**fig. 4.101**).[294] Karow surprisingly considers the ability to automatically generate new shapes 'as the birth of "digital type"',[295] but one could argue that type became 'digital' during the earliest approaches to numerical description (see 4.1.1). Typographic style variations were also not a novelty; phototypesetters such as Berthold's Staromat could perform slanting and back-slanting through lens distortion,[296] several phototype manufacturers offered 'rounded', 'shaded' and 'inline' variants of existing designs, styles that became particularly popular among advertising agencies. Brendel's interest in automated modifications and larger typeface families was likely sparked by the demand of his clients who were largely based in advertising.[297]

By May of that year, Karow had made unsuccessful attempts to extrapolate thinner and bolder weights from one existing weight.[298] It was Rubow who proposed that intermediate instances could instead be calculated from two existing extremes, which paved the way for a successful approach (**fig. 4.102**).[299] The ability to interpolate additional weights had a significant impact on devising much larger

292 From a conversation with Martin Majoor, 3 April 2021. Majoor used the Ikarus system during an internship at URW in December 1984, where he was joined by fellow student Wim Westerveld.

293 Majoor's professor Niko Spelbrink had made the arrangement with Karow and URW.

294 Karow 2013, p. 16 f.

295 Ibid.

296 See *Starsettograph, Staromat: Typenplatten, type fonts, plaques-matrices,* Munich: Berthold Fototype, undated (firm brochure, c. 1972).

297 Karow 2019, p. 23.

298 According to Karow, it was the constant crashing of Ikarus during these trials that led to the system's name, analogous to the story of Daedalus and his son Icarus in Greek mythology. Karow 2013, p. 17. Ikarus with a 'k' follows the German spelling convention of the name Icarus.

299 Ibid. Charles Hermite had specified the concept of interpolation mathematically in 1877.

Fig. 4.101 Promotional material of letterform modifications on Rubylith masking film, 1979. Photographed by the author [ES].

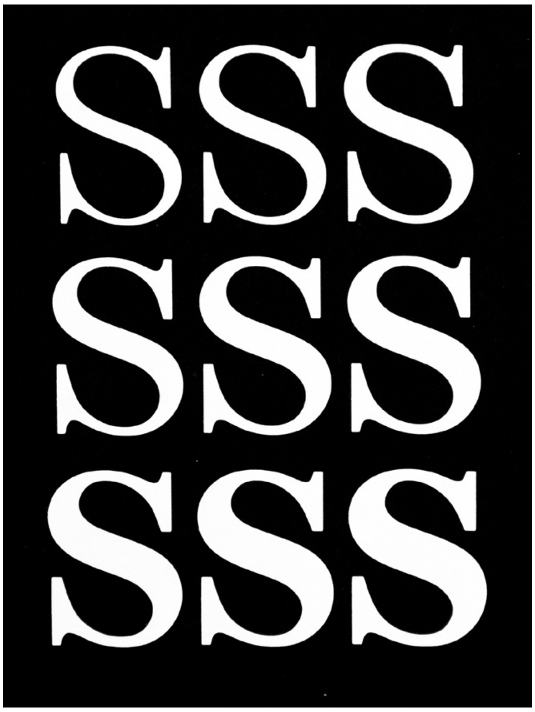


Fig. 4.102 Interpolation had been in use for typeface family extensions at URW since 1973. Reproduced from URW 1983, p. 25.

type families of multiple weights and styles than had previously been conceived or even thought of, in a drastically reduced production time. Karow and his business partners could not have foreseen the economic implications of these abilities in 1973. Years later, Karow admitted to having missed an opportunity for not filing a patent for letterform interpolation.[300] However, patent application for automatic outline digitization was filed over a decade later and was granted in 1986, after the release of PostScript.[301]

Given the programme's abilities it is quite remarkable that aside from Brendel, URW had not received advice from the typography community during the first two years of developing Ikarus. To Brendel & Pabst on the other hand, the collaboration with URW posed an economical advantage, upheld by URW's lack of contact with competitors.[302] When confronting Karow with Brendel's role, and whether URW had consulted any type designers before 1975, he responded:

> No, type designers were not useful for such issues at the time and the one who designed for Brendel, also copied others. Brendel retraced all kinds of typefaces and then made a few corrections himself from time to time. But apart from Hermann Zapf hardly anyone was a friend of digitization. Only later there were a few people who became occupied with this, also younger people [...] who had just finished their training.[303]

Aside from touching on Brendel's allegedly controversial business practise, Karow refers to two generations of designers that became important allies of URW in the mid-1970s: accomplished designers who would see an opportunity in Ikarus and help it gain acceptance among manufacturers, and an emerging generation of younger designers who could be trained to use it. The realisation of having developed a unique selling proposition grew by 1975, which also gave an impetus to establish new connections.

300 Karow 2019, p. 25.

301 A US patent application for a *Method and apparatus for automatic digitizing of contour lines* was submitted 29 June 1984 (a German application was filed 4 July 1983, just weeks before the ATypI working seminar at Stanford) and was granted on 16 December 1986 under US4630309A.

302 Karow claims that Brendel spoke only briefly of his competition and was actively reluctant to share information about the industry in order to maintain exclusive use of Ikarus. Karow 2019, p. 40.

303 Translated from Karow's original German in an interview with the author, 20 May 2019 (audio file 02, 13:05): 'Nein, die Schriftgestalter waren zu der Zeit für solche Dinge eigentlich nicht zu gebrauchen und der eine, der für Brendel entwarf und zeichnete, hat auch kopiert. Brendel hat alle möglichen Schriften nachvollzogen und selbst noch ab und zu korrigiert. Aber ein Freund von Digitalisierung war außer Hermann Zapf so gut wie keiner. Erst später gab es natürlich Leute, die sich damit beschäftigten, auch jüngere [...], die gerade aus der Ausbildung gekommen waren.' In response to a follow-up question regarding names Karow also mentions Matthew Carter and Kris Holmes.

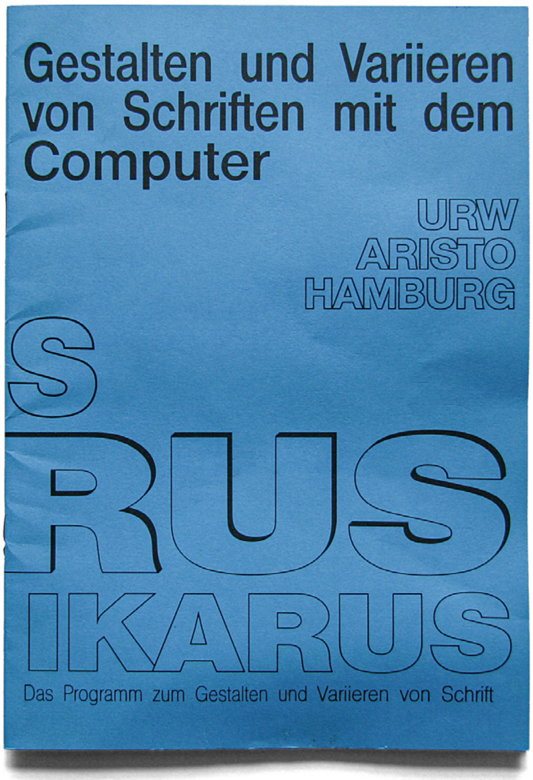


Fig. 4.103 URW's first promotional brochure, distributed at the 1975 ATypI congress in Warsaw: 'Design and modify typefaces with the computer'. Photograph by the author [DTGC, special collections].

In May 1975, URW initiated talks with Hell as a prospective client and it was during their first visit to Kiel that Karow and Weber also met Hermann Zapf.[304] Zapf had received the prestigious *Gutenberg-Preis* of the city of Mainz the previous year for his contributions in type design, including for his work on digital type with Hell,[305] who were awaiting to release the first set of digital fonts (including Zapf's Marconi and Edison) on their proprietary typesetting machine Digiset (see 4.1.1.). As the earliest series of Digiset fonts was merely described in a resolution-specific bitmap format the use of Ikarus was going to drastically improve Hell's possibilities by providing a resolution-independent format. While Hell and URW negotiated the conditions of a possible collaboration, Zapf signalled his interest to include an announcement of Ikarus in his lecture slot for the 1975 ATypI congress in Warsaw in September of that year.[306]

Veronika Elsner and Günther Flake were graphic design students at Fachhochschule Hamburg when they attended the 1975 ATypI congress and first met Karow after the announcement of Ikarus, an encounter that encouraged them to work for URW.[307] Back in Hamburg, Elsner began to work for URW as a freelancer financing her studies, after which she and Flake joined the firm on a full-time basis at the beginning of 1977.[308] Two-and-a-half years after its development, Elsner is likely the first designer to have worked with Ikarus. Eventually, Elsner mastered the tool to the degree that she became URW's main representative for demonstrations (see 3.4.1) and Ikarus training for clients; to many manufacturers at the time, she was literally the face of URW.

It has been suggested that Zapf's endorsement before the ATypI community marked the starting point of Ikarus' success.[309] Although URW's self-made promotional material would have left typographers unimpressed (**fig. 4.103**), manufacturers recognized a solution in Ikarus to their problem in preparing letterform templates for various phototypesetting machines. The ATypI congress became an opportunity for initial talks with Berthold, Linotype, Monotype and Stempel, but it was Hell, a manufacturer without an extensive library of existing typefaces that was willing to make the investment on an exclusive two-year deal in 1976. After two years, URW continued to work for Hell and sold additional licenses to Autologic, Compugraphic and Triple-I, three phototype manufacturers who also did not have a history in metal type, and to Typoart, the state-owned conglomerate of former

304 As Karow recalls, Weber discovered an article about Zapf in the papers that mentioned his collaboration with Hell, after which they briefly contacted Zapf by phone. Karow 2019, p. 40.

305 See *Gutenberg-Preis der Stadt Mainz und der Gutenberg-Gesellschaft verliehen an Hermann Zapf, Darmstadt, am 24. Juni 1974,* Kleiner Druck der Gutenberg-Gesellschaft, no. 97, Mainz: Gutenberg-Gesellschaft, 1975, p. 12.

306 Karow 2019, p. 42.

307 Stock-Allen 2016, p. 22.

308 Karow 2019, p. 59.

309 Weichselbaumer 2015, p. 297 f.

metal type foundries in East Germany.[310] Large type manufacturers with long histories and extensive typeface libraries only followed in the early 1980s. This shows the hesitance of established corporations, that may have been stuck in existing structures, had much more to lose and were far less enthusiastic about yet another technological change than younger firms. When URW sold a license to the New York subsidiary of Mergenthaler Linotype in 1980, Karow referred to the deal as 'our most important Ikarus', suggesting confidence that after business with this world-leading manufacturer other deals would follow.[311] In the autumn of 1980, licenses were sold to the H. Berthold type foundry, followed by Sha-Ken and Morisawa; within a little more than a decade URW's list of clients counted 25 international font manufacturers in ten different countries.[312] When Elsner presented Ikarus at Stanford in 1983, Ikarus was already well established.

In addition to selling equipment and licenses, URW also carried out font manufacturing services from their Hamburg office for selected clients. These services involved hand-digitization from existing drawings, usually provided by the type drawing offices of manufacturers, as well as output for any respective typesetting machine. The service appealed especially to clients such as ITC who did not manufacture their own typesetting machines. These services were mainly carried out by Elsner and Flake.

The price of an Ikarus system likely did not appeal to the growing group of independent type designers. Merely a handful used Ikarus in their studio, including Bigelow & Holmes and Georg Salden. An interview with Salden paints the picture of a designer who did not trust the in-house production of leading manufacturers with his designs and therefore wanted to stay in complete control[313] — the conflict between designers and digital punch cutters is further discussed in 5.2.2.

In the second half of the 1970s, Karow also established new relationships through the network of ATypI, not just with manufacturers, but with independent type designers such as Kris Holmes, Jovica Veljović and Gudrun Zapf von Hesse, as well as with educators. An arrangement between Karow and Gerrit Noordzij led to internships of five students of the KABK in The Hague.[314] When Petr van Blokland completed an internship at URW during his second academic year in 1976, he explored the possibilities of Ikarus by digitizing his own designs and by experimen-

310 Further research on URW's business relationship with Typoart in Dresden may reveal interesting aspects of intra-German relations between the typographic industries of both countries. A deal of this magnitude would not have remained unnoticed to the services of 'state security'; Karow hints at an attempted recruitment for 'computer espionage', which he apparently was able to talk himself out of, see Karow 2019, p. 68 f.

311 Karow 2019, p. 88.

312 Karow 1987, p. 101, fold-out.

313 See interview with Georg Salden by Jürgen Siebert, 'Schriftenmachen ist Meditation', in *Page,* vol. 6, no. 3, Hamburg: MACup Verlag, 1991.

314 Interview by the author with van Blokland, 3 May 2019 [audio file 01, 07:40].

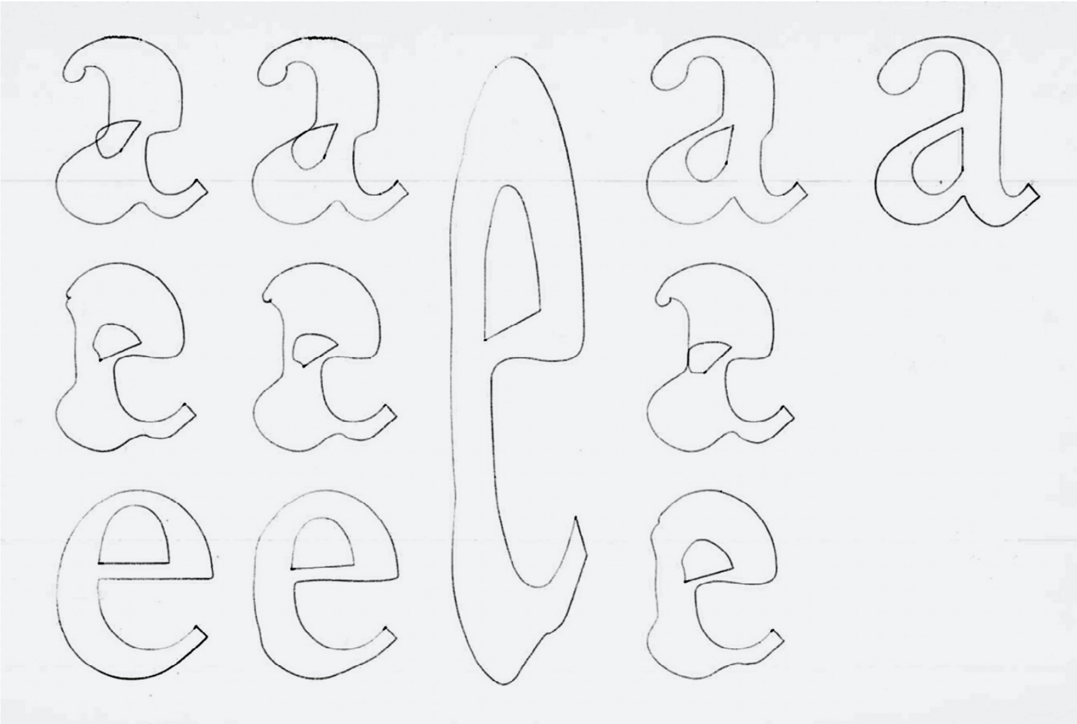


Fig. 4.104 Early results of Petr van Blokland's experiments with interpolation and extrapolation conducted during his internship at URW in 1976 [PvB].

Fig. 4.105 Van Blokland's final interpolation of the design space described in Noordzij's 'translation' and 'expansion' models. Photographed by the author. Noordzij 1982, p. 16/17.

ting with the boundaries of interpolation (**fig. 4.104**).[315] In return, URW received feedback and reflection from the mind of a young type designer. Van Blokland and URW built a lasting relationship beyond the internship: almost ten years later it turned into a close collaboration when van Blokland took the lead in the development of an Apple Macintosh-compatible version of Ikarus that became known as Ikarus M and found prominent supporters in Unger and Spiekermann, and users in a new generation of young type designers (see 5.2.2). Apart from the fact that Ikarus M was significantly cheaper at 500 DM, its improvements to the usability and interface of Ikarus were ground-breaking and had serious implications on the previous separation of type design and digital punch cutting, aspects that are investigated further in chapter 5.

315 Some of these experiments are the ground work for two diagrams of letterform interpolations of different styles and contrasts of the letter 'e', based on Noordzij's theories (see 4.2.2.) that were published in the 1973 ATypI congress publication (see **fig. 3.25**). The two diagrams that van Blokland finished later during his internship were then published in an article by Noordzij, 'Haags ABC', in *Compres,* 23 May 1978, pp. 13–19, and again in Noordzij's *The stroke of the pen,* The Hague: KABK, 1982, p. 16 f. (**Fig. 4.105**).

4.2.5. LIP: at the heart of a new business

Of the five digital type systems demonstrated at the 1983 Stanford working seminar the Letter Input Processor (LIP),[316] developed by the Camex Corporation and Bitstream, was the youngest. Bitstream was founded in Boston just two years earlier by former Mergenthaler employees Matthew Carter and Mike Parker with Cherie Cone and Rob Freedman. In 1983, Carter introduced Bitstream as a 'digital type foundry' in the sense that it manufactured device-independent digital type, but not corresponding hardware,[317] unlike Hell who produced digital type exclusively for use on their own Digiset machine (see 4.1.1). In order to 'support the introduction of the new technology', Bitstream devised a library of digital fonts that could be converted to match any output device including typesetting machines and an emerging market of imagesetters.[318] Initially, Bitstream used LIP to digitize existing classics, which has been controversially discussed, but later also included original designs by Carter and commissioned independent designers such as Gerard Unger and Gudrun Zapf von Hesse, among others to contribute to the library. After Monotype Imaging acquired Bitstream in 2011, the whereabouts of its company archive have been subject to speculation. There appears to be no previous work on the early years of Bitstream, but a decent amount of literature about the long, successful career of Matthew Carter,[319] who is ranked among the leading type designers of the twentieth century.[320] Carter's two presentations at the 1983 working seminar are published in *Visible Language,*[321] Unger's work for Bitstream is documented by Burke.[322] Archival findings in the collections at Reading and Rochester, in private collections, and an interview with follow-up correspondence between Carter and the author help revisit the environment in which LIP was developed and used.

316 Derived from a 'stream of bits', from the rasterizer of a system to an output device, see Carter 2016, p. 28 f. The name is spelled 'LetterIP' in Ruggles 1983, p. 18. This is probably where Southall borrowed the spelling, see Southall 2005, p. 157. Bigelow suggests, at the time it was pronounced 'let-her-rip' as in 'let it go', in an interview with the author, 7 September 2017 [audio file 01, 02:18]. For consistency with Carter's spelling of the name, 'LIP' is used here.

317 Carter acknowledges the term 'digital typefoundry' was coined by Bigelow. Carter, 2016, p. 30.

318 Early brochure on *Bitstream: digital fonts,* undated, c. 1981 [DTGC, Richard Southall collection, box 23].

319 Most notably: Margaret Re (ed.), *Typographically speaking: the art of Matthew Carter,* New York: Princeton Architectural Press, 2003. Catalogue of an exhibition of the same name with contributions by Johanna Drucker, Matthew Carter, Albin Kuhn and James Mosley.

320 Kinross places Carter 'in the company of the twentieth-century masters of typedesign — a Dwiggins or a Frutiger'. Kinross 2010, p. 176.

321 The presentation on 'Galliard: a modern revival of the type of Robert Granjon' is published in Carter 1985, while 'The digital typefoundry' is documented in Carter 2016.

322 See Burke 2021, pp. 158–163. For a typeface review see Max Caflisch, 'Bitstream Amerigo von Gerard Unger', in *Typografische Monatsblätter,* vol. 108, no. 3, 1989, pp. 17–32.

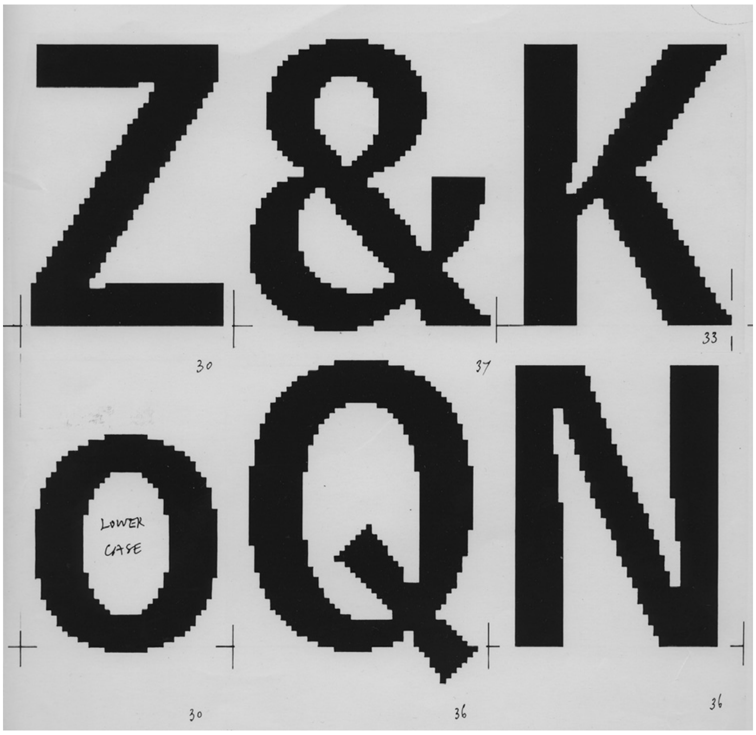


Fig. 4.106 Matthew Carter created every character of Bell Centennial manually pixel by pixel. An outline description was later derived from these bitmaps [MC].

Fig. 4.107 Four weights of ITC Galliard ranging from ultra to regular, reproduced from a Scangraphic type specimen [DTGC, library].

Before co-founding a digital type foundry, Matthew Carter gained years of experience working with previous type technologies as well as with the production of digital type. Shortly after finishing school, Carter received formal training in punch cutting before he began his career at Linotype in 1965, working mostly on designs for phototype, one of which was also released on the original line-casting machine in 1970.[323] At the end of the seventies, Carter finished his design on Bell Centennial, a low-resolution bitmap typeface for small sizes on CRT typesetting, on commission by AT&T for the US telephone directories (**fig. 4.106**). As a result of these previous experiences, having lived through the fundamental change from metal to phototype, *another* technological transition felt less significant to Carter:

> When digital type came along, in one sense it did not make as much difference as going from metal to film. Much of what we had done for film simply went digital perfectly well. The part of the digital change that I remember, happened in the later stages.[324]

Particularly as a designer associated with Mergenthaler Linotype, Carter would have experienced the 'emancipation from the constraints of duplex matrices' and from the lack of kerning in them.[325] When Carter joined Mergenthaler in 1965, Mike Parker was typographic director at a comparatively young age. Previously, Parker was a part of a group at the Plantin-Moretus Museum in Antwerp (of which Matthew Carter's father Harry was also a member) that identified and catalogued punches and matrices. As a result, early in their collaboration Carter and Parker evaluated which of the 'Plantinian treasures' would be suited for renditions in phototype.[326] One of these considerations came to fruition in a joint study of types cut by the Frenchman Robert Granjon during the middle of the sixteenth century. The study resulted in the design of Galliard, not defined as a revival of a specific face, but as a 'reinterpretation' of Granjon's style. In an attempt to release a design that would not only be used as a text face by book designers, Galliard was comprised of four weights (regular, bold, black, ultra) and corresponding italics that appealed to advertising agencies who had developed a particular preference for heavy weights and tight spacing since the advent of photocomposition. The typeface was first released by Mergenthaler in 1978 and three years later with ITC for a much wider market (**fig. 4.107**).

It is worth mentioning that after Carter and Parker met Peter Karow in the mid-1970s, Ikarus was utilized for interpolation between Carter's hand-drawn

323 See 'A check-list of typefaces designed by Matthew Carter', 2002, published in conjunction with the book on Carter by Margaret Re cited above.

324 Mathew Carter in an interview with the author, 14 September 2017 [audio file 01, 02:25].

325 Ibid. Duplex matrices of the Linotype held two faces of type, typically of an upright weight and its italic counterpart, which had to fit on the same body width. Letters designed for the matrices could also not be kerned.

326 Carter 1985, p. 79.

regular and black weights of Galliard, and to extrapolate the ultra weight in 1977 (see **fig. 5.35**). The use of Ikarus at this stage is quite remarkable, as URW had promised its services exclusively to Hell between 1976 and 1978 (see 4.2.4), and did not officially work for Linotype (or rather Stempel) before 1980.[327] As Carter points out, the employment of Ikarus (not yet fully developed) was a trial:

> The experimental use of Ikarus in the production of Galliard served really as a "proof of concept" that encouraged us to think that a fully developed Ikarus would be a very valuable production tool — as proved to be the case.[328]

This realization turned out to be valuable later. The critical consideration of technological advance (the extrapolated results at the time were considered useless and discarded[329]) is just one aspect in a range of skills exemplified in Galliard, in addition to lessons learned in type history and access to related resources, a pursuit of a clear business strategy (devising a design space for a specific target group) as well as an understanding of the market and its changing mechanism of distribution. According to Kinross, the Galliard project may be proof that 'the deepest contributions in typography are often made in-house, semi-anonymously, and for highly "industrial" uses (newspapers, telephone directories, display screens)'.[330] When Carter and Parker left Mergenthaler to form Bitstream, their collaborative procedures established at Mergenthaler were going to be one of the pillars of their new endeavours.

From the start, Bitstream's business plan was closely tied to a cooperation with Camex, a company also located in Boston that initially developed vector display computer terminals, referred to as CAM, for the composition of newspaper advertisement. Initially the systems could not accurately display composed paragraphs at a proper resolution until the final step of the process, but improvements from those 'anonymous characters' to clearly identifiable type on CAM devices led to Carter's conclusion, 'if you can see it, you can design it'.[331]

Another pillar of the new joint venture was the conviction that designers and engineers should co-develop a new digital type design system hand in hand from the beginning. In this regard, the conception of LIP is quite the opposite to the other systems discussed in this chapter. At the same time, as with any formation of a new business, there was a lot at stake and not much time for research and long cycles of

327 According to Karow, Hell granted URW permission to collaborate with Linotype and Stempel in 1977. During this time URW began to negotiate with Stempel's René Kerfante. Karow 2019, p. 58 f.

328 Matthew Carter in correspondence with the author, 29 October 2022.

329 Ibid.

330 Kinross 2010, p. 176.

331 Carter, 2016, p. 28.

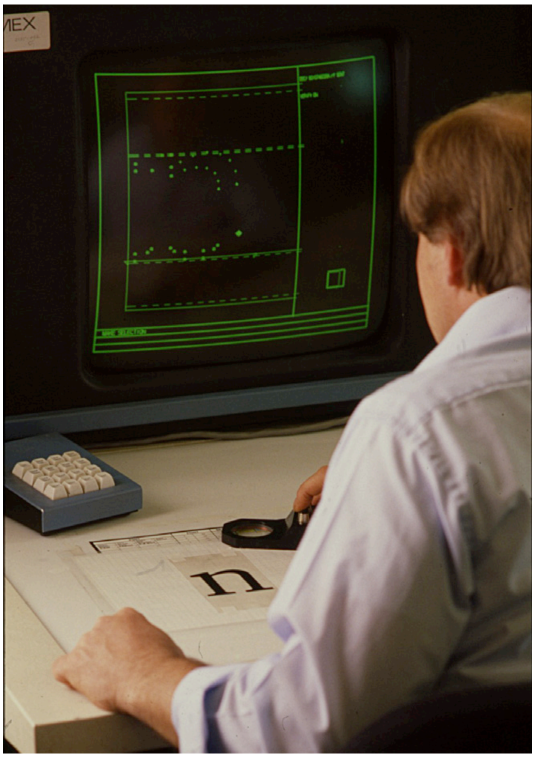


Fig. 4.108 A Camex LIP workstation in use at Bitstream. Photograph by Steve Marsel [MC].

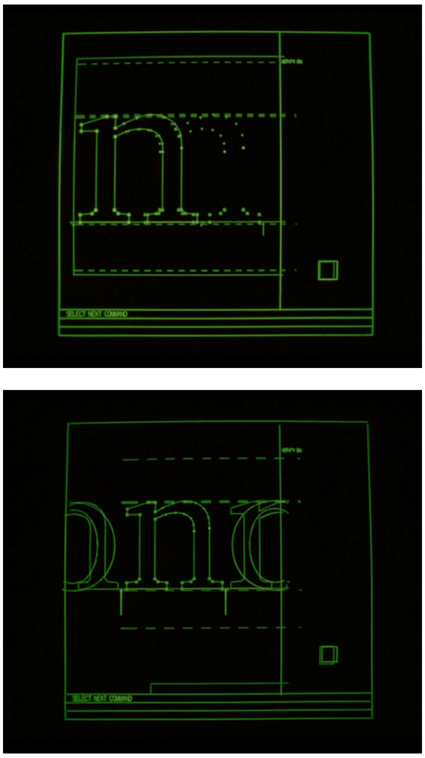


Fig. 4.109 Top: as each point is entered, it appears on the monitor almost simultaneously. Bottom: three letters with bows and straights can be displayed at the same time while adjusting the kerning [MC].

development before the new system could be deployed. Carter describes the early phase as an open-heart-surgery that depended on joint efforts:

> When technologies are first put out there they are never perfect. It is a shake-down cruise, you have got to get it out there. Like a Japanese car manufacturer: put it on the road and see what happens. First you build a digital type-setting machine and then you start thinking about the fonts. Designers are brought in to try to disguise technical problems. […] Until you start doing it, you do not really know what the problem is going to be, so you need type designers who have the temperament to work with engineers. Of course, practically that is not supposed to work. Traditionally, designers are suspicious of engineers and engineers dislike designers, but I have to say, working with engineers has been one of the best parts of my working life.[332]

A decisive role during this process must be assigned to Wendy Richmond, a design director at Camex, lecturer at MIT and an advisor to publishers and university presses, who was involved at both conceptual and technical stages in devising the type design system.[333] During a 1982 conference at RIT, Richmond explained the abilities of CAM and portraits it not only as a production tool, but as a 'graphic designer's sketching tool' for drafting type in different weights.[334]

Eventually, the CAM system for text composition was modified to create and store letterforms.[335] Just by the look at the final setup, the similarities between LIP and the Ikarus system are quite obvious. A document authored by Richmond, that was circulated to her colleagues at Camex, reveals a brief study of the key utilities and functions of Ikarus.[336] Certainly, Carter's previous experience with Ikarus and its 'proof of concept' would have also served as a reasonable argument to develop a tool with similar settings for internal use at Bitstream. Ruggles describes LIP as an 'interactive' system comprised of three main components: a digitizer, an editing system and a database for storage of the character description.[337] Large letterform representations of manually drawn outlines would be marked at significant points (starting point, curves, tangents, etc.) and then traced with a sensor on a digitizing tablet by a trained designer (**fig. 4.108**). While the system used cubic curves for input and storage (like Ikarus), the vector format for output and

332 Matthew Carter in an interview with the author, 14 September 2017 [audio file 01, 07:35].

333 See Richmond's short bio in a conference announcement, in *U&lc,* vol. 9, no. 1, p. 46.

334 Summary of Richmond's talk 'The CAM as a graphic designer's sketching tool', held at the conference *The designer and the technology explosion* at Rochester Institute of Technology. The document is dated 7 April 1982 [DTGC, Richard Southall collection, box 23].

335 Ruggles 1983, p. 17.

336 See untitled and unpublished document by Wendy Richmond, dated 21 May 1981 [DTGC, Richard Southall collection, box 23].

337 Ruggles 1983, p. 17.

A B C D E

Fig. 4.110 Different sizes (pt) at resolutions (lpi) ranging between 'high' and 'brick-laying', adjusted in x-height for comparison: (A) 96 pt at 1000 lpi; (B) 12 pt at 1000 lpi; (C) 24 pt at 300 lpi; (D) 12 pt at 300 lpi; (E) 6 pt at 300 lpi. Plotter output, reproduced by Norman Posselt [CC, CSC 030, box 1, folder 5], overlapped here for comparison.

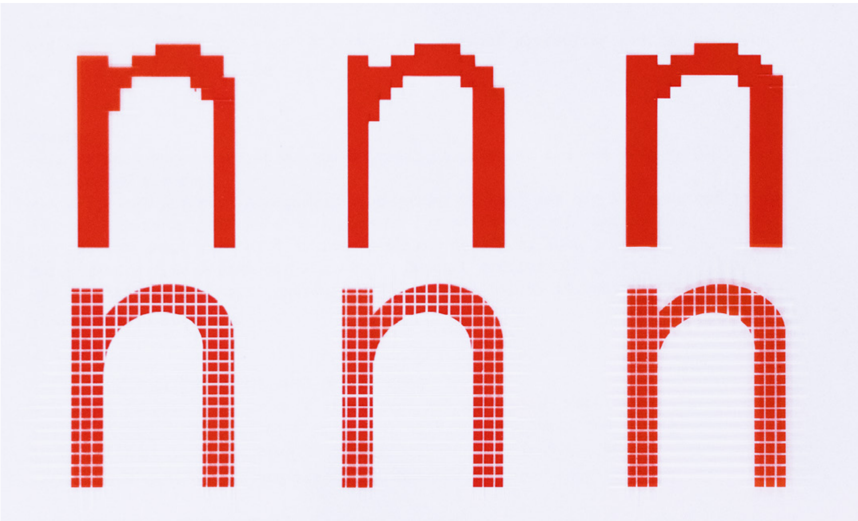


Fig. 4.111 Positioning the raster. Plotter output, reproduced by Norman Posselt [ibid.].

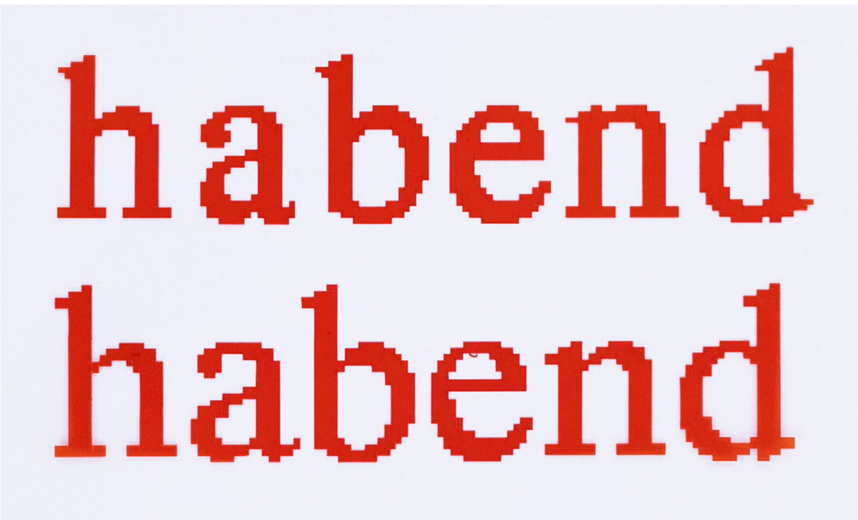


Fig. 4.112 Manual bitmap editing. Plotter output, reproduced by Norman Posselt [ibid.].

distribution followed a mathematical outline description of circular arcs.[338] Southall confirms that this system is similar to Ikarus in terms of utilizing a tablet and cursor as an input mechanism, but praises LIP's 'responsiveness' over Ikarus: as each point was entered, it appeared on the monitor almost simultaneously and the complete outline was displayed at the end of that process (**fig. 4.109**).[339]

The LIP outline description could be used for output on plotter devices and tape, but most importantly, as a result of Bitstream's particular concern with type for low-resolution output devices, a significant feature of LIP was the built-in raster image processor (RIP). With the emergence of new electronic non-impact printers in office spaces (such as early laser printers) available from a variety of manufacturers, in addition to other output formats that required character rasterization, the designers and engineers of Bitstream and Camex developed a series of automatic routines and manual editing techniques to maintain the quality of fonts in respective sizes at different resolutions.

In the second part of his presentation about the 'digital type foundry', Carter addressed some of these issues; they are revisited here with illustrations from the original material that Carter had used in his slides.[340] While type performs rather smoothly at high resolutions of 1,000 lines per inch in larger as well as smaller sizes, the basic challenges become visible at lower resolutions of 300 lpi, to which Carter sarcastically remarks that it has 'more to do with brick laying than with type design' (**fig. 4.110**).[341] A general problem of converting outlines into bitmaps is rooted in the positioning on the underlying raster grid. Bad positioning results in unwanted variations of stem widths, but LIP'S integrated Symbolics programme was able to calculate the appropriate fit of 'image to raster' (**fig. 4.111**). A comparison of a 'before-and-after' low-resolution 9-point Times New Roman specimen demonstrated the remarkable improvements of bitmap editing (**fig. 4.112**), some of which concern optical corrections such as handling overshoots, or maintaining stem width of gradually increasing type sizes at low resolution. A signature technique applied to horizontal strokes for low-resolution output fonts was known as 'half-bitting', when a line of bits is alternately on and off to simulate half a point size (**fig. 4.113**). This technique is also present in Unger's bitmap design of Oranda, a

338 Bigelow 2020, p. 16 f.

339 Southall 2005, p. 157.

340 The original slides were revisited during the interview with Matthew Carter (14 September 2017), after they had been rediscovered in the archives by the author at RIT (8 September 2017). The illustrations were prepared on translucent masking film in 1983 [CC, CSC 030, box 1, folder 5].

341 Carter 2016, p. 31.

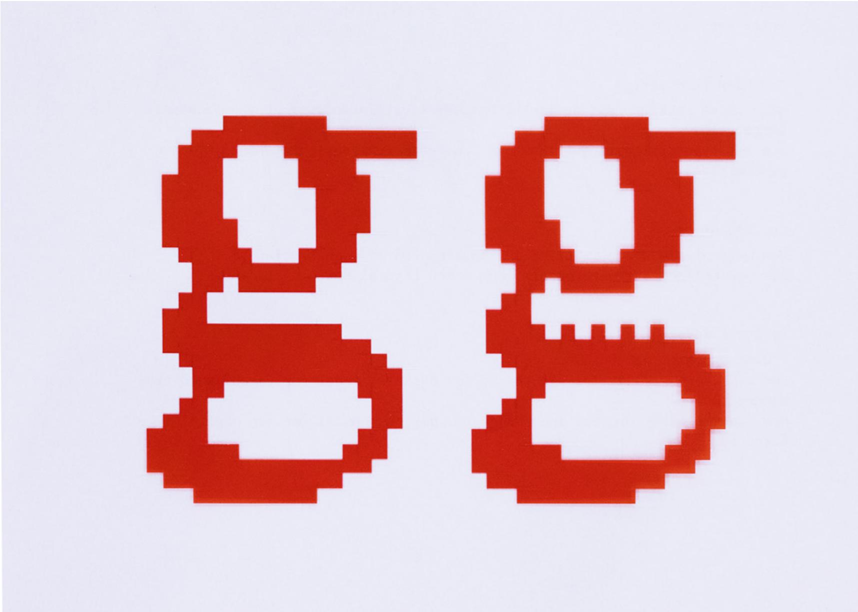


Fig. 4.113 Half-bitting on the top of the middle horizontal cross-bar. Plotter output, reproduced by Norman Posselt [ibid.].

Fig. 4.114 Grey-scaling performed on an Atex monitor. Photographer unknown, reproduced by Norman Posselt [ibid.].

typeface for low-resolution laser printers of Océ who employed Bitstream's services for digitization, while executing bitmap editing in-house.[342]

Finally, as Carter recalls, Richmond was involved in a study of grey-scaling at Camex as a technique to improve all previous methods of letter editing for varying resolutions.[343] The integration of two shades of grey in addition to black and white determined the values of surrounding bits of form and counterform (**fig. 4.114**). Carter says, at the time he became aware of this method he was not familiar with similar research pursued at Xerox PARC.[344] More research is necessary to explore the origins of greyscaling and its relevance in digital typography.

While significantly improving its technical foundation, Bitstream became involved in devising a typeface library. The aforementioned document by Richmond reveals considerations of licensing options, swapping deals with competitors, while also creating new original designs that would suit a constantly developing technology:

> While most older fonts (Baskerville, Bodoni, etc) are in public domain, there are an important and growing number which are not. Certain typesetting companies (e.g. Mergenthaler and Hell Digiset) have commissioned and thus own these newer faces, and although other companies can copy these alphabets, they cannot use the same names. […] Companies owning the originals of such faces have not been likely to sell them to other typesetters, though there have been deals involving swapping. But there have been some recent changes at Mergenthaler which involve Mergenthaler selling fonts independently of their typesetting machines. While it is unclear yet if they will have any sort of deals with competitors, I do feel that a connection with Mergenthaler would be extremely beneficial, and must be investigated.[345]

As mentioned in the introduction to this subsection, Bitstream allegedly devised a type library by adapting existing classics, but renamed them to avoid violation of trademark registrations in the United States.[346] Since the protection of intellectual property rights of type manufacturers was a founding mission of the ATypI in 1957 (see 3.1), the association was naturally concerned with such circumstances. As mentioned in 3.4.3, the issue of copyright was very present at the 1983 ATypI working seminar as a topic of discussion in the presentation of Edward Gottschall

342 Martin Majoor, who worked at Océ in 1986/87, recalls spending two weeks of advanced training at Bitstream in Cambridge/MA to learn how to operate LIP and edit bitmaps. From an online conversation between Majoor and the author, 4 April 2021. A bitmap of the lowercase 'g' in Unger's Oranda is reproduced in Burke 2021, p. 169.

343 Matthew Carter in an interview with the author, 14 September 2017 (audio file 02, 01:30).

344 Ibid.

345 Untitled document circulated by Wendy Richmond, dated 21 May 1981 [DTGC, Richard Southall collection, box 23].

346 Burke 2021, p. 158.

on *The state of the art of in typeface design protection,*[347] as well as in the talks of Unger and Zapf who were both strong advocates of typeface protection. Gottschall reminded Stanford's attendants of the so-called *Vienna Agreement* of 1973, that it was still 'the best protection for typeface designs', even though only France and West Germany had signed it.[348] In the United States, protection for typeface designs did not exist per se, however the laws permitted registration of tradenames and trademarks, as was practised by ITC, which prevented copies of existing designs be given the same name as the original.[349] At Stanford the issue was also discussed behind the scenes: according to an aforementioned protocol (see 3.4.2), representatives of the Haas type foundry were concerned with 'Bitstream's adopted Helvetica' (a typeface for which Haas, Stempel and Linotype owned the intellectual property and tradename) and consulted John Dreyfus about it.[350] While it seems that adapting typeface designs was not unlawful in the United States, it would have been considered unethical by the statutes of the ATypI. Gerard Unger took a stand against copyright infringement in his own talk:

> Copying has practically been institutionalized. Many maintain that it is primarily a legal problem, and surely the legal question needs to be answered. I think however, that it is just as much a matter of taste and care.[351]

Burke suggests that expanding the type library by including more original designs may have occurred to Bitstream at Unger's words of advice; following their meeting at the seminar, Unger was commissioned to design a new typeface.[352] Unger's concern with Optima at low-resolution output from early laser printers (see 3.4.3), eventually became a part of the brief to design a typeface in the genre of 'serifless romans' for an environment of office printers.[353]

Either shortly after the 1983 ATypI congress in Berlin or on another trip to Germany the following year, Mike Parker visited Gudrun Zapf von Hesse in Darmstadt with an enquiry to include one of her alphabet drafts in the Bitstream library. Like Carter, she belongs to the small circle of designers who worked on faces for all the major type technologies of the twentieth century, including her first

347 See Gottschall 1985.

348 The *Vienna Agreement for the Protection of Typefaces and their International Deposit* (agreed upon 12 June 1973) offered 25 years of protection for new typefaces based on 'novelty' and 'originality'. Although the terms were worked into federal law in Germany and France, the agreement lacked additional signatures to be 'internationally effective'. Gottschall 1985, p. 151.

349 All ITC typefaces carried the 'ITC' label, often followed by the name of the designer and the name of the typeface, e.g. ITC Zapf Dingbats. Jerry Kelly, *About more alphabets: the types of Hermann Zapf,* New York: The Typophiles, p. 55.

350 Protocol of the 1983 ATypI working seminar by A. Hoffmann, 31 August 1983 [DTGC, ATypI collection, 'ATypI working seminare, 5) Stanford 1983'].

351 Unger, 1986, p. 11.

352 Burke, 2021, p. 160.

353 Ibid., p. 162. The term 'serifless roman' is used in Zapf 1970, p. 39.

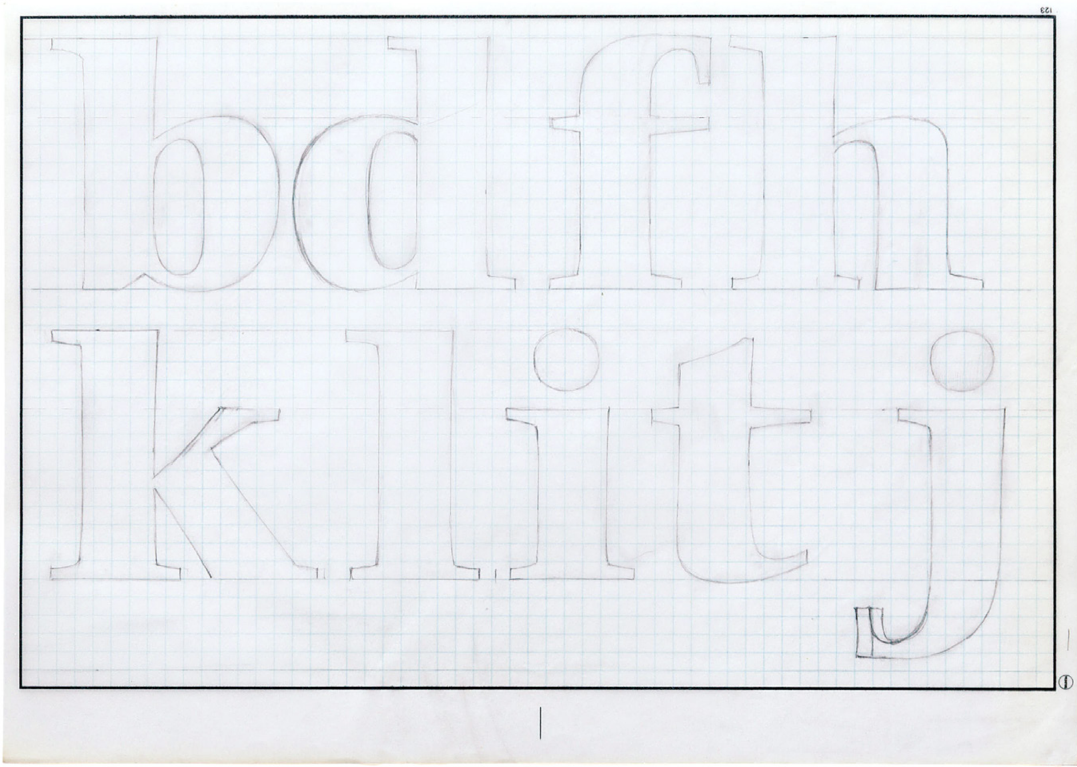


Fig. 4.115 Bitstream Carmina, outline drawings on graph paper. Photographed by Norman Posselt [GZvH].

Fig. 4.116 Plotted proof of Bitstream Carmina's black weight for final corrections and approval. Photographed by Norman Posselt [GZvH].

releases with the Stempel type foundry for metal in the early 1950s, and experience in punch-cutting at Bauer before that. All of Zapf von Hesse's text faces are derived from handwriting with a broad nib. Bringhurst suggests that the design that became known as Bitstream Carmina builds on her first text typeface Diotima (Stempel, 1951), yet is more versatile and more lyrical.[354] Just like Amerigo, Carmina was also developed in four weights, of which only two had to be drawn from hand, including 'black'.

After Zapf von Hesse's thirty-year absence from type design (with the exception of one custom phototype face for Hallmark in 1968), her career was revitalized by Bitstream and by another simultaneous commission from Berthold, for whom she contributed Nofret, a narrow redesign of Diotima. Berthold had employed Ikarus for digitization since 1980, therefore, with the project timelines coinciding, Zapf von Hesse prepared enlarged pencil contours of her original pen drawings on graph paper for both typefaces (**fig. 4.115**), but for separate digital type systems. Although the procedures were similar, the rules for marking points was slightly different. This process of turning pen strokes into pencil contours was a novelty in Zapf von Hesse's design process, but as Max Caflisch explains in a review of Carmina, her experience in type design was helpful:

> Gudrun Zapf-von Hesse has spent so much time with type and knows the contours of each letter previously shaped with a nib so well, that she can capture and retrace them unmistakeably and in all detail. By this manner, the type drawing preserves the directness of the originally written letterforms.[355]

By the summer of 1986, Zapf von Hesse received proofs of the black weight for final approval, before it was used as one of two masters for interpolation of the remaining weights (**fig. 4.116**).[356] When Carmina was released later in 1986, it became Zapf von Hesse's first digital typeface; ironically, the year also marks the end of the 90-year history of the Stempel type foundry. It was followed by the release of Nofret in 1987 and by another typeface for Berthold as well as two more for URW during the following years, all of which were digitized with Ikarus.[357]

354 Bringhurst 2016, p. 223.

355 Translated by the author from the German original: 'Gudrun Zapf-von Hesse hat sich so lange mit Schrift beschäftigt und kennt die zuvor mit der Feder geschaffenen Umrißlinien der Buchstaben so genau, daß sie diese zeichnerisch mit allen Feinheiten der Strichführung untrüglich nachvollziehen und festhalten kann. Die Schriftzeichnung bewahrt auf diese Weise die Unmittelbarkeit der ursprünglich geschriebenen Schriftform.' M. Caflisch, 'Bitstream Carmina, eine neue Schrift von Gudrun Zapf-von Hesse', in *Typografische Monatsblätter,* vol. 107, no. 6, 1988, p. 20.

356 In a letter by Matthew Carter to Gudrun Zapf von Hesse, 9 July 1986 [GZvH].

357 Zapf von Hesse's typeface URW Colombine, a script alphabets with connecting strokes, was produced for the Signus library in 1991.

With the successive releases of Amerigo, Carmina and Carter's own typeface Charter that followed in 1987, Bitstream consecutively built its own library of originals by experienced designers at the height of their career. After the introduction of Adobe's PostScript, all of the typefaces were also converted and made available for the new format. Carter and Parker demonstrated an understanding of a changing market; their primary concern was not to provide digitization services for other manufacturers, although they occasionally did that (e.g. for Océ), but producing and distributing device-independent fonts for new emerging markets in printing and digital use. Eventually, the use of LIP was abandoned in favour of a font editor that produced 'native' PostScript files. Co-founders Carter and Cone left Bitstream in 1991 to form their own business, which has been active since.

4.2.6. Systems for further research

The selection of digital type design systems demonstrated at the 1983 ATypI working seminar at Stanford is representative of the technological progress made in the United States and Western Europe. While Stanford was without a doubt a fortunate place for the gathering of available systems, significant advances were also made elsewhere. These were not necessarily *unknown,* but may not have been published in English and have not been fully acknowledged in a global perspective of the developments in digital type. Researchers with other language skills and access to different resources may be able to consider those systems for further research.

The presence of over a dozen representatives of South and East Asian type manufacturers and tech firms at the 1983 working seminar is a sign of communities on different continents moving closer together. Attendants included Vasant Bhat of the Institute of Typographical Research in Pune, India, Gopalkrishna Modi of the Gujarati type foundry, Nobu Ikeda and Masaru Tsukamoto of Morisawa and Shin-Ichiro Fukuda of Sha-Ken — a decade later, gatherings of these extended circles were common.[358] Particularly in East Asian scripts, objectives to utilize digital letterform description were rooted in the large numbers of characters that did not simply fit in an upper and a lower case of metal type. Akihiko Morisawa suggests that phototype was an 'indispensable invention in the history of Japanese typography, because it solved the language's unique problem'.[359] On invitation by Bigelow, the Japan Typography Association presented its activities and interests at Stanford in 1983 and discussed the challenges in the era of digital type:

> As there is an incredible number of kanji, some of which have an excessive number of strokes, kanji does not lend itself to being printed with the use of the dot matrix. These are some of the many problems which typographers in Japan face. Typographical efficiency and reforms can only be carried out gradually after much careful research.[360]

Parametric experiments on Japanese scripts in phototype have been discussed in subsection 4.1.3. at the example of Group Typo. Further investigation is necessary to explore where the group took the system in a digital environment, but most of the sources are available only in Japanese. Before most of the large type manufacturers

358 ATypI congresses outside of Europe and North America have since been hosted in Mexico City, Hong Kong, Sao Paolo and Tokyo; working seminars in Colombo and Puebla.

359 Akihiko Morisawa, 'Type: my life', talk delivered at the 2019 ATypI conference, Tokyo, 12 September 2019.

360 Hand-out of the Japan Typography Association, Overseas Committee, shared at the 1983 ATypI working seminar at Stanford [DTGC, Richard Southall collection, box 5].

Image redacted

Fig. 4.117 Choi Jeong-ho demonstrates Hangul letter designs on grids and graph paper, 1957. Photographer unknown, reproduced from Ahn, Han, Lee, *The textbook of Hangeul design,* Paju: Ahn Graphics, 2017, p. 32.

in Japan, including Iwata, Morisawa and Sha-Ken employed Ikarus systems in the 1980s, they had developed their own systems for character digitization, which would be worth exploring further. The situation at Sha-Ken poses another interesting case study: having used Ikarus as early as 1981 for its proprietary typesetting machine, the manufacturer agreed to convert its entire library to PostScript (OpenType) formats only very recently with the help of Morisawa.[361]

Type designer Choi Jeong-ho (최정호) began his career as a Korean specialist at Sha-Ken in 1969, for whom he designed nine Hangul typefaces until 1974, followed by typefaces released with Morisawa. Choi is regarded as a 'first-generation' Hangul type designer, meaning that his designs are considered influential to the 'substructure' of contemporary digital Hangul faces, particularly noticeable in the styles 'myongjo' and 'gothic' (**fig. 4.117**).[362] Eunyou Noh has pursued archival research in the Morisawa collection in Osaka and wrote a doctoral thesis on the work of Choi, in which she traces the lineage of his 1970s designs to the emerging early digital Hangul typefaces of the 1980s.[363] The dissertation is published in Korean, Noh has also given a talk about her findings at the 2018 ATypI conference in Antwerp.[364] In 1979 the Korean firm Compugraphy presented a prototype of a digital phototype system, the first models of which arrived on the market in 1982.[365] The designs of Choi, some of the ground-breaking digital typefaces created by Ahn Sang Soo (안상수) in the mid-1980s, as well as the relationship with Korean Compugraphy, would be worth investigating further in the light of simultaneous developments at Stanford and elsewhere.

Around 1977 Andrei A. Baers (Андрей А. Берс), a computer scientist at the computing centre in Novosibirsk, the Siberian branch of the USSR Academy of Sciences, developed a digital type design system for phototype-setting that generates an outline format from a bitmap character description.[366] The outline

361 See the press release of Morisawa, <https://en.morisawa.co.jp/about/news/5285> (last visited 31 October 2022). The collaboration is intriguing, as Nobuo Morisawa (Akihiko's grandfather) and Mokichi Ishii co-invented and patented a phototypesetting machine as early as 1924, before Ishii departed and founded Sha-Ken, one of Morisawa's main competitors for decades.

362 AG Typography Lab (eds.), *Ahnsangsoo 2012 type specimen,* Paju: Ahn Graphics, 2014, p. 4.

363 See Eunyou Noh, *Hangul type designer Choi Jeong-ho,* Paju: Ahn Graphics, 2014.

364 Eunyou Noh, 'A history of Hangul typefaces in the twentieth century', 2018 ATypI, Antwerp, 25 September 2018.

365 See Ahn Sangsoo, Han Jaejun, Lee Yongjae, *The textbook of Hangeul design,* Paju: Ahn Graphics, 2017, p. 32 (translated by Minjoo Ham and Nari Haase from the original Korean: 안상수, 한재준, 이용제, 한글 디자인 교과서, 파주시: 안그라픽스, 2017.)

366 See Baers, Andrei A., *Implementation, transformation and design of printing typefaces for photographic devices,* USSR Academy of Sciences, Siberian branch, computing centre, Novosibirsk 1977 (translated by Alexander Roth from the original: Берс А. А. Представление, преобразование и проектирование норм типографских шрифтов для автоматов. Академия наук СССР. Сибирское отделение. Вычислительный Центр, Новосибирск, октябрь 1977.)

Fig. 4.118 Cyrillic character set output from Baers’ system. Reproduced from Ruggles 1983, p. 10.

Image redacted

Fig. 4.119 Photograph of Andrei Baers operating a MRAMOR workstation equipped with vertical monitors, dated 1 July 1987. Photographer unknown, reproduced from Novosibirsk Computing Center online archive, inv. no. 311-248, < http://ershov.iis.nsk.su/ru/node/776358 > (last visited 30 April 2021).

format is comprised of straight segments as well as four kinds of curves and could be used to generate a range of stem weights and different widths for upright and italic shapes.[367] The only known proof of Baers' output shows a Cyrillic character set with some letters italic and some compressed, not enough to make any assessment (**fig. 4.118**). More research on Baers' system is necessary to fully understand its impact. A paper on the activities at the Novosibirsk computer centre shows that the type design system was one component of a large-scale electronic publishing system under the working title RUBIN that culminated in the development of the MRAMOR workstation, developed between 1980 and 1987.[368] It featured text processing, typesetting, complex grid-based layouts for newspaper design and provided planning and management functions for publication projects.[369] A portrait-format monochrome display stands out with a graphic user interface of 'windows' (**fig. 4.119**), reminiscent of the Xerox Alto.

An interesting link is found in the connection between the Novosibirsk institute and Stanford: Baers' superior, head of the programming department Andrei Ershov maintained a regular exchange with Stanford's computer science professors John McCarthy and Knuth.[370] An English version of Baers' papers could not be found, Knuth likely learned of the project in a correspondence with Ershov in 1978. Ershov, who had studied Knuth's preliminary report on what became TeX and Metafont, stressed 'there is a principle similarity of basic ideas as well as rather interesting and somewhat complementing differences' between Stanford's and Novosibirsk's research.[371] Ruggles' 1983 report cites Baers' 1977 paper; the lack of knowledge of Baers and his achievement may be attributed to the lack of translation — and the inconsistent tranliteration of Baers' name certainly does not help.[372]

367 Ruggles 1983, p. 9.

368 SS Andrei A. Baehrs, 'The MRAMOR workstation', in *First Soviet and Russian computing* (SoRuCom), Patrozavodsk, July 2006, pp. 134–141.

369 Ibid.

370 Knuth had been familiar with Ershov's work since the early 1960s. In 1979 they co-chaired the conference 'Algorithms in Modern Mathematics and Computer Science' in Urgench, former Uzbek SSR. In 1983 Ershov visited Knuth in California, but probably did not attend the ATypI working seminar. See Knuth's tribute of Ershov on the 50th anniversary website of the Computing Centre: http://pde.iis.nsk.su/inmemoriam/479 (published 2008, last visited 30 April 2021).

371 From a letter by Ershov to Knuth, Novosibirsk, 18 July 1978. Accessed in the online database of A. P. Ershov's academic archive: http://ershov-arc.iis.nsk.su/archive/eaindex.asp?pplid=713&did=1207 (last visited 30 April 2021).

372 There are at least three possibilities to transliterate Андрей (Andrey, Andrej, Andrei) from the original Cyrillic spelling and more variants of Берс: while Ershov transcribed it as Bears in his letters, the institute's website today uses Bersa and Beahrs, Lynn Ruggles writes Bers in her 1983 paper, and some East German scientists in the 1980s referred to Bährs. The spelling used here follows Ershov.

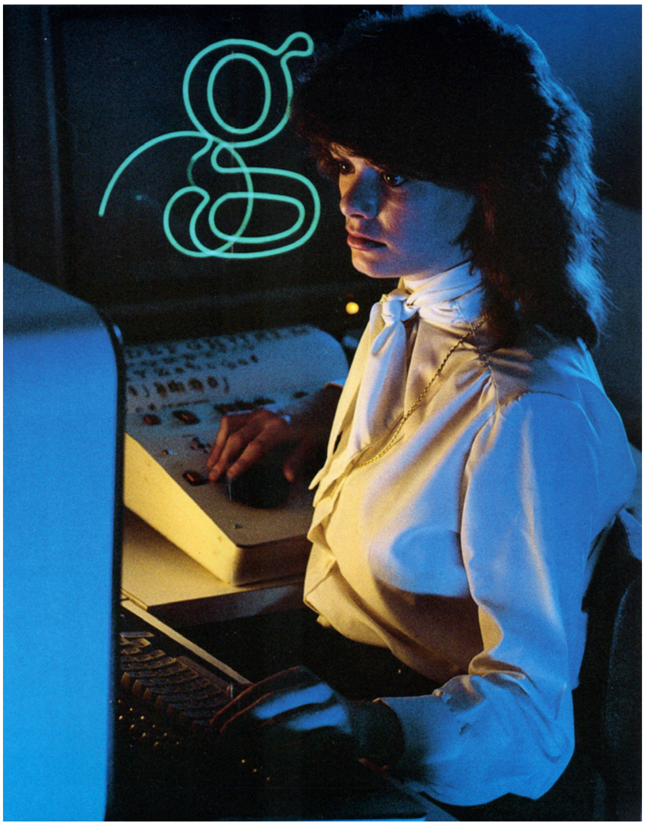


Fig. 4.120 PM Digital Spiral patent in use by AM's Varitype. Photographer unknown, reproduced by AJP from AM Nederlanden, *Varityper: Kompleet in Fotozetten* (firm brochure), c. 1986, from his personal collection.

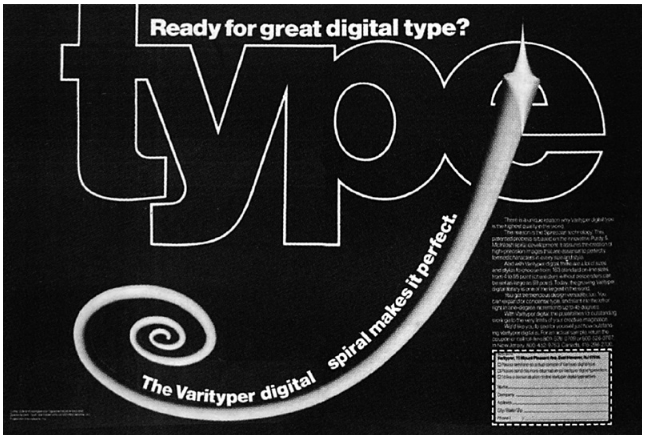


Fig. 4.121 Ad for AM Varitype digital spiral. Reproduced from *U&lc*, vol. 11, no. 2, August 1984, p. 52 f.

A digital type design system for consideration, that was already part of the larger discussion in preparation of the 1983 ATypI working seminar, is PM Digital Spiral. As has been established in 3.4.2, Bigelow considered the system in a provisional programme, but ultimately could not get in contact with its developers. It is the only system mentioned in this thesis that is based on the clothoid concept, an approach of 'digital spirals' explored at the end of 2.1.2, 'PM' stands for the British engineering duo Peter Purdy and Ronald C. McIntosh.

Before becoming concerned with letterform description, Purdy[373] and McIntosh had filed a patent for a 'photographic reproduction' system for CRT 'matrix letters' with the US patent office in 1965.[374] This technique was eventually adopted in a CRT machine by the British firm K. S. Paul, acquired by Mergenthaler in 1967, who then sold the machine as Linotron 505, one of the most popular third-generation phototype-setting machines of its time.[375] In an attempt to translate the metaphor of French curves in a digital environment, the PM Digital Spiral was developed to approximate bitmap characters by describing their outlines. The system allows users to 'uncurl' a pre-stored digital spiral (also referred to as 'master curve') and move it interactively across the screen, superimposed on an existing bitmap character, until its segment matches the 'desired curve of an edge'.[376] While Ruggles suggests the system utilizes an 'extremely high' resolution screen and thus creates a sharp image,[377] Karow criticizes PM Digital Spiral for its low resolution of 1000 units per em.[378] In the terminology established by Purdy and McIntosh, spiral segments were referred to as 'links', while a closed shape assembled from several links was called 'recipe'.[379] A final character, assembled from different segments of the spiral, is ultimately not so different from other outline descriptions that utilize arcs and circle segments.

Purdy and McIntosh filed a world-wide patent for a 'typesetting apparatus' with the integration of the digital spiral concept in 1978, which was granted in the US as late as 1987.[380] 1984 marks the only known implementation of the patent in an application: a catalogue of the Dutch branch of AM International Inc. promotes the

373 There is some confusion over the first name of Purdy, credited as Haydn Victor Purdy in the CRT patent, but as Peter Purdy in the 'digital spiral' patent. They may be related, but are assumed to be the same person.

374 See Purdy et al., *Photographic reproduction,* US patent no. 3,508,245, 21 April 1970 (filed 12 November 1965, applied for in Great Britain 13 November 1964).

375 Romano 2014, p. 213.

376 Ruggles 1983, p. 11.

377 Ibid., p. 11.

378 Karow 1987, p. 86.

379 Ruggles 1983, p. 12.

380 Purdy et al., *Reproduction of character images, particularly for typesetting apparatus,* US patent no. 4,682,189, 21 July 1987 (filed 2 September 1986).

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Two–Dimensional Graphics on Personal Workstations

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Prof. J. Gutknecht, co–examiner

1988

Fig. 4.122 Title page of Eliyezer Kohen's doctoral dissertation at ETH Zurich, entirely typeset in Hans Eduard Meier's Syntax, 1988.

use of a 'Spirascan' system in its Varityper typesetting machine.[381] The integral approach of the application allowed users to compose pages, while diving in deeper for modification of characters (**fig. 4.120**).[382] A Varitype ad in *U&lc* suggests that the application was making use of digital spirals at least since 1984 (**fig. 4.121**).

Around the time of the 1983 Stanford working seminar, digital typography and type design on computer workstations were being explored at ETH Zurich (Swiss Federal Institute of Technology), where computer scientist Niklaus Wirth taught since 1968, after returning from a professor position at Stanford. Wirth is primarily known for developing the programming languages PASCAL and MODULA, as well as MODULA-2. He had spent a sabbatical at Xerox PARC in 1976/77, and then began to work on 'Lilith', a personal workstation influenced by the Xerox Alto, written in Modula-2 at ETH.[383] In 1984 Charles Bigelow discovered one of Wirth's books on Modula-2,[384] and while he enjoyed the achievements of the workstation and software used to compose the book, he was less impressed with the quality of the typefaces; eventually he wrote a letter to Wirth, suggesting that he should consult Zurich-based type designer Hans Eduard Meier (see **fig. 3.27**) for typographic advice.[385] Meier, a long-time lecturer at Kunstgewerbeschule Zurich, was best known as a designer for his typeface Syntax, a humanist sans serif released with Stempel in 1968. He and Bigelow had known each other since Meier's 1978 US lecture tour, which commenced at RISD.

After ETH hired Meier as a consultant in 1984, he collaborated on the ETH Font Design System, primarily developed by Wirth's student Eliyezer Kohen 'with the purpose of offering professional type designers tools for the production of middle and low resolution fonts of high aesthetic quality'.[386] The system became a central part of his doctoral thesis on *Two-dimensional graphics on personal work-station,* submitted in 1988 — entirely typeset in Syntax (**fig. 4.22**).[387] At least two of Meier's typefaces may have been produced in Kohen's system, but further research will be necessary to identify Meier's impact on the system and to explore its use in practise. After Microsoft announced its switch to TrueType in 1989 (see 5.3), Kohen became the 'key developer' of their new code.[388]

381 Varitype was originally an independent manufacturer of typewriter-like 'cold-type' composition devices and was acquired by AM in 1956.

382 AM Nederlanden, *Varityper: Kompleet in Fotozetten* (firm brochure), c. 1986 [AJP].

383 See Hans J. C. Otten's 1982 review 'Lilith: personal computer' in *Radio Bulletin* (vol. 51, no. 4, Bussum 1982, p. 170 f.) as well as Ottens online ressources on PASCAL, Niklaus Wirth and Lilith via <www.pascal.hansotten.com> (last visited 26 April 2023).

384 See Niklaus Wirth, David Gries (ed.), *Programming in Modula-2,* New York: Springer Verlag, 1984.

385 Charles Bigelow in an interview with the author, 8 September 2017 [audio file 02, 51:20].

386 Kohen 1988, p. 6.

387 See Kohen 1988.

388 Berry 2017, p, 56.

4.3. Conclusion: sustainability of these models of encoding

The aim of this chapter has been to explore models of numerical letterform description that formed the basis of a discourse introduced in chapter 3. Section 4.2 explored the variety of approaches to designing and producing digital type during a period of transition through the example of a handful of available systems demonstrated and discussed at Stanford in 1983. Each system follows at least two of the methods explored in section 4.1, resulting in different underlying concepts of how to encode shapes, modify them and convert them into formats that met the technical demands of both phototype-setting machines and of emerging dot-matrix printers. The final chapter cross-examines whether these requirements met key prerequisites of type manufacturing in transition. The conclusion here evaluates the sustainability of these models of encoding, based on the evidence brought forward in this chapter. Sustainability as a measurement implies whether the systems were at all conceivable in type manufacturing and whether they had an impact on the rapid changes, while taking into account the circumstances and constraints of their respective environments: academic, for internal use or commercial.

By these measurements, Elf is probably the least sustainable of the five systems. It is suspicious that the setup of Elf was apparently not stable enough for a demonstration at Stanford, and, based on the clues uncovered here, that its developers discontinued their interest in Elf in favour of another project soon after. Although the approach in generating a path of stroke-like trapezium shapes is extremely intriguing and also promising in a duet with Kindersley's proven spacing method Logos, there is not enough material currently available to prove the many claims made in papers by Wiseman et al. As established in section 4.1, polygonal outlines required more storage and were impractical in larger sizes, and yet the developers of Elf adhered to the method. Wiseman claims that Elf had an 'appeal' for designers, but until now no other collaborators could be identified apart from Kindersley and Lopes Cardozo.

Although Metafont was also conceived in an academic environment, early on Knuth surrounded himself with a diverse group of accomplished type designers, with graphic design students, and with experts 'between the worlds' such as Bigelow and Southall. While some mastered the original Metafont 79, it was not intuitive or easily accessible for others with limited programming skills. In the Euler project, the first challenge in a semi-commercial setting, the separation of type designer and computer scientist was revealed as a central problem — better results may be achieved when they are the same person, i.e. a meta-designer. However, the sustainability of Metafont should not solely be measured upon the system itself, but with regard to its framework, the Digital Typography programme and the people in it. It enabled a playground of experimentation beyond the initial system (e.g. a new programming language for Chinese type design), empowering a new way of

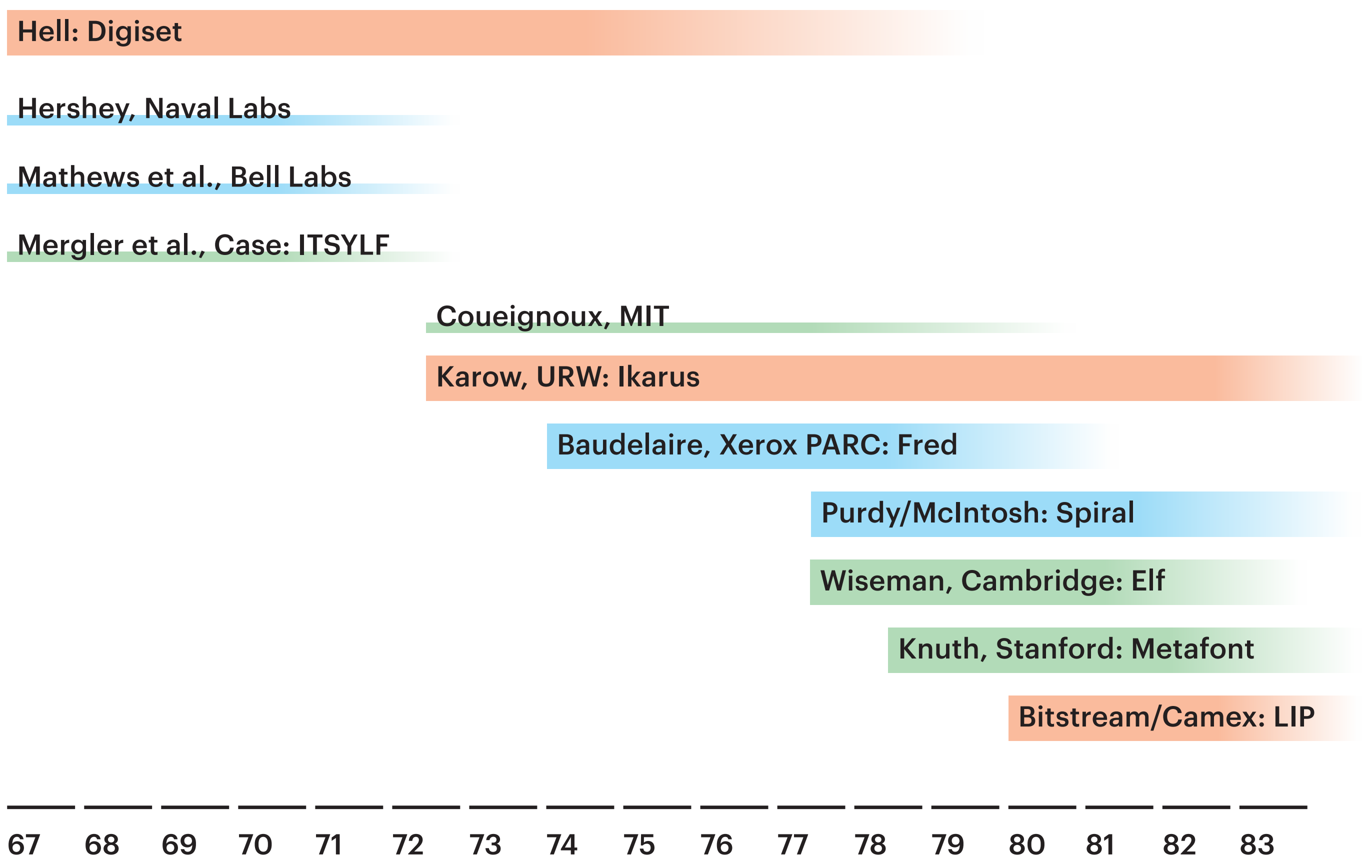


Fig. 4.123 Development and use of approaches to numerical description of letterforms at the example of systems explored in this thesis with distinction between academic research, industry research and commercial products.

thinking and advancing the field of digital type as whole. It helped raise a new generation of digital designers, some as prominent as Carol Twombly. To this day, Metafont and TeX remain the (open-source) standard that meets the typographic requirements of publishing in several scientific disciplines.

The sustainability of the Xerox Alto Font Design System must be measured in its setting at Xerox PARC, where it was primarily intended to be exploited for internal research. Despite its remarkable progress, it seems that its potential as a commercial product was not fulfilled. Section 4.1.3 alludes to a challenge that has been described as the 'competency trap', i.e. the inability to balance the 'exploitation of existing products' with the 'exploration of future opportunities',[389] a phenomenon that may have led to Xerox losing grip on a series of technological inventions, including digital type manufacturing. Details such as the two-column tool bar (left of the drawing area in Draw) are notable in comparison to contemporary software — the connections outlined in the section suggest that elements of the Xerox Alto and of its Font Design System live on in other commercial products.

In the aforementioned paper by Myers, it is argued that the contributions of university research have not been widely recognized. With examples of what is considered important research developments in HCI (such as the mouse, GUIs and manipulation of graphical objects), Myers demonstrates how commercial products are consistently preceded by industry research and academic research within a time span of three decades on average.[390] This narrative is not reflected in the 'brief history of digital type', e.g. URW had just kick-started as a new business with no intention to spend years of research before putting Ikarus to work with a client. This observation suggests that digital type manufacturing did not follow the same linearity between research and implementation (**fig. 4.123**).

After Bigelow confronted the Euler project with a a sense of the 'commercial design world', the resulting changes made to Metafont quickly resembled the approach in Ikarus and LIP, suggesting the outline method provided the most reliable model in a commercial environment. This shows that systems developed in a competitive environment were realized much more quickly and employed by industry within a relatively short time (research on Elf and Metafont began after Ikarus was already in use). URW was founded by engineers (Karow et al.) who collaborated with a type manufacturer (Brendel), while Bitstream was started by type designers and manufacturers (Carter, Cone, Parker et al.) who reached out to engineers (Camex). Digital outline description served as the main concern of type manufacturers during the early 1980s: encoding large existing typeface libraries for constantly changing typesetting technologies.

389 See David Robson, 'How to avoid the competency trap', <https://www.bbc.com/worklife/article/20200608-what-is-the-competency-trap>, 9 June 2020 (last visited 1 November 2022).

390 Myers 1998, p. 46, fig. 1.

5. Implications for consideration

The previous chapter explored models of numerical description that were available during the transition from phototype manufacturing processes to digital technologies, while considering some of the earliest approaches to encoding letters and letter-like shapes, as well as some of the much older underlying mathematical concepts that inspired and favoured these developments. In the second part of the chapter, five digital type design systems that became the main talking points during the 1983 ATypI working seminar were investigated in more detail. The focus of that investigation laid on the environments in which these systems were conceived and it considered some of their key features in manufacturing digital type.

Chapters 3 and 4 raise key issues on digital typefaces and shed light on a few selected digital type design systems that were employed to solve, realize and challenge those issues. The systems are interrogated in the following sections thematically by revisiting some of the main discussion points of the 1983 working seminar. These themes include shared responsibilities between the people involved in type manufacturing, in particular the changing role of the designer, the critical use of automated design modification, as well as the omni-present yet neglected relationship between optical sizing and type for low-resolution output. Cross-reference during this interrogation considers the different perspectives of institutions and people involved in type manufacturing.

As some of the systems discussed here have not previously been subject to such an interrogation, it is first necessary to establish a coherent terminology by reframing the essentials of a *type design system* — not just in each unique context of an emerging digital technology, but in a broader sense of type manufacturing.

5.1. Essentials of a type design system

In order to untangle essential aspects of digital type design systems that concerned type designers, manufacturers and educators alike during the early 1980s, it is useful to widen the discussion and regard type manufacturing processes of previous technologies as *systems* as well.[1] This approach enables examination through comparison of responsibilities and how they progressed over the course of time in relation to changing technologies. It is also important to develop a coherent terminology that can be applied across technologies to describe responsibilities, decisions and processes, some of which has been established in the second section of chapter 4.

Both Ruggles' report on *Letterform design systems* (1983) and Karow's book on *Digital formats for typefaces* (1987) focus primarily on the digital discipline and its technical aspects, but do not consider type design systems applied in previous eras of type manufacturing. Rubinstein's book on *Digital typography* (1988) presents a slightly broader scope, yet descriptive and detailed in technical issues. As his work is primarily conceived as an introduction to typography for 'system builders' and engineers without previous knowledge of type technology,[2] it offers valuable perspectives of 'the engineer's view' on digital type issues in comparison to the typographer's view (and the psychologist's view), some of which is reflected in the following section when it is relevant.[3] Rubinstein's technical jargon seems to follow Bigelow's terminology.[4]

The most substantial and profound work on type design techniques across different technologies is presented by Southall in a series of papers. In 1982, Southall began writing *A survey of type design techniques before 1978*, in which he introduces the basic terminology of his review scheme.[5] During his time at Stanford, he used that terminology to examine Metafont in two reports,[6] but significantly extended

1 In doing so, the term *system* is extended from its previous use in this thesis from the definition of a specific combination of hardware and software components to its broader meaning of an order of interrelated elements or processes within a greater scheme.

2 Rubinstein 1988, p. vi.

3 See Rubinstein 1988, pp. 38–48.

4 Rubinstein was active as consulting engineer at Digital Equipment Corporation during the 1980s, specialized in 'human factors', a design discipline at the intersection of engineering and psychology. In the acknowledgements he credits Bigelow for his 'typographical education'. Rubinstein 1988, p. vii.

5 See Southall 1997.

6 See Southall 1985. A shorter version of *Designing new typefaces with Metafont* was published as 'Designing a new typeface with Metafont', in J. Désarménien (ed.), *Tex for scientific documentation* (Lecture notes in computer science, no. 236), Berlin: Springer, 1986. The author falls back on Southall's typescript [DTGC, Richard Southall collection, box 14].

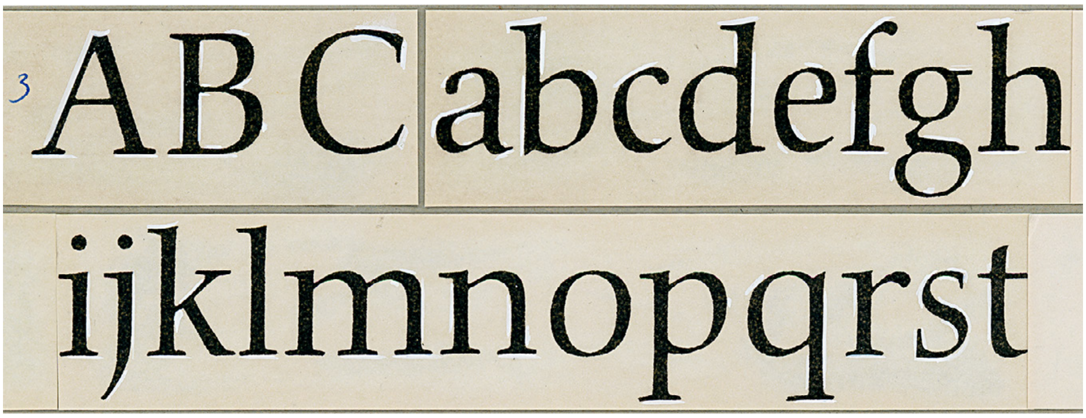


Fig. 5.1 Hermann Zapf's initial drawings of Hunt Roman (custom, 1962) provided punchcutter Arthur Ritzel with the necessary character appearance specifications for trial cuts, October 1961. This appearance was later rejected as too narow and was redrawn. Photographed by the author [Hunt Institute for Botanical Documentation, Pittsburgh/PA].

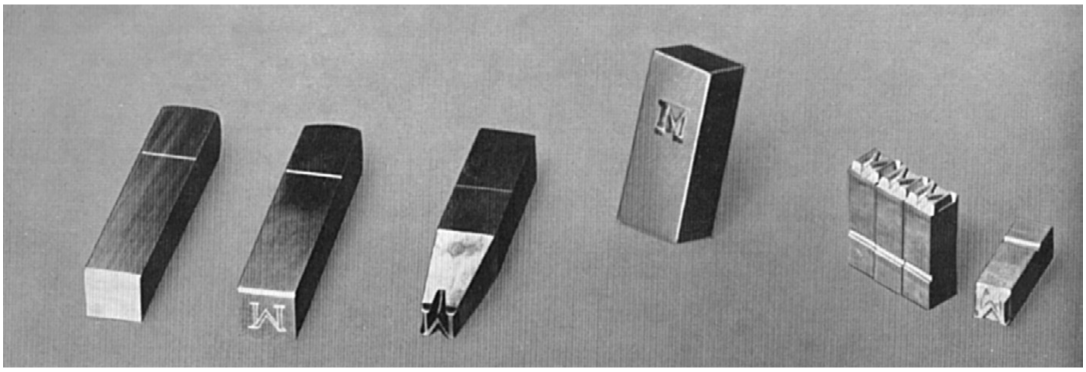


Fig. 5.2 FLTR: blank steel punch; carved shape; fully cut punch; matrix after being struck by a punch; metal types cast from a matrix. Reproduced from Bauer 1960, p. 16.

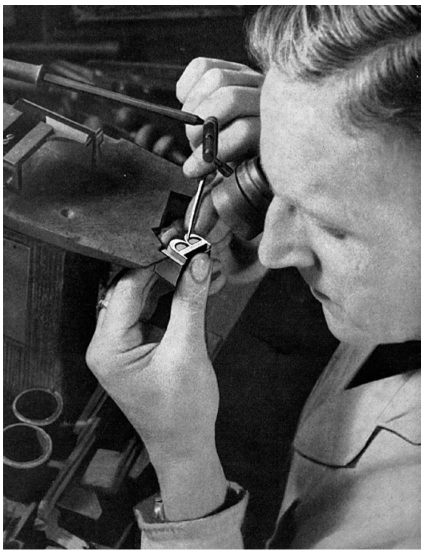


Fig. 5.3 Manual punchcutting. Photographer unknown, reproduced from Bauer 1960, p. 15.

some key terms with co-author Debra Adams in 1989,[7] and then revisited them again by himself in 1993.[8] His original terminology is preserved in the 1982 'survey', which was published in 1997; the following considers his refined terminology published earlier. That is to say, some adjustment to the terminology is appropriate today — this is pointed out when it becomes relevant. The terms that are italicised in the following are used by Southall to describe the scheme of a type design system.

The practise of type manufacturing is generally separated into the tasks of *type design* and *font production*.[9] Type designers provide a set of drawings of character specifications as a reference for font production (**fig. 5.1**). Southall insists that these drawings 'invariably' present *models,* 'objects whose purpose is to illustrate the desired appearance of the typeface to the producer'.[10] The overarching goal is to translate those *appearance* characteristics into *shapes* that ultimately result in fonts. Fonts give rise to *character images* in document production systems such as word-processing or typesetting. It is the task of a font producer to make sure the character images correspond to the type designer's initial appearance specifications.[11]

This context is best illustrated at the example of metal type manufacturing: in short (and in reverse order), types were cast from moulds or *matrices,* matrices were struck from *punches* and punches were manually cut from specifications of character appearances (**fig. 5.2**). With the introduction of mechanical punchcutting (and in the technologies that followed it) font production departments made their own drawings of characters, eventually in large drawing offices. According to Southall, these drawings are purely about shape, but not about appearance; he defines them as *patterns,* 'objects which contain precise specifications for the shapes of other objects'.[12] The use of the term pattern is not ideal, as the physical objects that are derived from them are also called 'patterns' (see below); for better distinction it may be more useful to refer to them as *master drawings*.

The distinctions between appearance and shape, between models and master drawings (or pattern drawings) provides linguistic prerequisites for critical review of any type manufacturing process. However, according to Southall, the central challenge in this scheme lies in the communication between type designer and font

7 See Adams 1989. The level of contribution from each author is not clear. Some footnotes are oddly written in first person singular, not plural.

8 See Southall 1993.

9 During the first centuries of type manufacturing in Europe, design and production were in the same hands, but with industrialization of manufacturing and, at the latest, with the establishment of type design as a professional activity in the nineteenth century, these responsibilities were separated.

10 Southall 1993, p. 91.

11 Ibid., p. 90.

12 Ibid., p. 91.

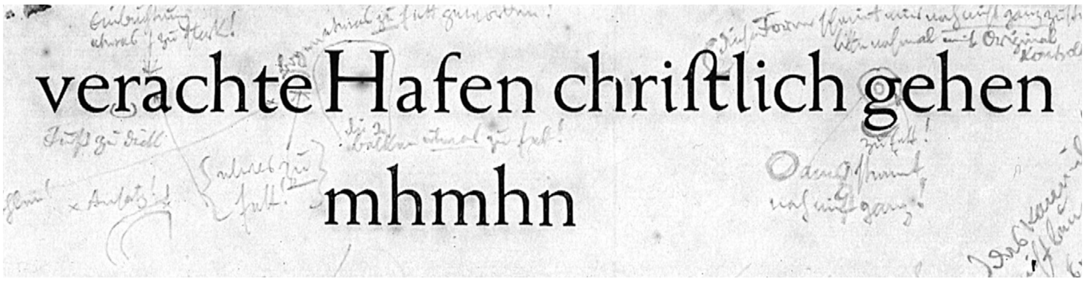


Fig. 5.4 Smoke proofs of Emil Rudolf Weiss' Weiss Antiqua, produced by Louis Hoell at Bauersche Gießerei, Frankfurt/Main. Reproduced from Bauer 1960, p. 7.

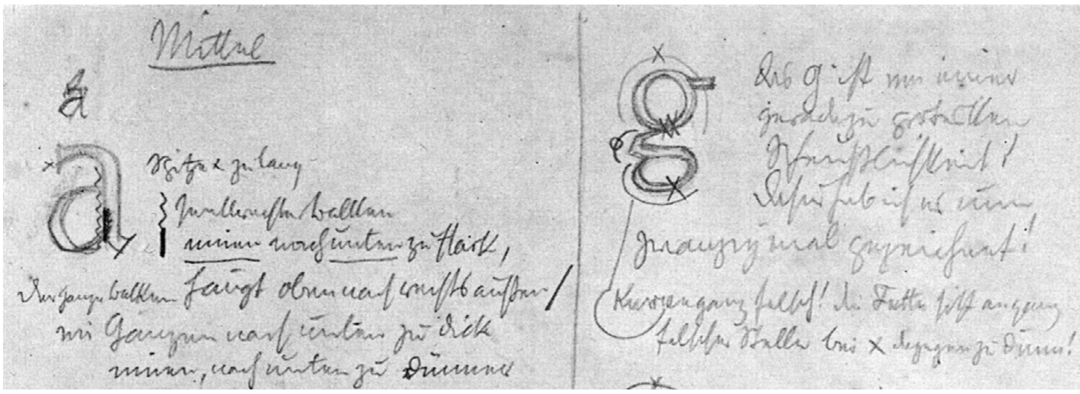


Fig. 5.5 Corrections and remarks by Weiss for punchcutter Hoell. The note in the upper right corner reads: 'The g is of grotesque dreadfulness! This is what I drew it twenty times for!' Reproduced from Bauer 1960, p. 8.

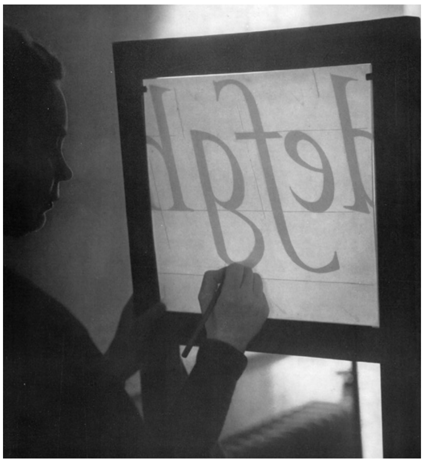


Fig. 5.6 Outline tracing of a photographically enlarged ten-inch character drawing of Perpetua italic. Repro from *Monotype Recorder,* vol. 40, no. 3, 1956.

Image redacted

Fig. 5.7 Outline drawing of 9-point Times New Roman character (Monotype, c. 1932), used as a master for the production of brass matrices. Reproduced from *Eye,* vol. 84, no. 12, p. 47.

producer.[13] It is precisely this aspect that entails some of the issues discussed in this thesis: responsibilities, relationships and the changing role of type designers during periods of technological transition.

In manual punchcutting the communication between type designers and punch cutters is based on visual references that help evaluate whether the shapes match the intended appearance. Punch cutters engrave the mirror image of a characters on a steel punch by carving away the 'white space', a process that requires steady hands while cutting the face of each weight and size using gravers, files and sometimes counter punches (**fig. 5.3**). Although experienced type designers were aware of the implications of optical adjustments that were necessary to represent a coherent appearance of the same typeface at various sizes (discussed in more detail in 5.2.3), this notion also involved a degree of interpretation on the part of the punchcutter. Punchcutting techniques varied among manufacturers; during his punchcutting demonstration at the 1983 ATypI working seminar, Henk Drost of the Enschedé Foundry explained that members of his guild made their own tools.[14] One technique known to all punchcutters enabled testing the progress of the carved shape through so-called *smoke proofs*, made by holding punches into a flame and pressing the soot onto paper (**fig. 5.4**).[15] Type designers could then react to those proofs, make corrections communicated through annotations and sketches. Updike explains that 'numerous' smoke proofs were involved in this procedure (**fig. 5.5**).[16]

The transition to mechanical manufacturing processes of metal type is closely tied to the introduction of Linn Boyd Benton's pantographic punchcutting machine in 1885 that profoundly changed the process explored above.[17] It has been considered the end of type manufacturing as a craft, heralding the discipline's entry into industrialization;[18] Walter Tracy calls it 'one of the salient developments in the history of printing' (a description of the pantograph before Benton is provided in 5.2.2).[19] At Monotype for example, the type designer's original drawings were (photographically) enlarged, projected and turned into ten-inch outline drawings by the type drawing office (**figs. 5.6+7**). In a sequence of two separate pantographic steps, the outlines were translated into metal patterns, characterized by a relief letterform on a flat base (**figs. 5.8+9**), before pantographically cutting punches from the patterns (**fig. 5.10**). Southall considers this process to be more challenging, because a font producer has to translate the designer's character appearance specifications into

13 Southall 1993, p. 90.

14 Drost 1985, p. 101.

15 Windisch 1953, p. 8.

16 Updike 1923, p. 10.

17 Filed for patent in the United States in 1885, it is predated by earlier pantographic devices in type manufacturing, see 5.2.2.

18 Southall 1993, p. 88.

19 Tracy 1986, p. 36.

Fig. 5.8+9 Patterns by different manufacturers, left: 'Renner Werkschrift' (10 cm, an unreleased weight of Renner Antiqua, c. 1941) for D. Stempel [Schriftgießerei Rainer Gerstenberg, Darmstadt]; right: 'Goudy Old Style' (12 cm), unknown. Photographed by the author [ES].

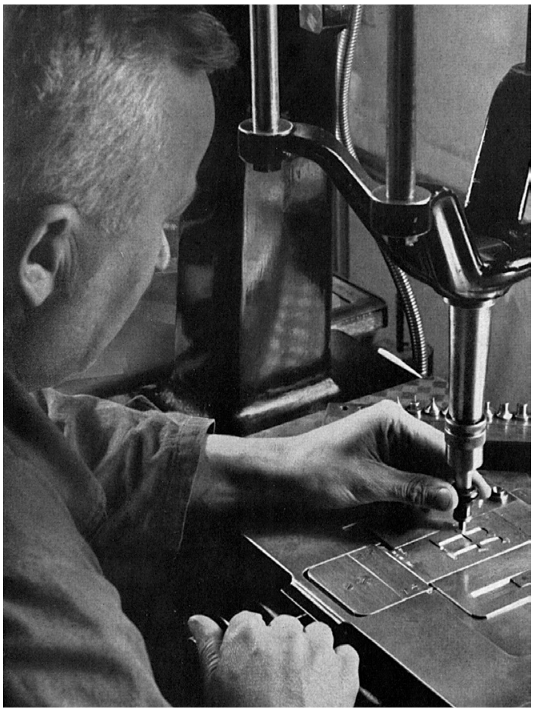


Fig. 5.10 Pantographic punchcutting at Stempel type foundry. Photograph by W. Dietz, reproduced from Windisch 1953, illustration no. 4.

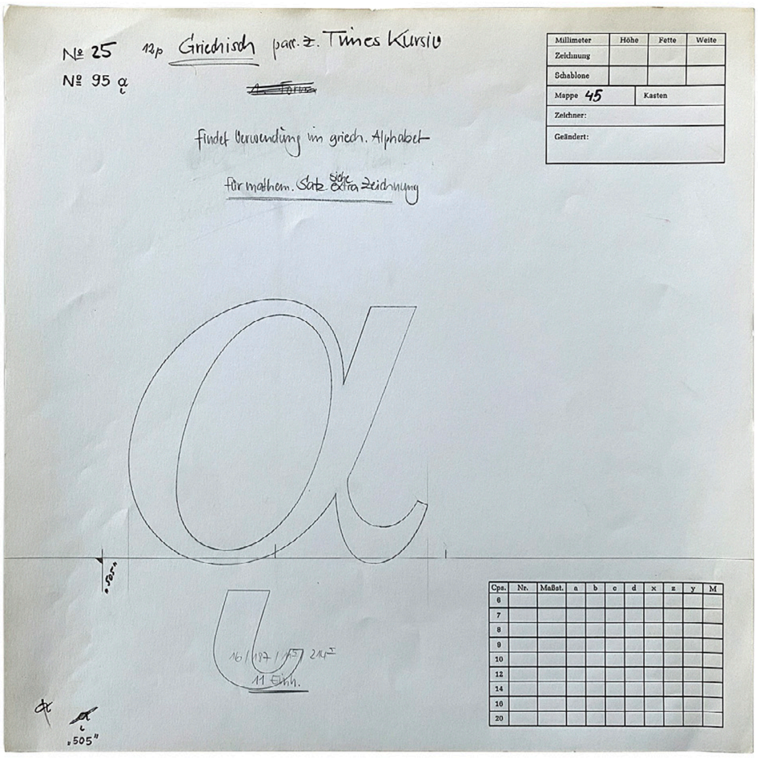


Fig. 5.11 Master drawing of a Greek character of Times Kursiv (italic) for the Linotronic 505, from the former Linotype Archives, Bad Homburg. Photograph by GL.

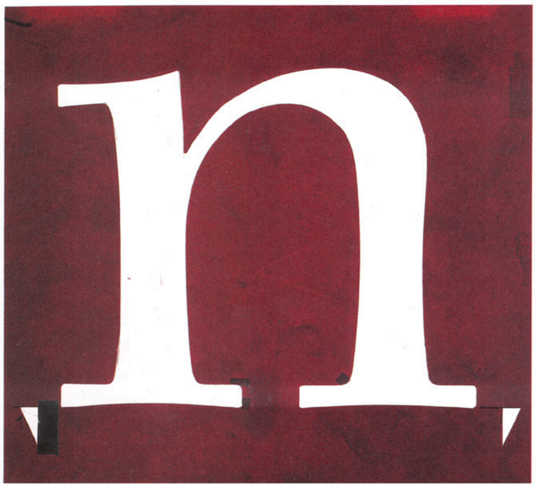


Fig. 5.12 Frisket of a Latin character of Iridium (Stempel, 1972) hand-cut with a blade by type designer Adrian Frutiger. Reproduced from Osterer 2014, p. 236.

'precise quantitative modifications' of pattern drawings. E.g. instead of manually cutting each size, patterns served a range of sizes, which has had a controversial impact on type manufacturing from then onwards (see 5.2.3). Operators of the second step did not have to be punchcutters and the process involved fewer levels of interpretation, because they did not have to work from the appearance of a model, but from the definite shape of a pattern.

The production process of fonts for photocomposition was different for each manufacturer before the introduction of the CRT; proprietary systems required different matrix carriers such as spinning discs, glass plates, plastic rulers, film strips, etc. However, in one widespread technique as the first production step, large negative character shapes, so-called *friskets,* were derived from the existing ten-inch master drawings (**fig. 5.11**).[20] As Tracy explains, in one method the outline drawings were placed on a light box with a superimposed sheet of red masking film from which draughtsmen manually traced and cut out characters with a blade, resulting in 'a perfect facsimile of the character, in clear on a solid background.'[21] The resulting negative shape could be reproduced on a film positive for matrix production. In one case, type designer Adrian Frutiger is known to have cut friskets of his typeface Iridium (1972 for Stempel) himself (**fig. 5.12**).[22] With the emergence of Ikarus in 1973, outline drawings were marked and digitized (**fig. 5.13**), while manually guided blades were replaced by the Aristomat flatbed plotter.

From this overview it can be gathered that while technologies have considerably changed from the 1880s to the 1980s (from mechanical punchcutting to phototype to digital type), considering that the medium of type has undergone noticeable dematerialization (from metal to film to numerical description), it is important to note that the preparation of contour shapes that carry the design's appearance specifications has been a constant in manufacturing processes during that century.

One aspect that does not receive much attention in Southall's scheme, but that is essential to any type design system, are the considerations manifested in the type designer's initial drawings. Southall explains that they carry 'specifications' of the character appearance, but he does not address what information is captured in those specifications apart from rather obvious attributes such as weight and size. It is important to acknowledge that type designers anticipate the output medium of the final fonts in the drawings, i.e. added weight in letterpress printing or weight-loss due to overexposure in filmsetting. As a result, master drawings intended for the manufacturing process of one technology are not suited in another without reconsidering the original model.

20 Alice Savoie explains the decision to re-use hot metal pattern drawings at the example of the manufacturing process for Monotype's Monophoto Filmsetter, see Savoie 2014, pp. 245–255.

21 Tracy 1986, p. 42.

22 Osterer 2014, p. 236.

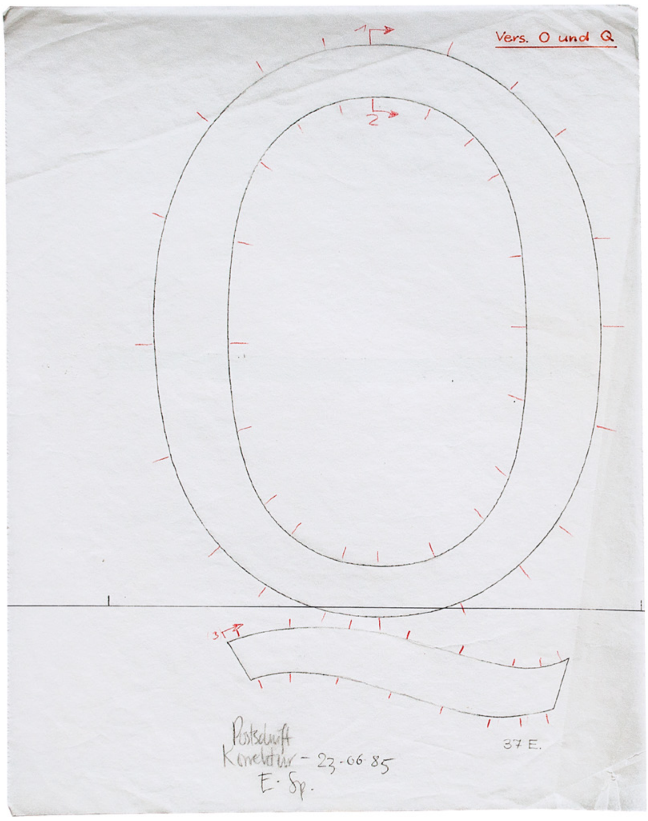


Fig. 5.13 Outline drawing of PT55, Erik Spiekermann’s unrealized custom typeface for the German Postoffice, marked for Ikarus digitization at D. Stempel, 1985. Photographed by the author [ES].

5.2. Designing and digitizing

The previous sections established a scheme and a coherent terminology that enables a consistent cross-examination of the five digital type design systems that have been explored in chapter 4. In preparation of the working seminar, Bigelow called upon engineers and programmers to 'provide us with effective design tools for creating digital type' and laid out 'questions of quality' as criteria to review those systems as they were demonstrated side-by-side at the event.[23] In his referenced papers published in the early 1980s,[24] Bigelow's concern for effectiveness and quality addresses issues such as the notion of optical sizes in historic typefaces, reinterpreted for the digital age, as well as the very much connected challenge of rasterizing type, old and new, for low resolution output (see 5.2.3). Both issues were present in the conference announcement and the subject of debate in each system. Hopes for improvement in optically compensating the issue of type size were placed in the abilities of numerical modification, which presents only one aspect of the growing field of automated design techniques, further discussed in 5.2.2.

Southall evaluates digital type design systems based on whether they are 'useful' and 'responsive'.[25] Usefulness refers to issues that generally concern developers of type systems, engineers who operate them or salespeople who have the next step in mind, i.e. the ability to use the output of these systems on as many different composing machines as possible. Responsiveness on the other hand speaks to the designers and characterizes a type design system that enables direct communication with font production, as was given in manual punchcutting. Such an interrogation of the five digital type systems is the subject of 5.2.1, while 5.2.2 also assesses the use of the predominant outline approach more critically. Finally, based on all of these discussions and their implications, subsection 5.2.4 investigates the debate around preservation and introduction of terminology in a changing discipline.

23 Working seminar proposal by C. Bigelow, circulated to ATypI board and CERL, undated (c. 1981) [DTGC, ATypI collection, folder 'ATYPI Working-Seminare'].

24 See Bigelow 1981, Bigelow 1982 and Bigelow 1983 I.

25 Southall 1993, p. 93.

5.2.1. Responsibility and interaction: decisions in the process

Based on Southall's criterion of usefulness, systems that employ an approach to outline description perform particularly well. As has been established in 4.2, especially Ikarus and LIP were developed in order to supply a large variety of digital formats and output used for phototypesetting machines, in fact, the success of the business models of URW and Bitstream was built on these abilities. Fred was highly useful by its own standards as it was developed mainly to supply fonts to computers and xerographic printers used in-house at PARC. However, if one were to envision an update of Fred on the Xerox Star, with InterPress in sight as a versatile page-description language, perhaps it could have been used to produce fonts for non-Xerox devices, predating PostScript fonts of the second half of the 1980s. Similarly, Metafont 79 was perfectly appropriate within its own family of systems, devised primarily to produce fonts for TeX. Since Knuth employed Bernstein Bézier cubic curves in Metafont 84,[26] it has been suggested that his revised system could solve issues associated with non-linear scaling (see 5.2.3) and with rasterization for low-resolution output on other devices,[27] therefore demonstrating a high rate of usefulness. The usefulness of Elf is difficult to assess based on the available sources. Wiseman et al. predicted its use in professional design studios, but there is no evidence to support that it was used in such environments.

The notion of a 'responsive' type design system is rooted in a straightforward interaction that enables quick realizations of ideas into character images.[28] Therefore it should also be measured on the ability to assess the progress of shapes during the manufacturing process, i.e. with the equivalent of smoke proofs. The ability in Elf to draw directly on screen (see 4.2.1) and to receive an immediate *response* would therefore characterize as highly responsive; it has repeatedly been described as 'interactive' by its developers who also highlight the capabilities of sketching, comparing ideas 'qualitatively' on screen before encoding fonts in the final stage.[29] Due to lack of documentation it remains difficult to verify these processes.

The challenging interaction with Metafont has been explored in 4.2.2: only few members of the Digital Typography Group were able to develop the same level of comprehension with the system as Knuth had. While its user interface was not very intuitive, Metafont is also the only one of the five systems that merely relies on the keyboard for input. However, in Metafont 84 Knuth implemented three different techniques to assess the encoded shapes by printing their character images on his

26 Bigelow 2020, p. 21.

27 Southall 1993, p. 93.

28 Ibid.

29 Wiseman 1980, p. 220.

Image redacted

Image redacted

Fig. 5.14+15 Two kinds of Metafont proofs for assessment, left: ‘proof mode’ with coordinates plotted on transluscent foil; right: ‘smoke mode’ laser-printed ‘as black as possible’ on paper. Photographed by the author [SUA, SC 1002, box 1, folder 5].

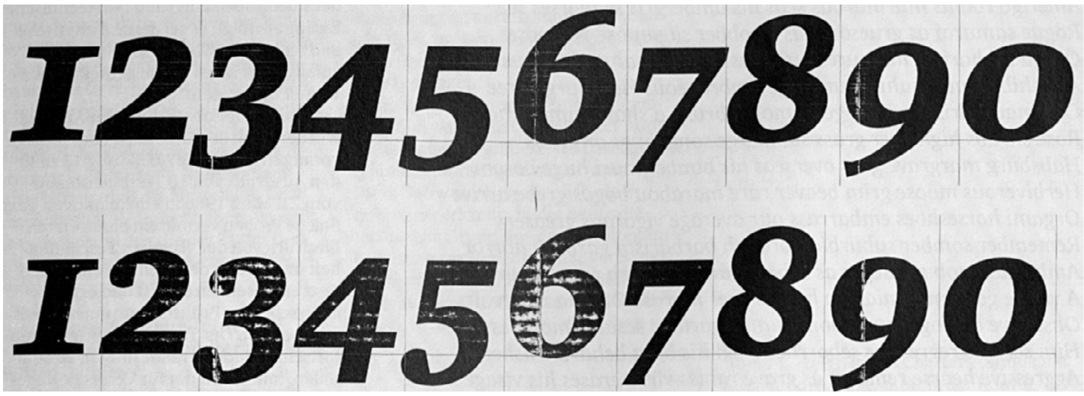


Fig. 5.16 Plotted proofs of Bitstream Charter. Reproduced from Caflisch 1988, p. 28.

own Imagen office printer: prints of the binary code (for a 'mathematical mind'); prints of characters in 'proof mode' that also visualized the grid units as well as the coordinates of pen paths and contours (**fig. 5.14**); and 'smoke mode', character proofs printed 'as black as possible' (**fig. 5.15**).[30] In these techniques, Knuth anticipated type design in a desktop-publishing-like environment that became a reality shortly after.[31]

Given its remarkable GUI, surely Fred demonstrates a certain superiority in terms of responsiveness and interaction. These advantages have been discussed in full in 2.4.3. However, the abilities of Fred, Draw and PrePress were demonstrated in creating character images from existing models. Although Draw shows promising routines for 'freehand' drawing using the mouse, there are no accounts of new original designs produced *from scratch*.[32] Bitsream's LIP is a system that could perform both of these techniques. Matthew Carter preferred to begin a design process with manual drawings, mostly to the stage of 'final artwork', while other designers at Bitstream started to draw character directly 'on screen' (but not like in Elf) without a model to work from.[33] In the early stage of devising LIP from the CAM workstation, Wendy Richmond suggested 'having a hard copy version of the character taped next to the screen for easi[er] comparison of shape'.[34] What sounds like a nostalgic recourse to punchcutting from a model character was soon improved in LIP. Via a Versatec plotter proofs of characters and entire characters sets could be printed at various sizes for assessment during the manufacturing process (**fig. 5.16**).[35] In these features that are more typical of the 1980s than of the previous decade it becomes evident that LIP was developed almost ten years after Ikarus was conceived.

For Carter, who worked directly at the studio, designing and digitizing became an interactive working experience that involved sketching new ideas, quickly trying out alternatives and proofing the results. These quick proof-and-revision cycles that became crucial in the design process of Charter have been described as an 'on-screen field of experimentation' by Max Caflisch.[36] At Bitstream, an operator of a LIP system could assume the roles of both type designer and punch cutter. Work

30 Donald Knuth in an interview with the author, while going through different proofs at SUA, 22 October 2018 [audio file 02, 00:01].

31 Knuth writes, 'sometimes it [the laser printer] would take several minutes per page, so I used it sparingly' [SUA, SC 0097, box 21, folder 10.9, 'Use of my own laser printer!'].

32 See the *Draw reference manual,* dated 1 July 1980, available at < https://xeroxalto.computerhistory.org/Indigo/BravoX/DRAW/.DRAWMANUAL.PRESS!2 .pdf> (last visited 15 November 2022).

33 Caflisch 1988, p. 24.

34 See draft of an undated Camex manual (likely early stages) for a 'font digitizing station' [DTGC, Richard Southall collection, box 23]. The word 'easier' has a spelling mistake in the original.

35 Caflisch 1988, p. 23.

36 Ibid., p. 28.

on Carmina however (see 4.2.5), was a transatlantic collaboration in the traditional separation of type designer and font producer, which shows that immediate or indirect access to type design systems is a significant component to consider at the time.

In 1983 it was still very much a privilege to realize a typeface design in numerical description. Independent type designers without access to a digital type foundry or to such services offered by URW could not digitize their designs. Martin Majoor's and Petr van Blokland's exercises at URW mark exceptional opportunities during this time period and only very few studios could afford one of the available systems — Bigelow & Holmes and Georg Salden are mentioned in 4.2.4. According to Salden, it was not enough to draw a typeface and then 'give production into other hands'; to him the process was as important as the type's appearance.[37] Gerard Unger, who was first introduced to Ikarus at Hell in 1976, made several attempts to set up a workstation at his home, but the total price of all necessary components left this endeavour unrealized.[38] His repeated inquiries to Hell demonstrate the willingness of becoming independent from external font production, like Salden did later.

The Berthold type foundry began digitizing their existing library of popular faces in a new edition called *Berthold exklusiv* at their Taufkirchen subsidiary in Southern Germany, when several Ikarus workstations and an Aristo plotter were installed there in the autumn of 1980. In order to ensure a consistent quality, the entire manufacturing process was kept in-house under the direction of Günter Gerhard Lange and Bernd Möllenstädt who explicitly refused to rely on digitization from URW.[39] The reviving digitizations were not made from old drawing patterns, but from letterpress prints, extracted from original type specimens, which were enlarged and redrawn by the personnel of Berthold's drawing office under the guidance of type director Möllenstädt.[40]

ITC on the other hand was not a manufacturer, but mainly a distributor and therefore outsourced digitization to URW since 1987, while commissioning new designs for a growing library of independent type designers. As Sumner Stone recalls, this relationship (that involved three parties) may have led to misinterpretations of some his original character specifications for ITC Stone, which were

37 Siebert 1991, p. 36. Salden set up an Ikarus workstation at his studio in 1988, comparably late.

38 Unger 1990, p. 33.

39 Karow 2019, p. 88.

40 This process is documented in full detail in Berthold's promotional film *Berthold type design* about the activities at the company's drawing office in Taufkirchen, near Munich. The film (12:40 minutes, directed by Martin Bauer, c. 1981) is available online, <https://www.youtube.com/watch?v=Noe7KQsePQo> (last visited 15 November 2022).

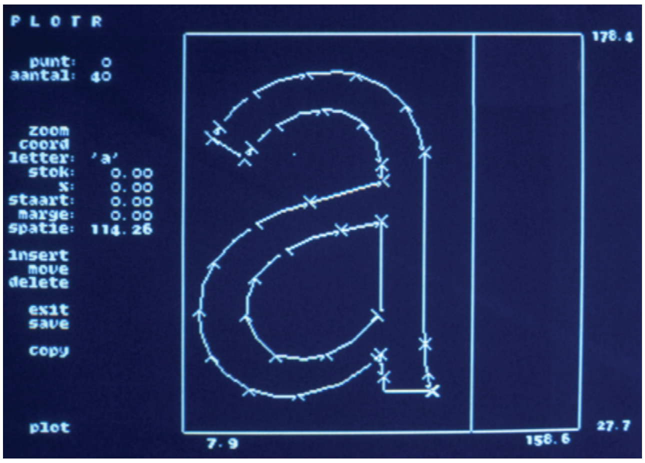


Fig. 5.17 Photograph of the graphic user interface of Plotr, a font editor by Petr van Blokland that utilized Ikarus curves [PvB].

Fig. 5.18 Ikarus M type design system setup on an Apple Macintosh, equipped with Aristo tablet and digitizer, Apple keyboard and mouse and outline drawings of PT55 marked for digitization. Reconstructed from the personal collection of ES, photograph by Norman Posselt, 2017.

released without his approval.[41] In another case, Erik Spiekermann laments that the final appearance of specific characters in his typeface ITC Officina differ from his original specification, which he noticed only after receiving proofs of the released fonts by mail.[42] In a terminology that slightly deviates from Southall's, Noordzij summs up the key challenge:

> In the actual custom the designer makes the shapes. Somebody else interprets the shapes in outlines and again somebody else defines the shapes by digitizing the outlines. Then the designer is invited to comment trial composition (in fact scanned bitmaps). This is the moment of mutual frustration.[43]

According to Noordzij, designers were better served if they retained responsibility not only of the character appearance, but of their interpretation in shapes and of the final definition in digital outlines. Noordzij's concerns were also shared by his former student Petr van Blokland, who, at the end of his internsip at URW in 1976, had received a non-disclosure agreement from Karow in order to pursue work on a smaller-scale workstation that was based on the Ikarus algorithm.[44] During his final year at the art academy in The Hague in 1979, van Blokland began to develop his own digital type design tool in an attempt to improve the responsiveness on Ikarus and continued to pursue this project on a home-built computer and a low-resolution monitor, well beyond his studies. While the groundwork was laid in a system called Plotr in 1982 (**fig. 5.17**),[45] the decisive impetus came with the introduction of the Apple Macintosh in 1984, in which van Blokland saw the opportunity to utilize the standards of a more advanced GUI. URW, with whom van Blokland had stayed in touch all those years, were not averse to support the development of a 'little system with the working name "Mac-Ikarus"' and agreed to carry out the programming under his consultancy in 1987.[46] Two years later the new system was released as 'Ikarus M' for just 500 DM. Equipped with smaller, redesigned Aristo tablets, the programme's interactive nature allowed type designers to carry out all of the steps of designing and digitizing that were previously separated, in one uninterrupted process in a desktop-environment (**fig. 5.18**). Perhaps its greatest improvement was

41 Sumner Stone in an interview with the author, 3 June 2016 [audio file 01, 14:35]. When Stone joined Adobe as type director in 1984, he had already gained experience in working with Ikarus at Autologic since 1979, followed by a one-year stint at Camex. Initially, Adobe did not have a library of its own, which is why Stone's eponymous typeface was released with ITC. However, by the time it became available in 1987, it was released almost simultaneously with Adobe, too — Adobe's version considered Stone's original specifications.

42 Spiekermann 1991, p. 74 f. He recalls changes made to the set of so-called 'hanging figures' (some figures go barely below the baseline, but not as much as in old-style figures). According to Spiekermann, font production at URW replaced those distinct figures with a normal set.

43 Noordzij 1987, p. 6.

44 Petr van Blokland in an interview with the author, 3 May 2019 [audio file 01, 09:25].

45 From correspondence between Petr van Blokland and the author, 28 May 2021.

46 Agreement between URW and van Blokland, 4 February 1987 [PvB].

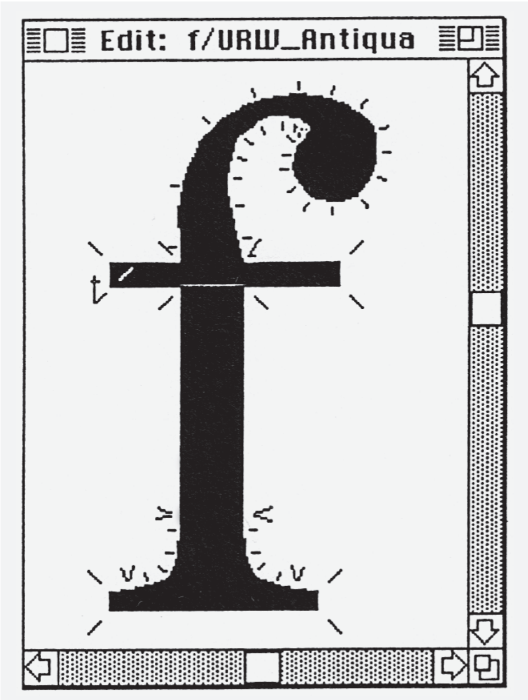


Fig. 5.19 Ikarus M editing window. The available resolution of the Ikarus data was higher (15,000×15,000) than that of the Mac II screen (640×480).

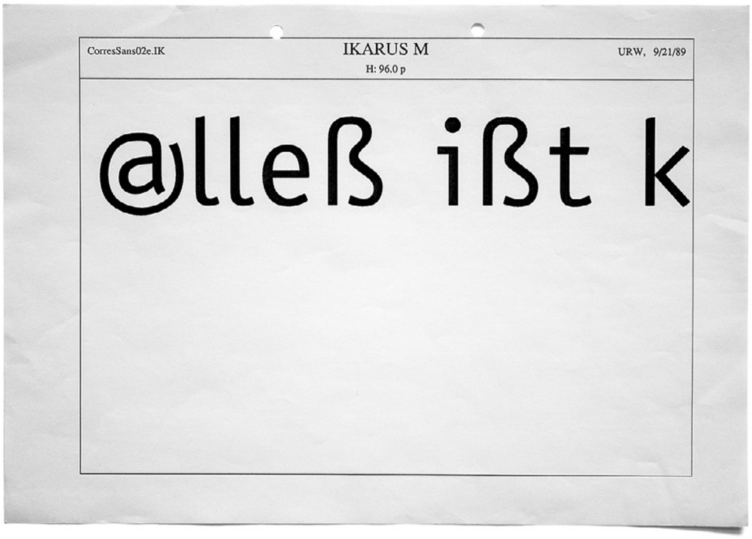


Fig. 5.20 Laser-printout of the proof mode window for trial letters of Correspondence Sans (working title of the later ITC Officina, 1990), digitized by Just van Rossum on an Ikarus M from appearance specifications by Erik Spiekermann. The rounded corners were added in an automated routine by Elsner+Flake, 1989. Photographed by the author [ES].

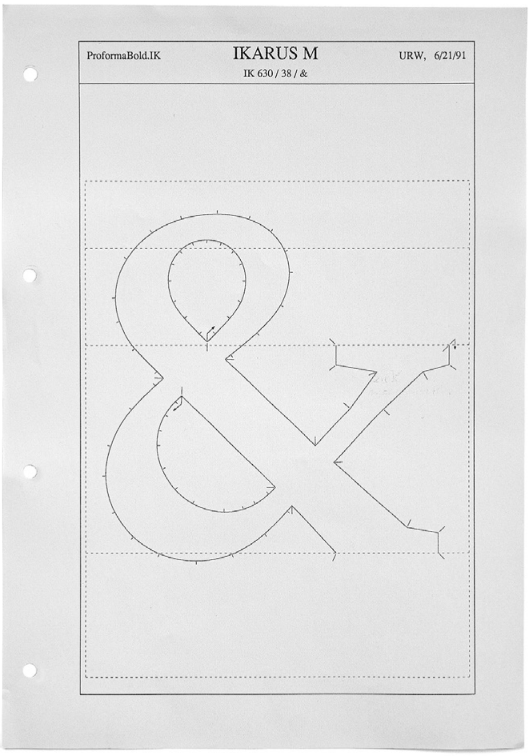


Fig. 5.21 Laser-print of the edit window of Petr van Blokland's Proforma (Purup Electronics, 1988; FontBureau, 1994), 1991. Reproduced by the author [PvB].

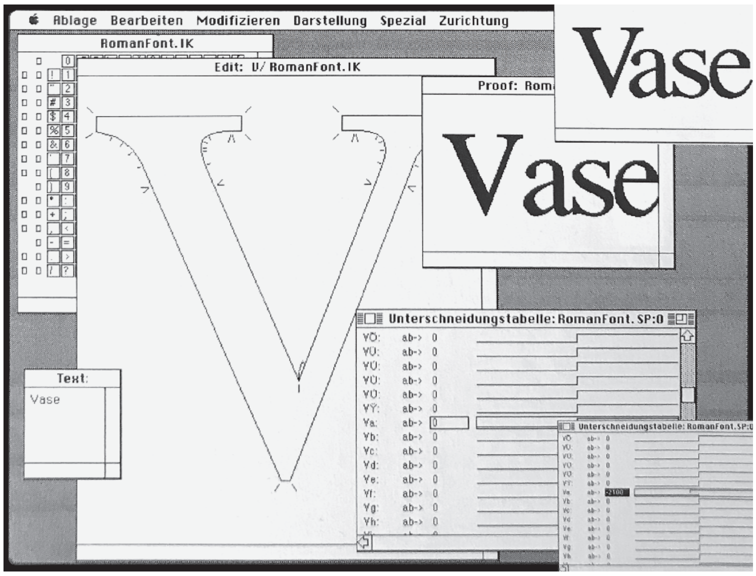


Fig. 5.22 Ikarus M user interface: two 'proof' windows are up for immediate comparison of kerning edits. Reproduced by Gabriele Günder from Unger 1990, p. 32.

a routine that enabled continuous switching between outlines and shapes, therefore providing *digital smoke proofs* (**fig. 5.19**). Users could 'zoom' into character shapes, edit details, rotate, flip and 'print preview' on a connected office printer — the laser-print equivalence of smoke proofs (**fig. 5.20+21**). These prospects sparked excitement in those type designers who have been mentioned above; Unger became a prominent advocate of Ikarus M, praising the abilities to access 'screen proofs' (**fig. 5.22**) and to quickly evaluate laser-printed character images in any desired size.[47] On the other hand, URW may have found themselves in a dilemma: with every additional feature integrated in the smaller system, Ikarus M placed more responsibility in the hands of its users, putting a 'handy' and significantly cheaper product in competition with the original Ikarus system and with URW's business model as a whole. Karow himself identified Ikarus M as the 'cheap version for independent font designers'.[48] Even though the rapidly changing industry signalled the need for these kind of solutions — the second half of the 1980s also saw the release of other Macintosh-based type design tools such as Fontographer, Fontastic and Fontstudio (see 5.3) — URW may not have given them the necessary attention. The distinction between the two Ikarus systems is therefore very relevant, but has not received much attention until recently. Based on some of the sources brought forward here and through research in van Blokland's personal collection, the author has recently revisited the transitions from Ikarus to Ikarus M elsewhere.[49]

The incidents described in this subsection, the accounts of independent designers and of manufacturers who seek more responsibility within the manufacturing process of their own typefaces, is proof of a changing mentality throughout the 1980s and beyond. The notion that this transitional phase ended over night with the introduction of PostScript is refuted in the continuous development of Metafont, Ikarus, LIP, and the type design tools that succeeded them, following the discussions on useful and responsive systems.

47 Unger 1990, p. 32.

48 Karow 2019, p. 133.

49 See Ulrich 2022.

5.2.2. Digital modifications and automated design

Numerical description of letterforms gave rise to automated processes, foremost to the ability to encode shape modifications of digitized character sets. As has been explored in 4.2.4, commercial demands of the phototype market, e.g. for decorative titling styles, were one catalyst of these procedures. Later the technology was exploited for the benefit of more sophisticated applications, such as optical sizes and other compensations of initial shortcomings of digital type, discussed in more detail in 5.2.3.

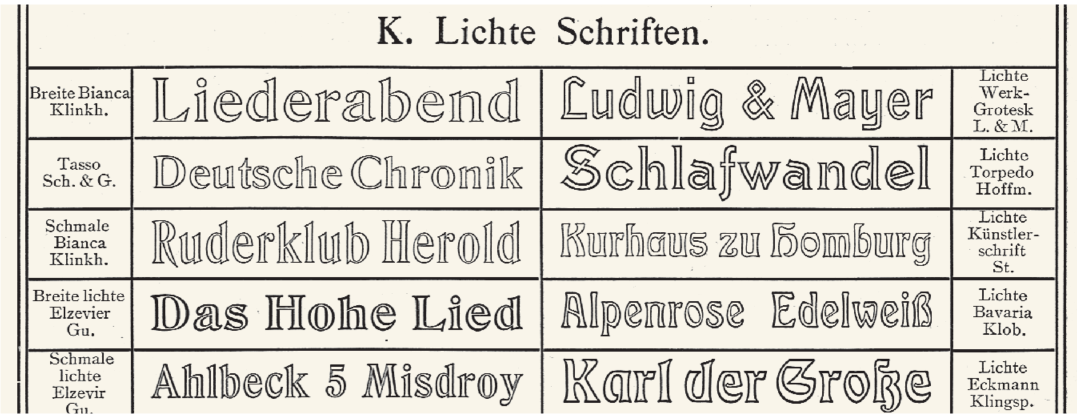
Donald Knuth's presentation of Metafont at the 1983 working seminar emphasized the abilities of parametric algorithms for automating design processes, applying complex changes to shape, not character by character, but to a complete character set 'at the push of a button'. However, with the demonstrations of Fred, Ikarus and LIP, with a presentation of the 'Euler-modified' Metafont (in addition to Knuth's original Metafont 79), and due to the absence of a demonstration of Elf, the Stanford participants would have been most familiar with the approach to numerical outline description at the end of the event. As was demonstrated in each session, it was precisely the method of vector-connected coordinates that enabled modifications and automated extensions early on. The following explores automated design techniques, while cross-referencing the discussions around them.

'Definitive outline' or 'raw material' for something new

With Ikarus employed by a good number of manufacturers and with Bitstream as an emerging digital type foundry, approaches to outline description were represented in the industry quite prominently. At the same time, outline description was under some scrutiny since the early 1980s and has repeatedly been challenged by alternative methods of encoding, more often by revisiting stroke-based approaches like Metafont. In a footnote to *A survey of type design techniques*, Southall insists that with Ikarus and LIP 'the concept of the "definite outline" emerged, for good or ill'.[50] Although Southall does not further clarify this observation, this criticism could be interpreted using his own terminology: while the approaches that employed the concept of outlines were useful, they lacked responsiveness. This concern has also been raised by others and entails conceptual and technical aspects, although the implications of the latter may have clouded the former. Kathleen Carter's doubts are fuelled by a critique of the usability of curve contours:

> When a new design is being created the use of a spline representation becomes very difficult. Not only is the control of a spline frequently counter-intuitive but the calculations can be so slow that interactive control is not really possible. [...] Once rapid interactive control is available it will provide designers with the

50 Southall 2007, p. 54.



K. Lichte Schriften.			
Breite Bianca Klinkh.	Liederabend	Ludwig & Mayer	Lichte Werk-Grotesk L. & M.
Tasso Sch. & G.	Deutsche Chronik	Schlafwandel	Lichte Torpedo Hoffm.
Schmale Bianca Klinkh.	Ruderklub Herold	Kurhaus zu Homburg	Lichte Künstler-schrift St.
Breite lichte Elzevier Gu.	Das Hohe Lied	Alpenrose Edelweiß	Lichte Bavaria Klob.
Schmale lichte Elzevir Gu.	Ahlbeck 5 Misdroy	Karl der Große	Lichte Eckmann Klingsp.

Fig. 5.23 A selection of *lichte Schriften* , a type genre historically referred to as 'inline', released by German type manufacturers in the early 1900s. Reproduced from Klimsch 1907/08, p. 314 [FU].

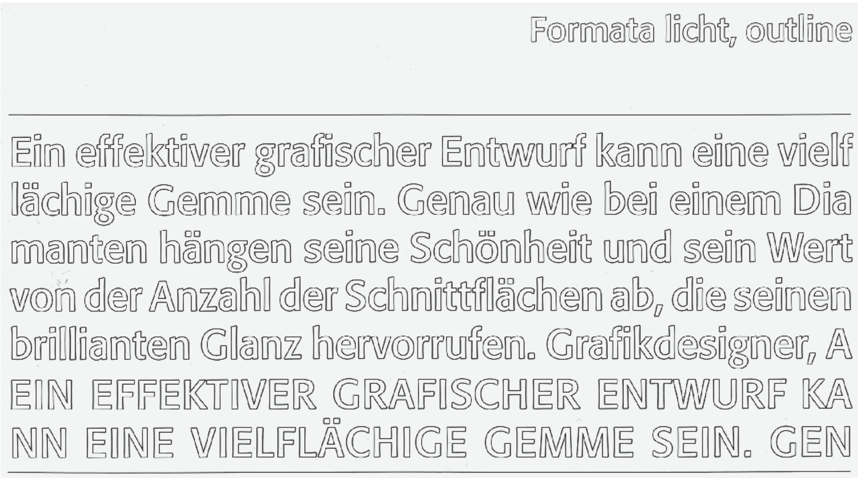


Fig. 5.24 Display weight of Bernd Möllenstädt's Formata.
Reproduced from Berthold 1984, p. 43 [FU].

> opportunity of developing an intuitive feel for splines, which can then enhance rather than hinder their work.[51]

While this is a reminder that the Rainbow Group did not employ spline-based algorithms, but polygons in their type design system prototypes, it is also an indication that outline technology did not perform well on underdeveloped computer workstations that lacked storage, power and decent screen resolution, all of which are necessary for interactive capabilities. When URW received a major commercial commission from Hell in 1976, much of the large-scale computing was only possible because Hell, as a Siemens subsidiary, was equipped with high-end process computers from its parent company.[52]

Discussing Ikarus, Gerrit Noordzij seems to criticize the underlying concept of outlines as a means to describe shapes:

> Defining a shape by drawing its outline is exactly as difficult as adjusting a balance with the scales removed; the draughtsman is making and changing shapes without actually seeing them.[53]

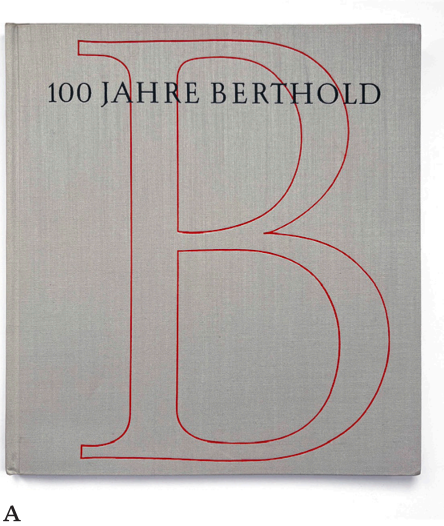
While this comment reflects Noordzij's traditional view of shapes defined by form and counter form, this concern also entails a technical component of the system's inability to reproduce 'filled' shapes on screen (see 4.2.4). After the release of Ikarus M, with the improved ability to switch between outlines and shapes (see 5.2.1), Noordzij recognized the system as 'a tool for type design' (perhaps because it was 'devised by a type designer', his student Petr van Blokland), while being reassured that the outline's purpose ought to serve as a technical aid:

> The position of the marking points is not just a basis for smooth outlines, it is the principle which governs the shapes of interpolated modifications.[54]

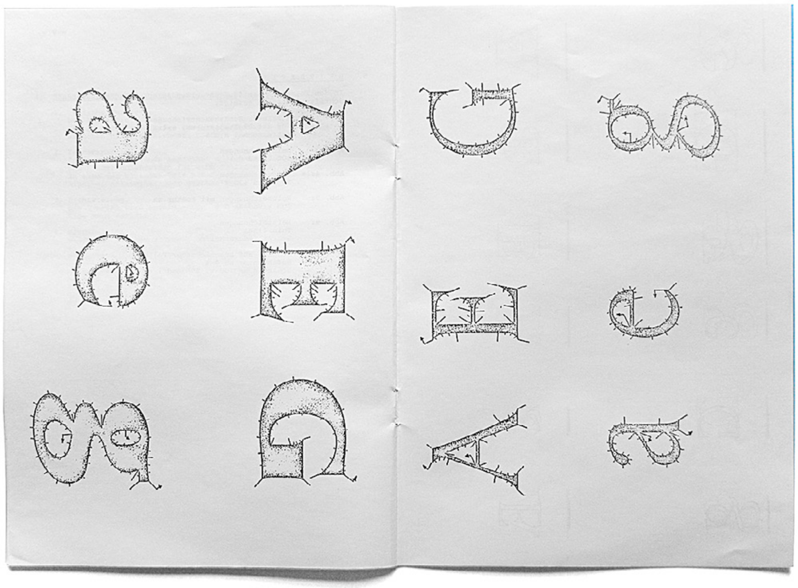
In this regard, Bigelow's approach was similarly pragmatic — as demonstrated in his decisions for the Euler project, which initiated a paradigm shift for Metafont (see 4.2.3), i.e. if one approach cannot offer a desired solution, maybe another approach can:

> Today, a glyptal letter, defined only by its contours or outlines, may be produced by inking, painting, drawing, or cutting a thin photo-opaque mask. In all cases, the contours define the letter, and are the main focus of the designer's attention. Any analysis of the glyptal letterform must take the contours as the primary feature.[55]

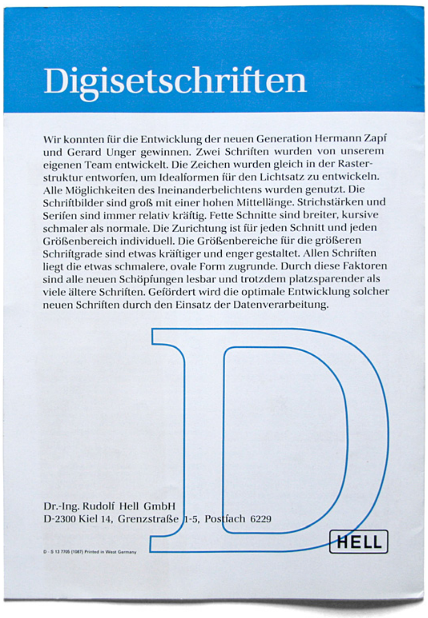
51 Carter 1986, p. 17.
52 Karow 2019, p. 69.
53 Noordzij 1987, p. 6.
54 Ibid.
55 Bigelow 1983 III, p. 3.



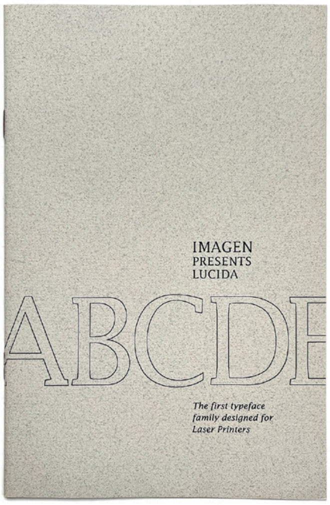
A



B



C



D

Figs. 5.25

A Berthold, 1958 [FU]

B URW, 1975 (see **fig. 4.103**) [DTGC]

C Hell, 1978 [DTGC]

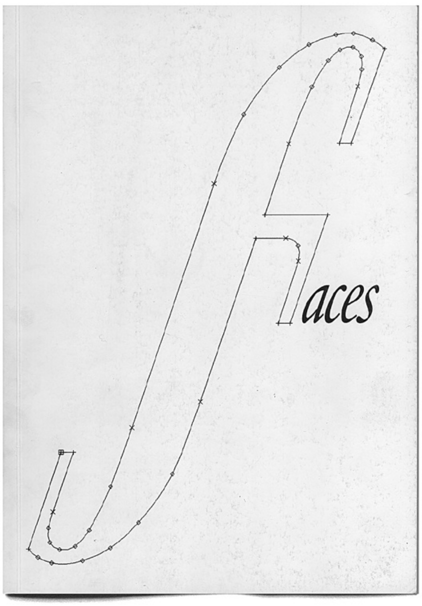
D Imagen, 1984 [CB]

E Hell, 1985 [ES]

F Brendel, 1988 [AJP]

All photographs by the author.

E



F

Although numerical outlines may have initially been perceived as a continuation of the static outline drawings for hot metal type manufacturing, 'definite' in shape, they began to be acknowledged as something new. As Adams puts it, outline descriptions served as the 'raw material' for the design and production steps that followed,[56] preparing fonts in additional weights, in different sizes and for specific resolutions. From today's standpoint, establishing the outline concept was a necessary step in a long evolution, in the expansion of design spaces (that are as much defined by the visible instances as by the invisible instances), and not least in the development of composite- and component-based outlines.

The outline as a visual statement

Apart from patterns hidden in the cabinets of the drawing offices and numerical outlines that are virtual descriptions, the notion of 'the outline' also offers a visible component for consideration in the disciplines of type and typography. Although it has been established that character images are represented by form and counterform, positive and negative shapes, contoured letterforms have not only existed as the artistic exercises explored in chapter 4.1, but as character images, too. Examples of typefaces that were designed to represent a contour rather than a filled shape were produced by type foundries at least since the late nineteenth century for use in advertising (**fig. 5.23**), typically offered in display sizes as part of an existing typeface family. This style flourished during the 1920s as the 'inline' style (sometimes referred to as 'light'[57]), a decorative companion of so-called geometric sans serifs. With Ikarus, 'inline' modifications of digitized typefaces became a standard, advertised by URW and Berthold as 'outline', adding confusion to the changing naming conventions (**fig. 5.24**).

In the context of type foundry publications and specimens, a contoured letter on the cover is not just a letter, but a motif: an image clearly reminiscent of a pattern drawing (**fig. 5.25** A). This use has an educational purpose, reflecting the technology available at the time. At the dawn of the early digital period, the visibility of outline representation increased in the printed material issued by typeface manufacturers, often including the characteristic digitization marks (**figs. 5.25** B–F). Some of the earliest examples discovered here date back to the mid-1970s, coinciding with the introduction of Ikarus to the ATypI community. Today, such visualizations remain largely unrecognized; since the late 1980s coarse bitmaps have taken over as the generic visual expression of 'digital type' (see **fig. 4.18**).

56 Adams 1989, p. 215.

57 The second term is probably an unfortunate translation. During the 1920s, this style became particularly popular among German type foundries. In German these weights are referred to as *licht/lichte* (sparse), an adjective of the noun *Licht* (light), but not to be confused with *leicht/leichte* (light, as in weight) for thin weights of typefaces.

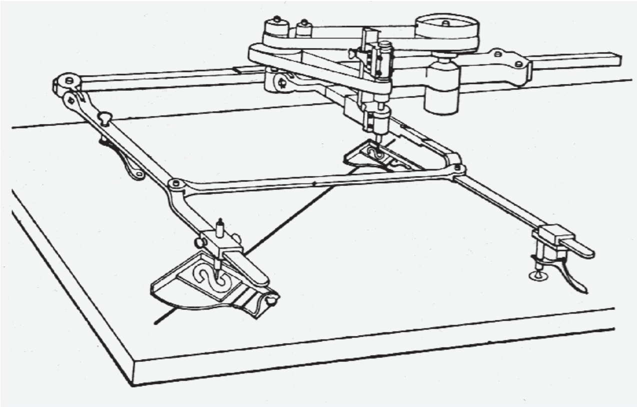


Fig. 5.26 Technical drawing of a 1880s panto-graphic device. Reproduced from Kelly 1977, p. 53.

Fig. 5.27 Wood type modifications extremes of ‘roman’, ‘antique’ and ‘gothic’ styles available by the 1880s. Reproduced from Kelly 1977, p. 91.

Fig. 5.28 Photographic lens distortion of Eurostile. Reproduced from the brochure *Berthold Starsettograph,* c. 1972.

Digital modification

Ikarus was the first available digital type design system that could easily modify encoded characters as early as 1973. The term *modification* implies that the condition of an existing shape is affected by adjusting corners and angles or basic geometric proportions such as width and height. By this definition, Sutherland laid the groundwork for such numerical alterations in Sketchpad a decade earlier (see 4.1.2). It has also been touched upon in 4.2.4 that letterform modification is not an invention of the digital era. Around fifty years before Benton filed a patent for the pantographic punchcutting machine in 1885, George Leavenworth and Edwin Allen in the United States had independently adapted the pantographic principle to the routing machine to cut wood type, but neither of them filed a patent.[58] The original pantograph is a scissor-like apparatus made of an open framework of axes connected by flexible joints. On one extreme of the framework a guide rod attached to one joint can trace the outline of a pattern, while the movement is repeated in a joint on the other extreme. A rotating router that is attached to this joint, cuts a relief character from a wooden block (**fig. 5.26**). An existing shape, easily used as a pattern, could simply be scaled in size, but could also be altered in width or other parameters by manipulating the positions of the other axis. From the late 1830s onwards, American wood type manufacturers produced new typographic styles that were not available in metal type at the time.[59] By the 1880s these variations included a wide range of new extremes of existing type families (**fig. 5.27**).

With the introduction of phototype technology, lens distortion replaced the pantographic router. At Berthold for example, typical modifications on the display typesetter Staromat, a high-performance compact device, included slanting, backslanting and tilting (**fig. 5.28**).[60] More often than not however, unofficial modifications of licensed (or unlicensed) fonts could be carried out by typesetters on phototype machines, causing unwanted malformations and dents particularly in curves that did not correspond with the intentions of the designer and manufacturer. Unsurprisingly, the ATypI became concerned with the matter and put 'distortion/modification' on the agenda of its committees throughout the 1970s. Based on the 1973 *Vienna Agreement* for typeface protection, the Neufville type foundry in Barcelona proposed that if a composing studio modified original fonts they would have to pay a license fee to the affected manufacturers, and if this customized font appeared in their catalogues, it would have to carry a note to emphasize its

58 Kelly 1977, p. 51.

59 Ibid., p. 72.

60 See the trilingual manual: *Starsettograph, Staromat: Typenplatten, type fonts, plaques-matrices,* Munich: Berthold Fototype, undated (c. 1972).

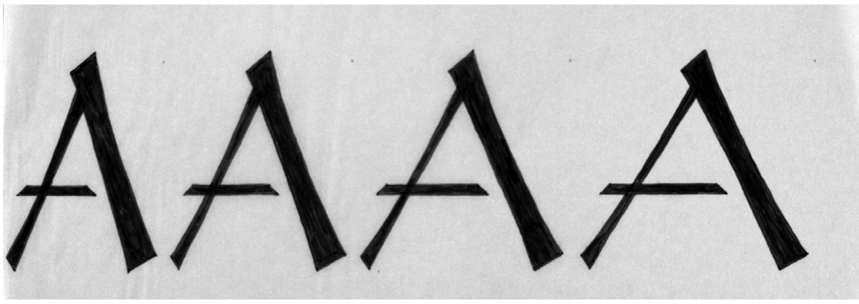


Fig. 5.29

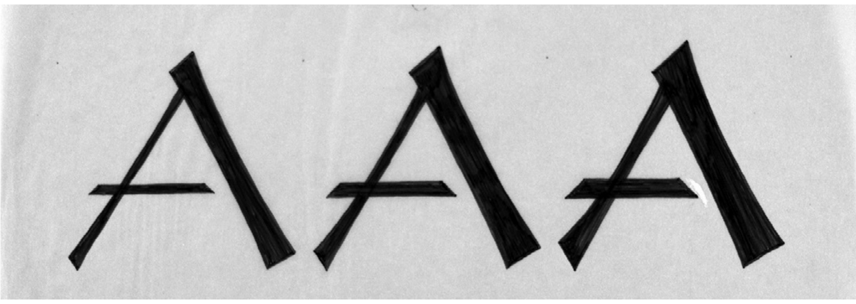


Fig. 5.30

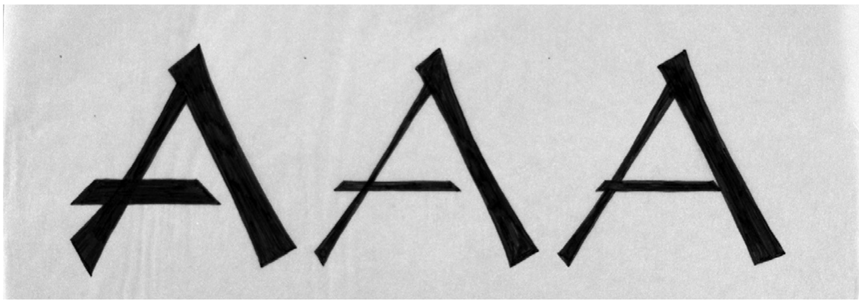


Fig. 5.31 Plotted and filled with black marker on paper for better reproduction in the proceedings. Photographed by Norman Posselt [CC, CSC 030, box 3, folder 6/7].

modifications.[61] The ATypI board agreed to these terms during the 1975 annual congress.[62]

Some level of transformation and modification could be performed in each of the type design systems presented at Stanford, although the degree of automation of these routines varied. Given its calligraphic approach, Elf allowed changing of the pen widths and angles; 'facilities were provided […] for interpolating between designs', yet examples of these abilities could not be found in the available material.[63] As is mentioned in 4.2.3, the Xerox Alto Font Design System performed 'geometric shape transformation' not in Fred, but in its sister programme Draw.[64] In their Stanford presentation, Baudelaire and Pellar did not show a very wide range of transformations, but it is also likely that these features were not exploited to the fullest in the repertoire of tasks that the system was set up to do.

The idea of *modification* does not apply to Metafont in the same fashion, since the ability to constantly generate new instances is rooted in underlying parametric concept of a meta-font. If Computer Modern Roman was not a reinterpretation of a specific weight of the original Monotype Modern Extended 8A, according to Knuth's idea of meta-ness it would not even be clear which of the many weights was the starting point of all other variants. In CMR Knuth had programmed more parameters than in any other meta-font (by 1982 there were over 30[65]), allowing a multitude of combinations, only some of which became visible in his infamous 1982 article. As a result, Knuth does not refer to these alterations as modifications, but as 'parameter variations' or as 'circumstances'.[66]

Some of the variations presented by Knuth during his working seminar presentation include degrees of character slant, width, pen size (weight), length of the serifs, or changes of the overall appearance, e.g. changing shape from square to circle in the letter 'o', which is perhaps the most impressive transformation. According to Knuth, the parametric variations can reach degrees of complexity where the pen stays the same, but the path is different, creating character images that could not be achieved by 'optical transformation'.[67] As briefly mentioned in 3.2.3, Knuth adopts the capital 'A' from Sumner Stone's logotype and demonstrates more complex variations as an example of alternating parameters and constants: changing unit width while maintaining stroke weight (**fig. 5.29**); increasing weight

61 See 'Guidelines for the wording of licensing agreement for the manufacture of type modifications', drafted by Neufville type foundry (presumably by Wolfgang Hartmann) to the ATypI committee of type manufacturers, Barcelona, 27 January 1975 [DTGC, ATypI collection].

62 Report of the board meeting, Warsaw, 30 September 1975 [DTGC, ATypI collection].

63 Carter 1986, p. 21.

64 Baudelaire 2016, p. 18.

65 Knuth 1982, p. 7.

66 Knuth 1985, p. 37 f.

67 Ibid., p. 37.

Fig. 5.32 Basic Ikarus modifications plotted on masking film for promotional material issued by URW, undated. Photographed by the author [DTGC, special collection].

Fig. 5.34 Four levels of 'antiquing' applied to a digitization of William Morris' Golden Type. Reproduced from *Ikarus M manual for update 2.5*, 1992 [FU].

Fig. 5.33 Automatic modifications applied to a digitization of Aldo Novarese's Eurostile: outline, drop shadow, rounded. Reproduced from Karow/URW 1993, p. 155.

while maintaining width (**fig. 5.30**); opening and closing the counter form while changing stroke contrast and weight, but maintaining width (**fig. 5.31**).

URW demonstrated early on that it was fairly easy to develop routines for modifications of single characters and complete fonts by applying 'certain mathematical procedures' to the coordinates on the outline (**fig. 5.32**).[68] At the most basic level, these procedures enabled linear scaling and italicising, which produced slightly more satisfying results than the unfavourable slanting routines of other systems. Karow identified the problems of what he called 'electronic cursive' and developed a solution that could optically correct those distortions.[69] Since Ikarus enabled independent variation of simple x-and-y values, calculating new coordinates created a series of 'contouring' styles (outline, inline, relief, drop shadow and round, **fig. 5.33**), some of which have been mentioned in 4.2.4.[70]

Southall bases his assessment of Ikarus on the fact that the system utilized finished character drawings as input, implying that at the moment the digitizing tablet is turned on, 'all the decisions about the design of the typeface have already been taken' and concludes that Ikarus is therefore not a 'design tool'.[71] According to this analysis Ikarus is no more and no less a type design system as a manufacturing process that employs the Benton pantograph. However, Southall overlooks the paradigm shift that happended to the traditional separation of type design and font production in digital type design systems. The outline drawings are no longer a definite manifestation of the designer's intentions, but a preliminary stage of the design process. This new understanding is exemplified in a design modification in Ikarus M known as 'antiquing', a technique that 'deliberately destroys' a previously smoothed contour (**fig. 5.34**).[72] The effect was achieved by insertion of points between existing point, which were repositioned at random coordinate values.[73] A more subtle application would result in an 'artificial aging effect' to imitate the appearance of letterpress printing from imperfect metal type (a reproduction

68 URW 1983, p. 21.

69 Ibid.

70 These variations became more relevant economically after URW presented a new system in early 1983 called SIGNUS, internally known as 'Mini-Ikarus'. A Signus workstation stored up to 300 existing fonts (some of which URW had digitized for clients). It was also equipped with a tablet and digitizer and with a small-scale Aristomat that could plot logotypes and single words in a desired font on weather-resistant and self-adherent foils for shop windows, cars, etc. — a complete system with all components sold for 60,000 DM. Signus could be described as a 'logo design system'. See Karow 2019, p. 103 f. In 1983 URW also opened a branch in London (its first office abroad) called SIGNUS Ltd., co-founded by the partners with Mike Daines and Roger Ward. See Karow 2019, p. 112.

71 Southall 2007, p. 54 f.

72 Karow 2013, p. 21.

73 URW 1992, pp. 40–43.

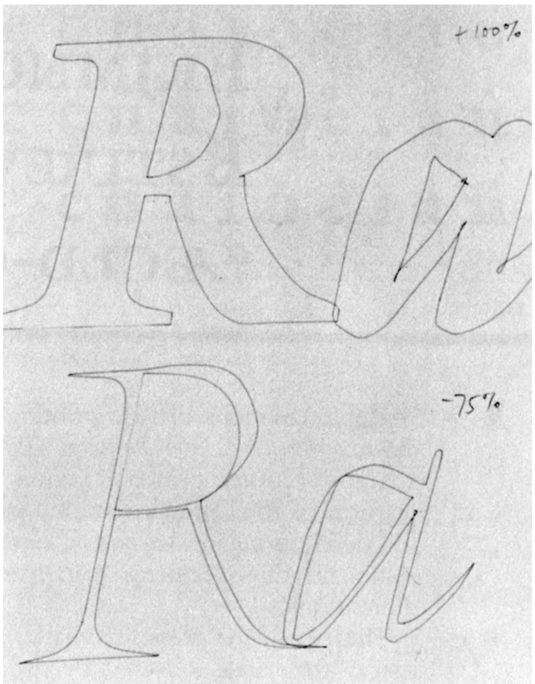


Fig. 5.35 Discarded Ikarus interpolation trials of ITC Galliard. Reproduced from Carter 1985, p. 33.

Fig. 5.36 Four hybrid weights interpolated between Bembo and Helvetica Black. Reproduced from URW 1983, p. 25.

technique that had even been explored in mechanical punchcutting[74]), but when taken to extremes it could result in 'random fonts'.[75] 'Randomness' by means of parametric algorithms is a design technique of digital design systems that seemingly contradicts the traditional notion of 'all the decisions about the design of the typeface have already been taken' and allows drawings and 'digital actions' to be viewed as a more fluid process.

Automated design

The principal of interpolation, the ability to estimate new points based on an existing discrete set of points, had been explored mathematically long before outlines were adopted as a method for numerical description of letterforms.[76] Baudelaire has a pure understanding of interpolation, as a means to improve the approximation of shapes by specifying control points along splines and to explore curvature continuity,[77] while Karow and Rubow utilized the mathematical findings of their contemporary Helmuth Späth to automatically calculate new shapes from two existing shapes (see 4.2.4), early on. URW's close collaboration with type designers and manufacturers in the second half of the 1970s allowed them to put those developments to the test, as has been demonstrated at the example of Matthew Carter's Galliard in 4.2.5. After a few years of experimenting, commercial projects like these allowed Karow to apply the technique, even though not all of the results were viable yet, as is visible in the italic designs that were 'pushed to deliberately absurd extremes', which in return allowed conclusions to be drawn for future improvement (**fig. 5.35**).[78] Similarly, the ability to generate a new shape from one existing shape, called extrapolation, was unsuccessful at this stage. By the early 1980s, URW's brochures demonstrate proficient results of interpolation, including specimens of up to ten intermediate weights and examples of what was known as 'hybrid interpolation', generating instances between serif and sans serifs styles (**fig. 5.36**).[79]

The concept of joining a serif and a sans serif design in a shared design space had already been explored by Jan van Krimpen in Romulus in the 1930s,[80] but not to the extent that this idea was revisited during the 1980s, which can be largely

74 As Zapf recalls, some punchcutters revived old typefaces by making contours rough in imitation of manual punch cutting, an effect he considered to be 'factitious "primitiveness"'. Stauffacher 1965, p. 22 f.

75 Ikarus M manual for update 2.5, URW Hamburg, 1992, p. 40.

76 Bigelow 2020, p. 20.

77 Baudelaire 2016, p. 22 f.

78 Carter 1985, p. 32.

79 URW 1983, p. 25.

80 Romulus with serifs was released by Monotype in 1937, its serifless counterpart remained a draft. Before van Krimpen, designers had designed serif and sans serif typefaces that share certain attributes, as in Eric Gill's Gill Sans (1928) and Joanna (1937).

Fig. 5.37 Made in Ikarus: overview of Otl Aicher's Rotis family. Reproduced from *Eine neue Schriftengruppe bei Agfa Compugraphic,* 1989.

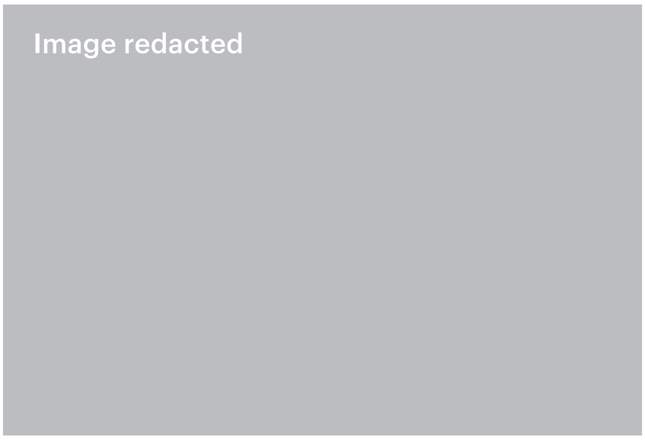


Fig. 5.38 Monika Schnell 'strips' a character from masking film, interpolations of Rotis on the wall behind her. Photograph by Timm Rautert, reproduced from Eskildsen/Steidl (eds.), *Otl Aicher: Rotis,* 2021, p. 103.

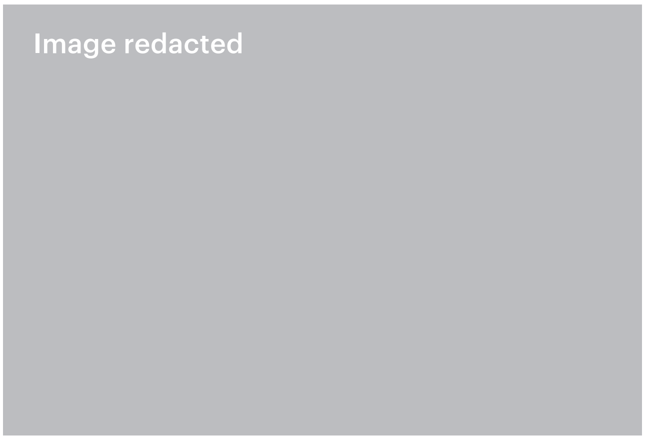


Fig. 5.39 Schnell operates an Ikarus workstation at Otl Aicher's studio in Rotis to digitize the typeface of the same name. Photograph by Timm Rautert, reproduced from Rathgeb, *Otl Aicher,* 2008, p. 210.

attributed to the available technology. Such designs include Kurt Weidemann's Corporate A-S-E,[81] the Lucida family by Bigelow & Holmes,[82] and Otl Aicher's Rotis, all of which were realized in Ikarus. After Aicher had identified serif and sans serif as the two most relevant genres of the twentieth century, he planned to 'forge a union between these two families and link them into a single extended family', while envisioning two additional hybrid appearances in-between called 'semi-sans' (which Aicher considered the heart of the new family) and the rather peculiar 'semi-serif' (**fig. 5.37**).[83] Apart from the controversial discussions on Rotis that followed its release in 1989, in contradiction to Aicher's own theories on legibility,[84] Mike Daines suggests it is unlikely that Aicher would have undertaken a project like Rotis without the availability of a tool like Ikarus.[85] Furthermore, Daines implies that some results in Rotis reflect an 'over-dependence' of automated design features, in which he alludes to the 'semi-serif' design.[86] At the same time, it is most unlikely that Aicher, who was initially critical of computer-aided design, could have manufactured such a large family without the contributions of Monika Schnell (**fig. 5.38**), Barbara Klein (both of whom had previously worked with Ikarus at Berthold) and Stefanie König.[87] For the realization of the project, an Ikarus workstation and Aristo plotter were set up in Aicher's studio in Rotis (a small village in Southern Germany; the typeface is named after it, **fig. 5.39**).

Interpolation had a fundamental impact on the development of larger typeface families than had previously been planned or conveived, including families of multiple styles and genres, which also had economic implications. Interpolation greatly reduced the time it would have taken to draw each weight manually, therefore significantly cheapening production, and allowed a certain homogeneous curve description across the full range of styles.

Particularly the latter aspect has been sparking discussions on whether or not 'perfect' shapes were desirable, not least since the introduction of mechanical punchcutting, as a remark by Bruce Rogers in a letter to Daniel Updike shows:

81 A-S-E stands for Antiqua (roman), Sans and Egyptienne (slab serif). Originally designed as a custom typeface for Mercedes-Benz in 1985, it was later released through the library of URW who digitized it.

82 Lucida includes serif, sans serif, blackletter and typewriter designs among other styles. Originally digitized in Ikarus on a VAX workstation at the studio of Bigelow & Holmes in 1985, it was later transferred to an early version of Ikarus M in 1990 for further editing and was then converted to TrueType format for release on the 1992 Microsoft Font Pack with the Windows operating system. Charles Bigelow in correspondence with the author, 25 August 2021.

83 Otl Aicher: *Typografie,* Berlin: Ernst & Sohn, 1989, p. 187.

84 See Ralph Burkhardt, Christian Hartig, *Rotis: eine Streitschrift,* Mainz: Hermann Schmidt, 2006.

85 Daines 1993, p. 80.

86 Ibid.

87 See photographs by Timm Rautert of the team working on Rotis, some of which are published in Markus Rathgeb, *Otl Aicher,* London: Phaidon, 2008, pp. 207, 209–211, and in Ute Eskildsen, Gerhard Steidl (eds.), *Otl Aicher: Rotis,* Göttingen: Steidl, 2021, pp. 71–111.

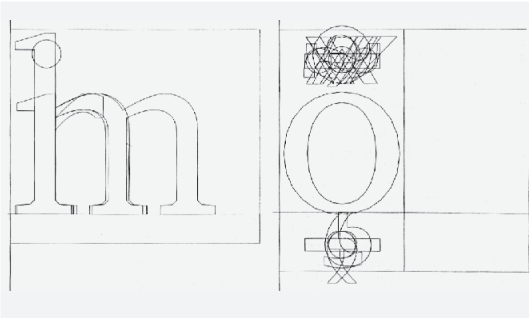


Fig. 5.40 Matthew Carter's Bitstream Charter made heavy use of automated components in Camex LIP. Reproduced from Caflisch 1988, p. 23.

> Even with strict instruction and with best intentions, [...] it is difficult for the habitual user of a very accurate machine not to insensibly smooth out what he has always been taught to consider "imperfections" and to make as mechanically perfect a letter as possible.[88]

While modifications and interpolation affected primarily design decisions across weights and styles, imperfections between characters could be reduced even further with the automated use of character components (see 4.1.3). In Camex LIP, recurring shapes such as bows, strokes and diacritical marks, so-called 'standard-component' could be 'cut out' or copied, stored in the system in a toolbox-like manner and pasted back to construct another character (**fig. 5.40**).[89] Carter made great use of these routines in the development of Bitstream Charter, which allowed him to draw selected characters that served as a template for others instead of 'having to draw the entire alphabet'.[90] Such an approach was also met with criticism, particularly by Salden who also had all of these automated design routines at hand in the Ikarus system, but decided not to utilize them:

> I have never needed this. It is nonsense. I have already attached and detached serifs in phototype and quickly realized that it does not work. In the process of letter-fitting it becomes rather clear that a capital I needs larger serifs than a capital H. That is the case for every letter.[91]

Salden's opinion shifts the discussion to a considerate use of new technical features. Mike Daines explains that if modification programmes were placed in the right hands (he cites Frutiger and Zapf) these features would become valued design tools, while on the other hand their uncritical use would result in 'the curse of many unnecessary typeface weights'.[92] Such critical voices accompany every introduction of new technologies and techniques, not least the rise of mechanical type manufacturing at the turn of the twentieth century. Almost forty years after the introduction of the Benton pantograph, Updike, who cannot hide his disapproval of mechanic punchcutting, concluded that it seemed to be 'the eye and the hand that determine the excellence of the product of a machine, and it is only when a machine is as flexible as the hand that it is as good as the hand.'[93] Even Karow, who tends to maintain a technical view of type design and rarely expresses concern for design choices, explained that the approval of hybrid interpolations would depend on

88 Updike 1923, p. 12.
89 Caflisch 1988, p. 23.
90 Ibid.
91 Siebert 1991, p. 38.
92 Daines 1993, p. 80.
93 Updike 1923, p. 13.

Fig. 5.41 Instances of Thomas Huot-Marchand's Roman at the example of 30° 'translation' contrast from the simulated stroke of a broad-nib pen. Reproduced from *Eye,* no. 102, 2022, p. 37.

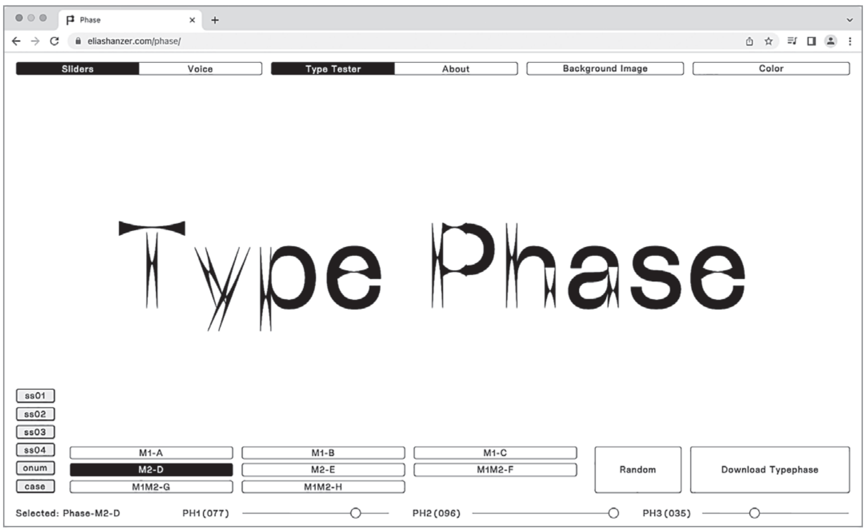


Fig. 5.42 Elias Hanzer's 'Phase' is based on a generative concept to systematically modify a sans serif archetype through variable-font technology, while using modular components based on a set of rules and stylistic alternates; each parameter is represented by a slider. Screenshot of www.eliashanzer.com/phase

'a high degree on aesthetic judgement', a remark that anticipates designs such as a 'semi-serif' Rotis.[94]

During the early 1980s, Knuth's parametric algorithms were by far the most impressive automated designs, and yet many of his achievements were overshadowed by the 1982 *Visible Language* article and the responses that followed it (see 4.2.2). Knuth's concept of a meta-font appeared to remodel some of the foundations of the discipline and most critics were not willing to recognize its merits. Carter and Karow were more subtle in their use of automated design: as a means to improve project hours, reduce expenses, develop larger typeface families in shorter periods etc., but not as an attempt to reinvent the wheel. In recent years, attempts to do just that have been revisited by admirers of parametric concepts and by those who seek to challenge the established idea of an outline-based design approach.[95]

94 URW 1983, p. 25.

95 To name a few: In 2022 Thomas Huot-Marchand announced the type project 'Roman', which projects 'the skeleton of different axes, at different angles and at different distances (*Eye,* no. 102, 2022, p. 36 f., **fig. 5.41**); Elias Hanzer devised a generative and interactive web-based tool in 2018 that employs variable-font technology, called 'Phase' (**fig. 5.42**); Lee Brimelow demonstrated a prototype of 'Faces', a stroke-based approach to type design, at the 2015 Adobe Max conference; Christoph Knoth developed a 'Computed Type' tool as an MA thesis at ECAL Lausanne, presented at the 2011 ATypI congress in Reykjavik; Yannick Mathey and Louis-Rémi Babé devised 'Prototypo' in 2009, a tool that has drawn the attention from thousands of registered users; Changyuan Hu wrote a thesis about the *Synthesis of parametrisable fonts by shape components* at EPFL Lausanne in 1998.

5.2.3. Aspects of quality: considering optical sizes and low resolution

Few aspects of designing and manufacturing type during the twentieth century have undergone as much change and consideration as that of character sizing; each new technology had significant implications on its original concept and with the introduction of numerical description of letterforms the consideration of resolution for different output devices added to the complexity of this challenging task. This was especially true in the reassessment of existing designs of metal type technologies. After initial improvements, optical sizes were side-lined in favour of other issues such as low-resolution output that drew a lot of attention in the early 1980s. In a reconsideration of optical sizes, however, it was necessary to include the aspects of resolution, both of which became attributes of 'quality' in digital type.

In manual punchcutting of foundry type, punches and matrices had to be manufactured for every available size separately, in which case, as Updike points out, 'each size is a law unto itself'.[96] Optical adjustments that were necessary in proportion and shape at each size were well-known to punchcutters: smaller sizes generally have to be slightly bolder, require a larger x-height and overall more generous letter spacing, including open counter forms. Larger sizes on the other hand, tolerate much tighter fitting and a higher contrast between thick and thin strokes. These considerations in shape had serious implications on specific designs that could not be maintained in smaller sizes, e.g. the high contrast in neo-classical designs could not be well preserved, lost its sharpness, while assuming a warmer appearance.

Available sizes followed a sacred sequence of only even numbers above 10 point and leaps in intervals of 1 cicero or 1 pica (i.e. 12 point) above 36 point (followed by 48, 60, 72 and so on), each of which went along names from *Diamant* to *Cicéro,* to *Palestine* and *Double Canon* in French.[97] This also implies that type designers' intentions for a typeface could be aimed specifically at small sizes (e.g. for legibility improvement) or for titling — not merely as a recommendation, but as a design decision that manifested itself in the available sizes.

As has been explored in 5.1, the manufacturing process of metal type changed fundamentally with the introduction of pantographic punchcutting. Type designers provided character appearance specifications for a pilot size, while all other sizes could be derived from that model. Although certain modifications of contraction and expansion could be applied in either dimension of a character for optical adjustment, Updike critically remarked:

96 Updike 1923, p. 11.

97 Each European language had its own naming conventions, although names in Dutch and German followed French and Italian examples in several sizes. See Updike 1923, p. 27.

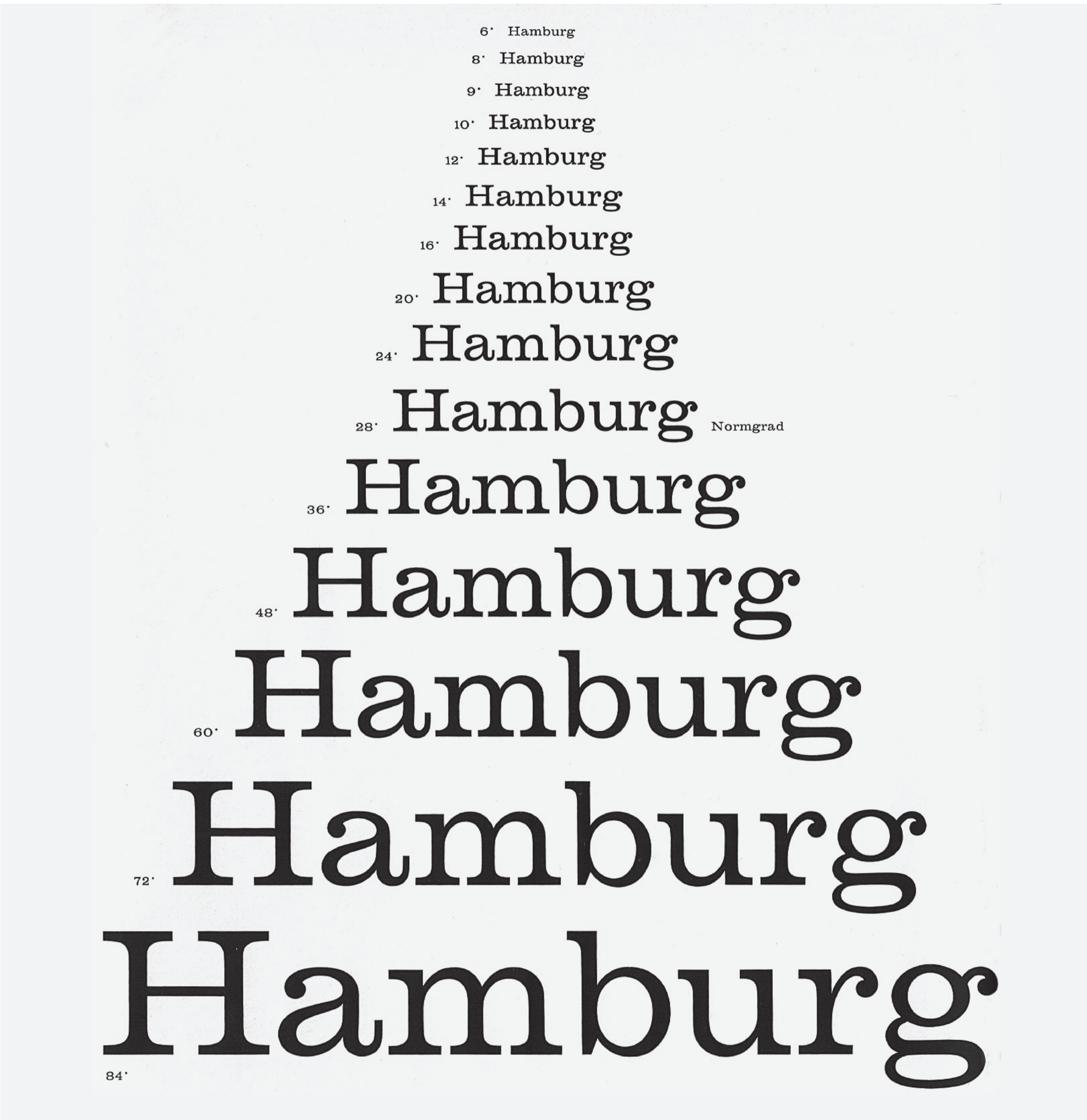


Fig. 5.43 Optical sizing applied to the typeface Volta of Bauersche Schriftgießerei. *Normgrad* indicates the 28-point model size. Reproduced from Bauer 1960, p. 12.

> At first sight it would appear that this was a wholly admirable invention; and it would be, if it did not tend to mechanize the design of type. But a design for a type alphabet that may be entirely successful *for the size for which it is drawn,* cannot be successfully applied to all other sizes of the same series.[98]

While Updike proposed that a new 'model design' should be supplied for every other size, he lamented that it was common practice during the 1920s, to cut sizes ranging from 6 to 120 point and even further from the same model letter,[99] a claim that Southall dismisses as 'almost certainly' an overstatement, while acknowledging such practices existed, though in a smaller range.[100] Despite the availability of such technology, its application depended as much on the standards established by each type foundry. At Bauersche Gießerei, photomechanical scaling was a common method since the beginning of the century to simulate the appearance of a design at smaller sizes, yet merely as a reference before determining the necessary optical changes made to patterns for every single size (**fig. 5.43**):

> Modifications in size must not be executed mechanically. A typeface that looks good in its pilot size would appear much too tight if it were reduced to smaller sizes manually. Therefore, drawings from the pilot downwards must be kept wider and lighter step-by-step, while the opposite is the case for larger sizes.[101]

The same standards were held up at Stempel, where the degree of care and attention given to these steps was believed to determine the 'spirit of the type foundry leadership'.[102]

However, with the introduction of phototype Updike's worries became a reality encouraged by technology. In photocomposition it was possible to use one set of matrix-negatives for typesetting a full range of type sizes by adjusting the lenses of the device. As a result, the fixed sequence of sizes was replaced by a continuous sequence of available sizes. The main difference between so-called linear scaling and traditional optical scaling lies in the relationship between each of the weights in that continuous sequence: in linear scaling a 6-point type is exactly half of the 12-point, exactly 50% in each of its typographic parameters; in optical scaling, particularly the enlarged x-height provides the necessary optical adjustment to

98 Updike 1923, p. 11.

99 Ibid., p. 12.

100 Southall 2005, p. 48.

101 Bauer 1960, p. 9. Translation by the author of the original German: 'Die Veränderungen der Größe dürfen nicht mechanisch vorgenommen werden. Da eine im Normgrad gut aussehende Schrift bei mechanischer Verkleinerung in den kleinen Graden viel zu eng wirken würde, muß die Zeichnung vom Normgrad abwärts stufenweise weiter und lichter gehalten werden, während für die größeren Grade das Umgekehrte gilt.'

102 Windisch 1953, p. 13.

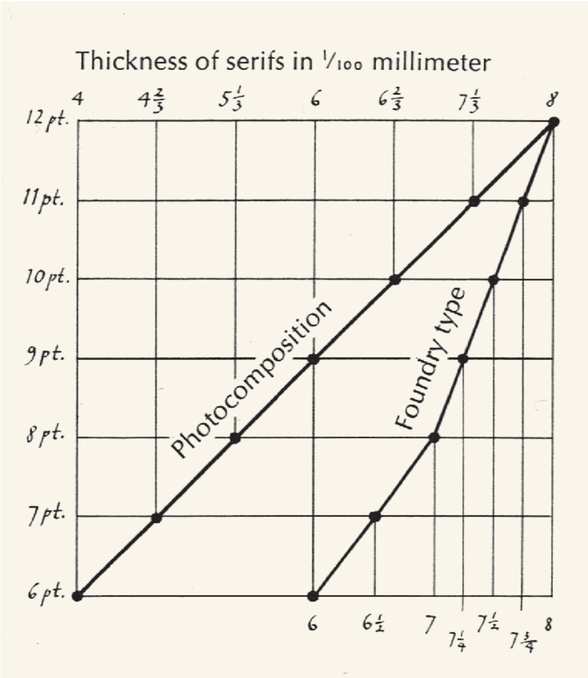


Fig. 5.44 Diagram of the relationship between point sizes in typefaces developed for photocomposition in comparison with foundry type. Reproduced from Zapf 1987, p. 70.

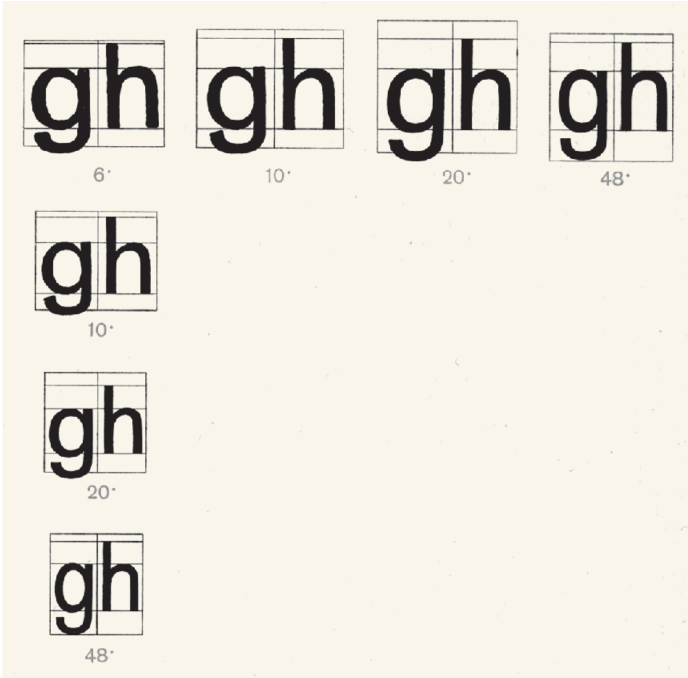


Fig. 5.45 Gerstner's analysis of optical sizes in Akzidenz Grotesk: different sizes shown in the same size for comparison (top to bottom); the same letters adjusted in height (left to right). Reproduced from *Der Druckspiegel* (supplement), June 1963, p. 6.

Technische Daten — Schriften — Größen in Punkt — 5 Zeilen — Seite 11								
Größen in Punkt								
Schriftgrößenbereich I	4	4 1/2	5	5 1/2	6	7	8	9
Schriftgrößenbereich II	8	9	10	11	12	14	16	18
Schriftgrößenbereich III	16	18	20	22	24	28	32	36
Schriftgrößenbereich IV	32	36	40	44	48	56	64	72

Technische Daten — Schriftauflösung (pro Geviert — 4 Zeilen — Seite 11		
Schriftgrößenbereich I	(4— 9 Pkt.)	50 × 120 Bildelemente
Schriftgrößenbereich II	(8—18 Pkt.)	100 × 120 Bildelemente
Schriftgrößenbereich III	(16—36 Pkt.)	200 × 240 Bildelemente
Schriftgrößenbereich IV	(32—72 Pkt.)	400 × 480 Bildelemente

Fig. 5.46 Type size ranges *(Schriftgrößenbereiche)* and respective resolution of picture elements *(Bildelemente)* employed at Hell. Reproduced from *Digiset 40 T1* (brochure), October 1971.

merely appear half the size, while remaining legible.[103] Visualized in a diagram, this results in a perfectly mathematical diagonal versus a steep curve (**fig. 5.44**).

According to Savoie, similar to the situation in hot metal described above, the reconsideration of optical sizes in phototype depended on the preferences established by each individual manufacturer.[104] Linotype supplied patterns for three different size ranges for its Linofilm machine, labelled 'A' (for size ranges 6–12 point), 'B' (12–18) and 'C' (18–36), but ultimately the majority of customers was unwilling to pay separate fees for each set and was typically satisfied with 'B', while using it for the full range.[105] It was no longer exclusively about what the manufacturers offered, but what the market demanded and whether the users of type held up the same standards as their creators.

One of the most considered and careful reinterpretations of a metal typeface with a messy history for phototype composition presents itself in Karl Gerstner's rendition of Akzidenz Grotesk for Berthold's Diatype machine. In a very detailed published proposal, Gerstner outlines several typographic aspects that he felt had been lost in the transition to phototype, including a thorough examination of appearance changes in relation to size (**fig. 5.45**).[106] Ultimately, many of these aspects fell short in the new typeface known as Gerstner Programm, released in 1967, which shows that awareness of quality issues alone could not overcome the constraints of the available technology.

As has been explored in 4.1.1, optical sizes were initially reinstated by Hell as a result of designs that needed to be resolution-specific on the Digiset. By the early 1970s, Hell had established a system of four *Schriftgrößenbereiche,* type size ranges that covered the sizes 4 to 72 point in total, with implications for the number of pixels within each range (**fig. 5.46**, see also 4.1.1). In this regard, native bitmap-editing (without being rasterized from an outline description in a previous step) is closest to the notion of size ranges cut from a set of available patterns. However, the time and cost involved in preparation of these sizes was unreasonable in comparison to the limited resolution, which is one of the reasons Hell sought collaboration with URW.

With the discovery of straight-line vector formats as a numerical description of letterforms, the consideration of separate designs for specific sizes was rooted in the limitations of the mathematical polygons: if small sizes are scaled up, their line-segments would unfavourably show, if larger sizes with multiple segments were scaled down, their data storage would be unreasonably high. When Mathews, Lochbaum and Moss presented their approach to polygonal outline description in 1967 (see 4.1.2.), the 'three fonts of computer-drawn letters' were therefore three

103 Zapf 1987, p. 69 f.

104 Savoie 2014, p. 265.

105 Ibid., p. 273.

106 Karl Gerstner, 'Die alte Akzidenz Grotesk auf neuer Basis', supplement 'Typografische Beilage 6', in *Der Druckspiegel,* June 1963, pp. 5–9.

Fig. 5.47 Sumner Stone's design of the ATypI logotype for the 1983 working seminar, seen here rasterized in four different resolutions. Reproduced by Stone from his original slides [SSt].

different sizes of the same design (Baskerville) intended for footnotes, for main text and titling.[107] Hershey's principle of three different kinds of overlapping vectors seems to follow this idea as well. This technological limitation is likely the reason why Wiseman et al. make no mention of display type in Elf and why polygonal outline description was soon superseded by splines.

With these challenges in mind, the impact of spline-based outline description and its resolution-independent ability to linearly scale to any desired size somewhat side-lined the traditional standard of optically sizing designs. During the early years of this transition, attention was directed towards the necessary adjustments to multiple rasters for different resolutions; one pressing issue relegated another in the background. This sentiment is quite present in the development of Matthew Carter's Galliard (also discussed in 4.2.5). As a trained punchcutter, Carter was of course more than familiar with the notion of optical sizes, however, in Galliard this features remains largely absent. As with any revival or reinterpretation that is based on historical models, the considerations of rendering specific sizes of an existing design plays a crucial part in this process. Carter and Parker selected a pair of roman and italic that Granjon had cut in the body size 'Ascendonica', equivalent to 20 point according to Carter.[108] In any case this was a comparably large model, but given Carter's objective that Galliard should 'gain a footing in advertising typography' this consideration seems reasonable.[109] Carter insists that the released version of Galliard is a 'fairly complete family'; there was an emphasis on the extension of weights and the inclusion of small caps, flourished characters, accents etc., but not on different sizes.[110]

In the early 1980s, type design for low-resolution output devices captured most of the discourse — as mentioned before, the issue was particularly visible in Sumner Stone's design for the announcement of the 1983 working seminar (**fig. 5.47**). Rasterizing from existing type descriptions is system-dependent; each of the five digital type design systems had developed its own method (see 4.2). Breaking up the character images into a raster of horizontal and vertical lines runs smoothly in all areas that have 90-degree-angles, but it is in diagonals and especially in curves where information loss occurs. While this issue is relative at high resolutions (a large number of bits can be distributed about the shape, even imitating smooth contours),

107 Mathews 1967, p. 346.

108 Carter 1985, p. 88. According to Updike, Ascendonica was the Italian name assigned to 22 point, while the name of the 20-point body was Parangone/Parangone in most European languages, see Updike 1923, p. 27.

109 Carter 1985, p. 91.

110 Ibid., p. 97. At the end of Carter's presentation, his sensitivity towards differences in size is demonstrated in a class assignment at Yale in November 1980: on the basis of a 12-point drawing of Galliard, students made necessary adjustments 'with narrower characters and thinner hairlines specifically for use at poster size'. Although the resulting Poster Galliard was not released, Carter presented it in his 1983 talk.

this becomes a significant challenge at low resolutions (fewer bits to describe the character shapes). If a pixel only barely fits into the imposed raster, it is discarded by most systems, which can result in deformation. Therefore, the loss of information has implications not only on maintaining the original character appearance, but on legibility.

Some of the methods to overcome these challenges have been laid out in chapter 4.2. Bigelow's second article in the *Seybold Report* also provides an overview of challenges and discusses the ability to remain faithful to the original appearance of a design, as intended by the type designer, across linear sizes, weights and resolution.[111] Manufacturers were most concerned with the ability to adapt existing designs to the new technology in light of the constraints and compromises forced upon them, to which Bigelow responds:

> Two of the type faces that you will see in mid- to low-res versions are Times Roman and Helvetica. These designs were excellently suited to the analog technologies of their day, but they are not necessarily well suited to digital technology. Their adaptation to digital systems is a result more of cultural inertia than of consideration of digital design needs.[112]

The discussion that followed at Stanford eventually shifted towards the need for new designs. The dialogue between Unger and Zapf in their respective talks with regard to Optima, 'reduced to heart-breaking compromise', underlines the new direction (see 3.4.3).[113] Bigelow & Holmes' Lucida, which was designed to overcome some of these limitations and Carter's Bitstream Charter are examples of typefaces, developed with the challenges of emerging low-resolution output devices in office spaces in mind. The design process of Charter is documented in detail by Caflisch.[114]

Aside from releasing a series of new typefaces for the new technology, following the Stanford seminar, Bitstream also equipped Camex LIP with the most impressive repertoire of routines that maintained control of the positioning of the raster and offered solutions to manual bitmap editing as well as automated processes (e.g. 'half-bitting', see 4.2.5). This is also a reminder that while URW was mostly concerned with cutting friskets from numerical data during the first two years of its business and only began to consider challenges of rasterization through their collaboration with Hell in 1976, Bitstream employed rasterizing techniques through a built-in RIP from the start.

With all the attention directed towards the issues of resolution, the concern for optical sizing was postponed until better solutions became available. From the point

111 See Bigelow 1982.

112 Bigelow 1982, p. 17.

113 Zapf 1985, p. 29.

114 See Caflisch 1988.

of view of engineers who implemented and built these solutions, Rubinstein provides an explanation why one quality was favoured over another:

> Engineering is compromise, finding good trade-offs among the various aspects and characteristics of a product. Printing technology is no different. Any machine for making letterforms represents a set of choices that favors certain properties to the detriment of others. The process of designing printing and publishing equipment forces engineers to make choices that affect the cost, quality, and effectiveness of the resulting designs.[115]

While the industry was concerned with resolution, the discussion on optical sizing continued in academia. Knuth's Metafont could generate optical sizes by considering a complex structure of several simultaneously applied parametric variations. In fact, Knuth claims, one of the reasons of working in parameters in the first place was to 'keep the letters readable as the type sizes changes'.[116] Although the principle of adjusting these parameters is applied in Knuth's 1982 article as the type sizes change with every other paragraph, the legibility is not particularly improved.[117] Michael McPherson suggests that size variations within a family should be designed individually from the available 'transformation' modifications as separate fonts.[118] This approach is not dissimilar to Knuth's understanding of parameters, although McPherson may not have been familiar with Metafont at the time.[119] McPherson's suggestion sound like a proposal for multiple patterns, however, he suspects that the cost of manufacturing and the cost of additional memory storage on typesetting machines could prevent such an approach from being feasible.[120] McPherson also imagines these changes ('esthetic adjustments') to be carried out in an a separate programme, but concludes that such a development from manufacturers was unlikely unless typographic designers demanded it,[121] i.e. only users of type who had previously rejected such aspects of typographic quality could reclaim them.

Bigelow, who co-supervised McPherson's thesis, argues similarly in the first of two articles in the *Seybold Report* in 1981: in what can be described as a call in favour of reconsidering optical size compensation, Bigelow portrays sizing as the greatest 'two-edged sword' in the transition from hot metal to photocomposition.[122] He claims that while manufacturers made some effort in offering slightly optically adjusted sizes (he uses the example of Linotype's optical size range of A, B and C —

115 Rubinstein 1988, p. 40.
116 Knuth 1985, p. 37.
117 See Knuth 1982.
118 McPherson 1979, p. 36.
119 Knuth's work on Metafont is not covered in McPherson's thesis (1979).
120 McPherson 1979, p. 36.
121 Ibid.
122 Bigelow 1981, p. 10.

Fig. 5.48 In Bigelow's use of the illustration in his 1981 article in the *Seybold Report* (vol. 10, no. 24), the point-size indications were absent. Reproduced from Karow 2013, p. 36.

see above) even though machines existed that could produce the entire range from a single master, it was their customers who did not appreciate this possibility enough 'to make this trade-off':

> We must clearly understand that the fact that a machine is capapble of doing this does not mean that the user is *compelled* to use it in this fashion.[123]

Bigelow declares optical sizes a sign of quality and aesthetics that was either valued by the users of type or not. With regard to digital type, he extends his criticism towards manufacturers who did not offer more than one master size, even tough there was no technical reason not to.[124] Through the example of a type specimen by URW, Bigelow makes a proposal for a 'computer-aided design compensation for scale'. The specimen is an interpolation of ten instances of the same word between two masters, the typeface in use is Albert Kapr's Leipziger Antiqua (**fig. 5.48**).[125] With each line from top to bottom, the words increase in character width in relation to a slight, but gradual increase in weight and character spacing, analogous to the necessary optical adjustments when size decreases — except for a change in x-height. For comparison of these modifications, all lines are adjusted in cap height. Bigelow suggests that this approach may be 'the best hope for "optically corrected" designs in the future'.[126]

Interestingly this proposal is nowhere to be found in URW's promotional material at the time. The Ikarus brochure that was also distributed at the 1983 working seminar includes examples of character modification, e.g. contouring, expanding, condensing and interpolation, but does not explain how these features could be used to achieve Bigelow's idea of 'compensation for scale'.[127] A simplified version of the Leipziger Antiqua specimen (showing five lines of type instead of twelve) illustrates the articles by Elsner (1980) and Daines (1981), but no mention of optical size. According to Karow, his improvement of automated kerning, developed in 1982, considered different kerning values depending on the intended type size.[128]

In 1987, Bridget L. Johnson, a student at RIT concluded that little work had been done to combine optical scaling with the abilities of digital type design systems, i.e. to 'automatically perform nonlinear scaling of a reference character' and offered her own worked-out mathematical model for scaling of letterforms.[129] Karow was

123 Bigelow 1981, p. 10.

124 Ibid., p. 11.

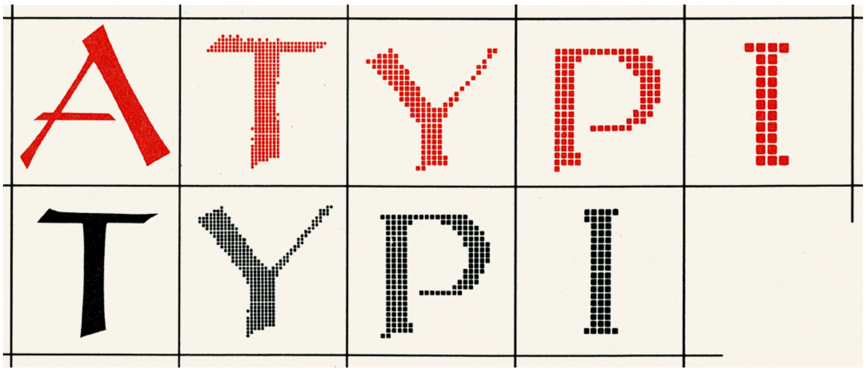
125 Albert Kapr's Leipziger Antiqua was released by Typoart Dresden for metal type in 1971 and was among the first to be digitized after Ikarus was employed by the East German manufacturer in 1978. See 4.2.4.

126 Bigelow 1981, p. 13.

127 See URW 1983.

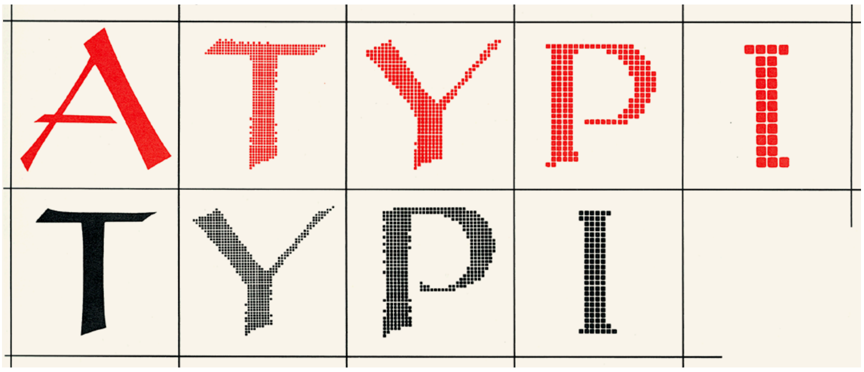
128 Karow 2019, p. 99.

129 See Johnson 1987.



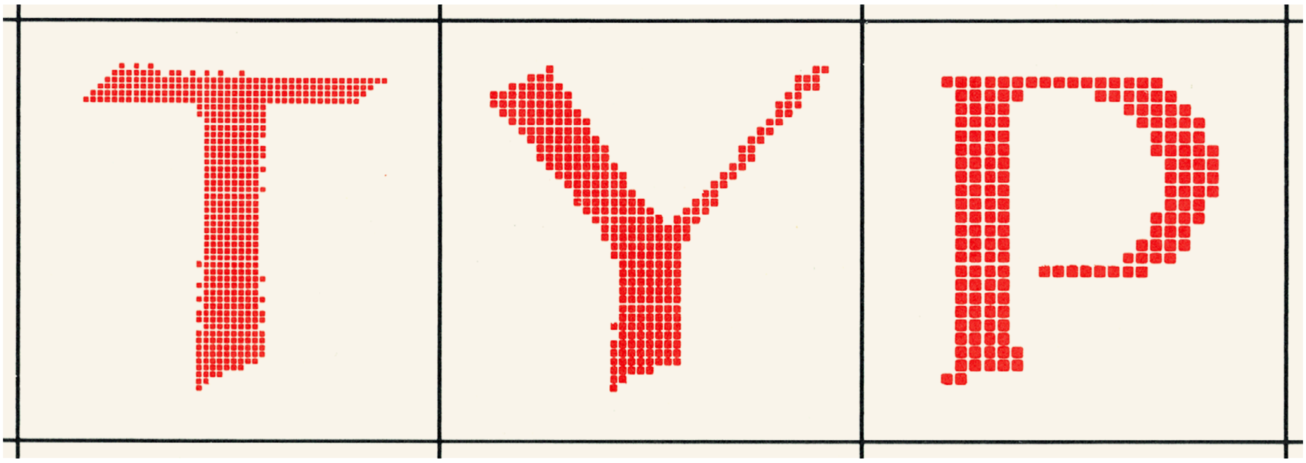
(1)
100%

A B C D E



(2)
40% of the
original
size below

(2)
100%



B C D

Fig. 5.49 Sumner Stone's logotype for the announcement of the 1983 ATypI working seminar addresses the relationship of letterform rasterization and size as it considers the design's use in two applications of significantly different sizes: on the programme cover (1) and on a poster (2). A closer look reveals that the letters in positions B, C and D are different in the two versions. While the vertical strokes of D are three pixels wide in (1), they are four pixels wide in (2). The original solid letters (A) and the most extreme level of rasterization (E) remain the same in both versions. As a result, the pixel 'gradient' is not as smooth in the poster size. However, at first glance one tends to compare the extremes and might not recognize the differences, which could be a design decision. Reproduced by the author from original prints [FU].

familiar with Johnson's work,[130] and revisited his own interest in optical sizes in collaboration with Adobe in the early 1990s, which led to the filing of a patent in 1993 — with an illustration of the full version of the Leipziger Antiqua specimen.[131]

In the early 1980s, rasterizing made the most noise, but with improved resolution in screens and office printing some of the issues received less attention. Issues of low resolution were a snapshot of concerns based on the available technology at the time. At the 1983 Stanford seminar, the issue of optical sizing in relation to rasterization for specific application was present in the most prominent way: in Sumner Stone's design for the announcement of the 1983 ATypI working seminar, through a detail that may have been unnoticed by most attendees, visible only to the keen eye. In consideration of the logotype's use in the printed programme (9⅜ × 6 inches, and later for the cover of the published proceedings) as well as on a poster, Stone prepared two separate final artworks in relation to 'the progression of bit maps' (**fig. 5.46**, Stone's considerations are discussed in the caption).[132]

130 Karow dates Johnson's thesis to 1994 (see Karow 2013, p. 51), however, Johnson's work was completed six years before Karow filed his patent (see next footnote) in 1993.

131 US patent no. 5,577,170, filed 23 December 1993. A summary of Karow's basic concept is published in Karow 2013, p. 35.

132 Stone 1985, p. 4. Stone credits Bigelow and Stauffacher for advising him on these design decisions.

5.2.4. Inheritance and change of terminology

Every new innovation is accompanied by new words that describe it. When new tools are introduced to a current technology, then those words are added to an existing vocabulary and grammar. However, from today's standpoint we can conclude that most of the terminology in the disciplines of type and typography are informed by the traditions of metal type and letterpress printing. 'Leading' is a valid term to describe space measured between the bodies of type as opposed to 'line-spacing' (measured from baseline to baseline), even though there is no lead involved in the process ('pixeling' would be an accurate, but misleading description). Similarly, 'retouching' survived the transition to digital photography, although the term has little to do with the analogue technique of the 1920s.

In the early 1980s, the survival of these terms were still being negotiated. Ruggles called for an analysis of a 'digital grammatology'.[133] Throughout the phototype era and in the early transitional period of digital type, the design community debated whether to preserve words, reconsider meaning and introduce new terms to the typographic discipline, a discussion that was still ongoing at Stanford in 1983. When the introduction of photocomposition called for a reconsideration of sizing, Zapf demanded:

> The lack of limitations in reduction and enlargement create interim sizes which certainly cannot be classified into the usual range of sizes. We need a new language and new terms.[134]

Eventually (not because Zapf demanded it), the naming convention of specific sizes (see 5.2.3) became obsolete and remains an entry in selected type history books. This was an example of the community abandoning terms when they are obsolete and no longer needed.

At the 1969 ATypI congress, Wim Crouwel went even further and questioned whether the term 'typography' could at all be sustained.[135] In his talk, Crouwel speaks of the 'cell principle', declining 'cells', 'nuclei', and 'units' only to admit a few lines down, 'I use the expression "dots" as an example for convenience sake'.[136] Neologisms were not very convenient and therefore not crowned with success. Bigelow's made-up words (ductal, glyptal, pictal) introduced throughout this thesis, served their educational needs at the time, but found little or no acceptance

133 *Grammatology* is a term established by linguist Ignace Gelb in 1952 to describe the scientific study of writing systems or scripts.

134 Zapf 1987, p. 69.

135 Crouwel 1970, p. 58.

136 Crouwel 1970, p. 54.

among the community.[137] And Kathleen Carter's generic use of 'line chains' is forgotten in favour of the mathematical description of 'polygons'.[138]

The typographic community was more appreciative of 'transitional terms' such as 'digital type foundry', prominently used to introduce Bitstream at the 1983 working seminar.[139] While it signals praise for the new technology, it also preserves the original craft, analogous to the digital pianos of the 1980s that merely emulate the sound of traditional acoustic pianos, but pianists can perform on them as they did on a grand piano. No alloy of antimony and lead is pured into a mould today, but the term 'type foundry' is as common as ever; indeed, as digital technologies become ubiquitous, the prefix 'digital' is omitted, sometimes 'type' is omitted as well.[140]

As highlighted in chapter 3, the search for a new language coincided with ATypI's efforts to preserve standards, while establishing new ones. Meanwhile, *Visible Language* editor Merald Wrolstad sought to find a common terminology that would unite his readership of practitioners and scientists; existing loanwords were more likely to be accepted in the neighbouring discipline. As Tracy recalls, with the introduction of the CRT, 'resolution' was added to the vocabulary of the discipline.[141] Bigelow refers to them as 'exotic terms', words that mostly stem from a 'jargon from the realm of digital image processing',[142] but ultimately it was these terms that found most use. URW, originally a group of physicists, decided to use the 'technical terms of the trade' (meaning the typesetting trade) in order to gain acceptance in an existing market.[143] Karow's 1987 publication on *Digital formats for typefaces* offers a glossary in English, French and German, which demonstrates a mix of mostly traditional terms, while adding some vocabulary from the domain of engineering.[144]

As has been explored in 3.4.2, the 1983 working seminar was probably the first ATypI event that ended the multilingual tradition of simultaneously translated presentations and initiated the convention of conferences held almost exclusively in English, a development that was favoured by the predominantly US American manufacturers of computers and software.[145] As anglicisms of specialist termino-

137 Bigelow continues to use 'mosaic' for bitmaps today, see Bigelow 2020.

138 Carter 1986, p. 97.

139 Used by Bigelow to introduce Bitstream, see 3.4.3. The term was previously used by editor Jonathan Seybold in the introduction to Bigelow's second article in the *Seybold Report,* see Bigelow 1982.

140 See 'Process Type Foundry' by Nicole Dotin and Eric Olson, 'Black Foundry' by Grégori Vincens and Jérémie Hornus or 'Just Another Foundry' by Shoko Mugikura and Tim Ahrens.

141 Tracy 1986, p. 43.

142 Bigelow 1982, p. 3.

143 See *Signus* brochure, URW c. 1983 [CC, CSC 030, box 2, folder 9].

144 Karow 1987, pp. 172–179.

145 It took well into the 2010s for typographic conferences in other languages to reach global prominence.

logy entered other languages across the globe, traditional terms were being driven out. While the German names of typographic styles and weights, like *schmalmager* (light condensed) and *halbfett* (medium), were still present in Berthold type specimens during the mid-1980s, they disappeared towards the end of that decade and have been largely forgotten today.[146]

Lastly, the dematerialization of the discipline has changed the meaning of specific terms: although leading remains in the accepted grammar, it is often used synonymously with line spacing, although it has a different meaning. The same is the case for kerning and spacing, because their physical effects were not preserved in the words. The early digital type period laid the foundation for this mix of inherited, loaned, invented and crossbred words. It is hoped that more light can be shed on these aspects, while also considering a linguistic approach, in the future.

146 Comparison of random Berthold specimens from the 1970s, 1980s, and 1990s.

5.3. The aftermath: PostScript, new font editors and the 'Font Wars' for further research

By 1984, one year after the Stanford working seminar, the established environment of proprietary systems that has been explored in this thesis was significantly challenged by the introduction of personal computers and Adobe's PostScript language,[147] a convergence of much-improved GUIs with a page- and letterform-description language. In an industry previously dominated by stand-alone solutions, PostScript served as a connecting language between devices; its implementation in Apple's LaserWriter in 1985, in word-processing and layout tools for digital 'desktop publishing' (DTP) paved the way for success. Daines identifies the Macintosh, the LaserWriter and PostScript as 'the three most important elements of the dtp revolution',[148] but it is crucial to consider third-party software as a significant fourth element on that list. This subsection considers all of these components that were introduced from 1984 onwards for further research and, in keeping with John Dreyfus' phrase, thus portrays another 'turning point' in type design (see 3.4.3).

Adobe and PostScript

After leaving Xerox PARC in December 1982, John Warnock and Charles Geschke founded Adobe Systems in Mountain View, California. The formation of Adobe and its rapid expansion were covered at the time,[149] while the early years have also been documented by the company itself recently.[150] Following Warnock's and Geschke's involvement in the development of early page description schemes including JaM, Press and Interpress at PARC (see 4.2.3), the partners and their team eventually developed the entirely new page description language (PDL) PostScript at Adobe. A technical comparison between these PDLs is provided by Oakley and Norris, who identify the handling of fonts as a key ingredient of PostScript and as one of its distinctions from Interpress:

> The two languages also differ in their treatment of character information. The Interpress standard does not refer to fonts whereas PostScript has a powerful font strategy using mathematical outlines.[151]

147 The spelling of PostScript et al., is referred to as 'CamelCase', the practice of capitalizing the first letter of words in a phrase, replacing word spaces. Its origin has been traced to the missing underscore key (to separate words in file names) on the Xerox Alto keyboard. See Maier 2009, p. 365.

148 Daines 1993, p. 80 f.

149 See for example T. S. Perry, 'PostScript prints anything: a case history', in *IEEE Spectrum,* vol. 25, no. 5, May 1988, pp. 42–46.

150 See Tamye Riggs's illustrated ten-part series 'Celebrating 25 years of Adobe Originals' on <blog.typekit.com/25-years-of-adobe-originals/> (last visited 14 April 2023).

151 Oakley/Norris 1988, p. 87. Bigelow suggests that Warnock and his Xerox PARC colleague Douglas Wyatt had already presented a 'device-independent imaging model' that handled font characters as 'shapes' during the 1982 SIGGRAPH conference, see Bigelow 2020, p. 21.

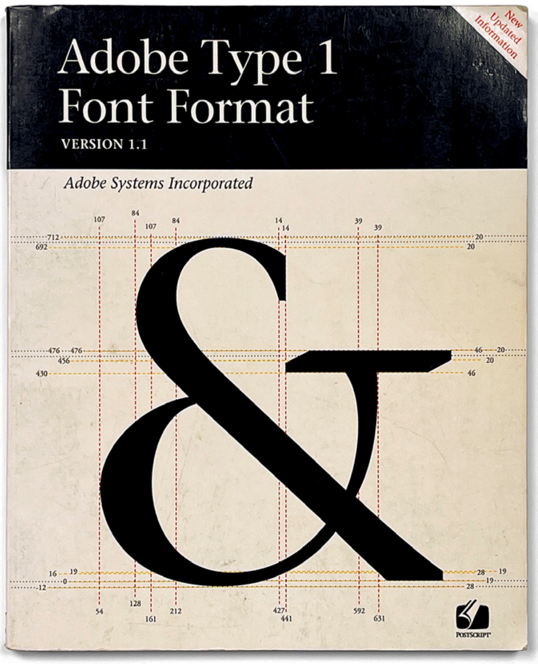


Fig. 5.50 Adobe Type 1 technical manual, first printing August 1990. Photographed by the author [PvB].

Fig. 5.51 Apple LaserWriter. Photographs by Norman Posselt [MoP].

PostScript is a device-independent language that mediates between document composition systems and output devices, e.g. numerically describing text and graphics of a digital layout and then rasterizing that data through a PostScript-interpreted RIP in a laser printer. Essentially, any output device could be utilized if their manufacturers licensed PostScript. It has been suggested that while printer manufacturers would have had little interest in such a standard, it had to come from an independent third party like Adobe.[152] Furthermore, Adobe uses Postscript to describe letterforms for which they utilized cubic Bézier splines early on as the outline description model stored in their own font format called 'Type 1' (**fig. 5.50**):

> This language unifies text and graphics by treating letter shapes as general graphic objects. Since letters are used so frequently in printed images, the PostScript language has special operators to handle collections of letter shapes conveniently. These collections are called fonts; each font usually consists of letters and symbols whose shapes share certain stylistic properties.[153]

Eventually, digital type became an integral part of Adobe's business model: in order to use Type 1 fonts, a company had to license PostScript. Apple's interest in Adobe was manifested in the implementation of a PostScript interpreter in the LaserWriter, Apple's first laser printer that was launched in March 1985 (**fig. 5.51**). As a part of this deal (for which Apple paid royalties for every printer sold) Adobe provided a set of core Type 1 fonts.[154] The series comprised different type genres, e.g. Helvetica as the default sans serif and Times as the main serif face, etc. (also see **fig. 4.88** for comparison with the Alto font set). Following this prominent deal, the PostScript language became widely adopted.[155] Credit for this rapid success must also be given to the *PostScript Language Reference Manual*.[156]

In 1984 Adobe hired Sumner Stone as Director of Typography (he joined them as employee number 25).[157] Stone proposed that in addition to overseeing the digital revival of typefaces, he wanted to build a team and and establish a library of new original designs.[158] Before his previous one-year stint at Camex, Stone had been in the position of type director at Autologic, where he had become familiar with the Ikarus system. Although Ikarus was not licensed by Adobe, they did acquire outline

152 Maier 2009, p. 377.

153 Adobe 1990, p. 2.

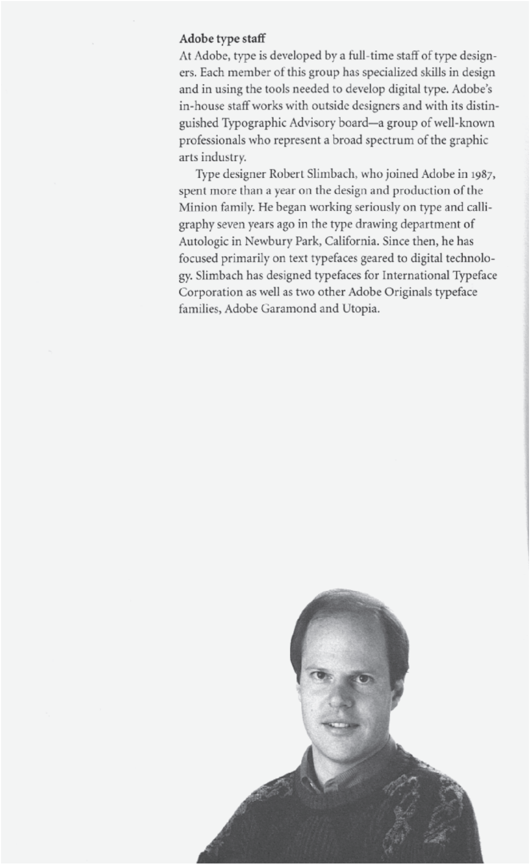
154 Wang 2013, p. 144.

155 In 1992 Adobe introduced the Portable Document Format (PDF), which became the standard for compressed document description, independent of operating systems and software.

156 See Adobe Systems Inc., *PostScript language reference manual,* Reading/MA: Addison Wesley, 1985.

157 See 2.3 for a short biography. Before Stone joined, Lynne Garell (a former student of Zapf at RIT) took care of typography at Adobe.

158 Sumner Stone in an interview with the author, 3 June 2016 [audio file, 00:45].

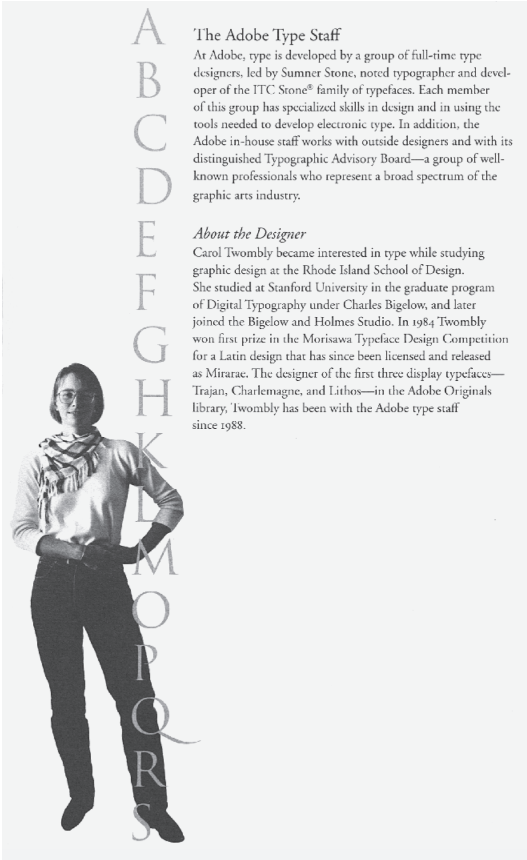


Adobe type staff

At Adobe, type is developed by a full-time staff of type designers. Each member of this group has specialized skills in design and in using the tools needed to develop digital type. Adobe's in-house staff works with outside designers and with its distinguished Typographic Advisory board—a group of well-known professionals who represent a broad spectrum of the graphic arts industry.

Type designer Robert Slimbach, who joined Adobe in 1987, spent more than a year on the design and production of the Minion family. He began working seriously on type and calligraphy seven years ago in the type drawing department of Autologic in Newbury Park, California. Since then, he has focused primarily on text typefaces geared to digital technology. Slimbach has designed typefaces for International Typeface Corporation as well as two other Adobe Originals typeface families, Adobe Garamond and Utopia.

Fig. 5.52 Portrait of Robert Slimbach. Photographer unknown, reproduced from *Adobe Originals: Garamond,* 1989.



The Adobe Type Staff

At Adobe, type is developed by a group of full-time type designers, led by Sumner Stone, noted typographer and developer of the ITC Stone® family of typefaces. Each member of this group has specialized skills in design and in using the tools needed to develop electronic type. In addition, the Adobe in-house staff works with outside designers and with its distinguished Typographic Advisory Board—a group of well-known professionals who represent a broad spectrum of the graphic arts industry.

About the Designer

Carol Twombly became interested in type while studying graphic design at the Rhode Island School of Design. She studied at Stanford University in the graduate program of Digital Typography under Charles Bigelow, and later joined the Bigelow and Holmes Studio. In 1984 Twombly won first prize in the Morisawa Typeface Design Competition for a Latin design that has since been licensed and released as Mirarae. The designer of the first three display typefaces—Trajan, Charlemagne, and Lithos—in the Adobe Originals library, Twombly has been with the Adobe type staff since 1988.

Fig. 5.53 Portrait of Carol Twombly. Photographer unknown, reproduced from in *Adobe Originals: Trajan,* 1989.

Fig. 5.54 Booklets of the *Adobe Originals* series include historical backgrounds, insights into the type design and font production process at Adobe as well as several specimen pages of the character set and of the typefaces in use. Some of the booklets were compiled with the help of Advisory Board members. Photographs by the author [FU].

data from URW for further production.[159] Karow later admitted that initially URW did not suspect that Adobe would 'destroy the perfect world of proprietary systems in the type industry within just a few years'.[160] Despite this 'turning point', URW's digital outlines were still considered to be of the highest quality.[161]

While also finishing his own first commercial typeface family ITC Stone (see 5.2.1), Stone conceptualized a type library that was comprised of both digital revivals and new original designs called 'Adobe Originals'. He hired type designers Robert Slimbach in 1987 (**fig. 5.52**) and Carol Twombly in 1988 (**fig. 5.53**) to join the department;[162] their names have become inseparable with many of the typefaces released in the Originals series. Myriad, co-designed by Slimbach and Twombly, became Adobe's signature typeface for coming decades. For each typeface of the Originals series, Adobe issued a type specimen booklet that contained an essay about the design process and an introduction of the designers (**fig. 5.54**). The company periodical *Font & Function* was published regularly in the tradition of ITC's *U&lc*.

Font production steps were carried out in-house at Adobe: especially 'hinting', the use of numerical instructions for the adjustment of outlines in correspondence with the rasterized grid on low-resolution screens, became one of the main tasks at the type department. As neither Ikarus, nor any other commercial font software were used at Adobe during the early days of the type department, the team implemented its own tools and procedures: programmer William Paxton, who had been involved in the making of PostScript, developed hinting software as well as an in-house Bézier-based outline drawing tool — eventually released as a commercial software product known as 'Illustrator' in 1987. As Stone recalls:

> We used an editing system, through which we basically entered many points on the outline — it was brute-force. Then I redrew it on the computer, I made pencil drawings first and then scanned them. But we did not really *draw* — we did not have a template for that — we just ended up entering many points to the outlines. Illustrator, however, worked beautifully to design individual characters. [...] I think most of the typefaces were begun on Illustrator at that stage: individual characters were drawn and then transported into the editing software that we used.[163] (**fig. 5.55**)

159 Ibid. [32:50].

160 Karow 2019, p. 110.

161 Wang 2013, p. 144.

162 Twombly joined Adobe as a young, but experienced designer: as a graduate of Stanford's Digital Typography, after which she worked at Bigelow & Holmes. Her typeface Mirarae received the first prize in the 1984 Morisawa Typeface Design Competition, in 1994 she received ATypI's prestigious Prix Charles Peignot. See Stock-Allen 2016 for a detailed biography.

163 Sumner Stone in an interview with the author, 3 June 2016 [audio file 01, 19:15].

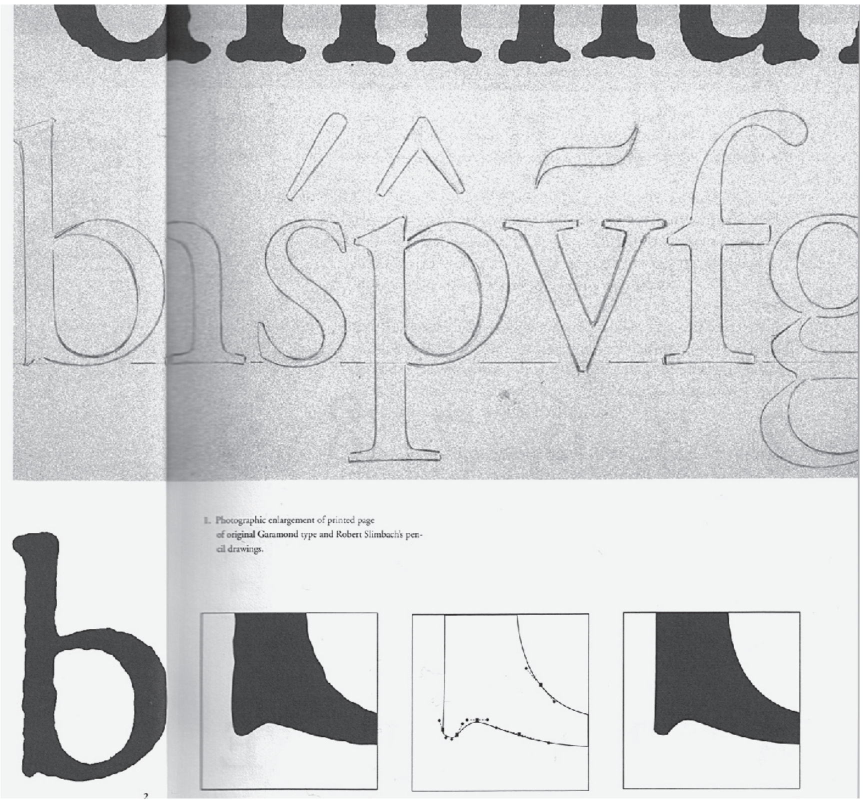


Fig. 5.55 The process of reviving Garamond at Adobe visualised: from enlarged original proofs (Egenolff-Berner specimen, 1592) to Slimbach's pencil drawings below. The bottom frames show outline tracings using Adobe Illustrator. Reproduced from *Adobe Originals: Adobe Garamond*, 1990.

Fig. 5.56 The Adobe Type Advisory Board, FTTB and FLTR: Stephen Harvard, Roger Black, Lance Hidy, Alvin Eisenman, Sumner Stone, Jack Stauffacher, in 1988. Photographer unkown, reproduced from <blog.typekit.com/25-years-of-adobe-originals/> (last visited 14 April 2023).

Fig. 5.57 Jack Stauffacher, Sumner Stone and Hermann Zapf on Stone's farm in Capay Valley, California. Photograph by Dennis Letbetter, September 2001.

In order to position Adobe in different fields of the industry, Stone established the Adobe Type Advisory Board, a group of experts with different backgrounds who would advise the department on the kinds of typefaces that might be needed in their respective domains.[164] The board included members such as editorial designer Roger Black, head of the Yale graphic design department Alvin Eisenman, type critic Max Caflisch (see 3.3) and typographer Jack Stauffacher (**fig. 5.56**). Stauffacher, who was open to digital technologies, gathered that digital type foundries with no history in metal type manufacturing were seeking affirmation from representatives of that era.[165] At the same time, experts like Bigelow and Stone had a genuine interest in the continuation of certain typographic traditions and cultivated friendships with Stauffacher, Zapf and others (**fig. 5.57**).[166] Stauffacher's design of the 1983 working seminar announcement and poster (using Stone's logotype) is a reflection of that relationship.

The developments at Adobe are central to an exploration of the discourse in digital type during the period after the 1983 Stanford seminar. Adobe's business model, the significance of digital type to the success of PostScript and the relationships that Adobe formed with other companies are worth investigating further. Comparison with other PDLs (such as Imagen's Document Description Language and its corresponding conic-based font format) need to be included in that discussion. With regard to typeface protection it should also be mentioned that US copyright for a PostScript font was granted in 1989: although previous laws could neither secure the design nor the encoded data of its appearance, Adobe convinced the US Copyright Office by demonstrating the uniqueness of different letter encoding[167]— further research is necessary to understand where typeface protection went from there.

Font editing on the personal computer

As has been alluded to in 5.2.1, faster processors and improved GUIs became significant preconditions for the development of new tools for typeface digitization and font production: the launch of the Apple Macintosh has often been portrayed as the initial impetus of this transition, but of course this development did not come over night. Apple co-founders Steven Jobs and Stephen Wozniak had gained some recognition with the personal computers Apple I (1976) and Apple II (1977), both of which still featured rather crude user interfaces. Only one year after the release of their less-successful office computer LISA (1983), Apple launched the

164 Ibid. [24:25].

165 From an informal conversation with Jack Stauffacher at his home in Belvedere/CA, 7 August 2016.

166 Bigelow & Holmes shared the same building with Stauffacher's Greenwood Press at 300 Broadway in San Francisco for several years (in the early 1990s, Spiekermann's agency MetaDesign opened an office there as well).

167 *The Seybold Report on Desktop Publishing,* vol. 4, no. 5, January 15, 1990, p. 35.

Fig. 5.58 1987 Apple Macintosh SE. Photograph by Norman Posselt.

Fig. 5.59+60 The 1984 Apple Macintosh desktop (left) in comparison with a detail of the 1981 Xerox Star graphical user interface (Xerox PARC), reproduced from Seybold 1984, p. 367.

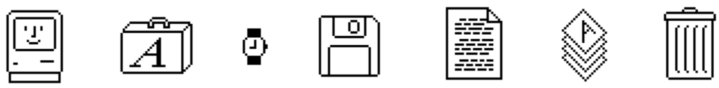


Fig. 5.61 Icons designed by Susan Kare for the Apple Macintosh desktop. Reproduced from www.kare.com/apple-icons (last visited 13 April 2023).

slightly smaller, fast and cheaper personal computer Macintosh in 1984. The Macintosh is best described as a team effort: e.g. its compact case, a nine-inch screen integrated into the body with a floppy disc port below, was designed by Jerry Mannock and Terry Oyama, and remained the iconic appearance for succeeding Macintosh generations until the early 1990s (**fig. 5.58**). The history of Apple is generally well documented, especially alongside biographies of Jobs.[168] More recently, the Steve Jobs Archive released a book in digital format in Jobs' own words, illustrated from archival resources.[169]

Like LISA before it, the Macintosh GUI featured a digital desktop interface of folder icons and files that open up in overlaying windows (**fig. 5.59**). Seybold suggests it was with the introduction of both of these computers that the impact of the Xerox Star (**fig. 5.60**) became visible.[170] However, Apple introduced a sophisticated set of icons to distinguish digital folders and files on the Macintosh desktop and took the selection of fonts to another level. Since 1983, Susan Kare had designed a vast collection of icons (**fig. 5.61**) and a set of bitmap fonts, each for a different size (based on pixel heights), named after different cities: Athens, Geneva, Monaco, San Francisco, etc.; Chicago became the 'system font' of Apple's operating system. Shortly before Licko, Kare used a bitmap font editor to create those alphabets and like Emigre's typefaces, they were revisited and revised in digital outlines years later (see 4.1.1).

The Macintosh was equipped with Apple word-processing software and with a drawing tool called MacPaint, but significant type design tools were first introduced by third-party developer Altsys, a company founded by James von Ehr in 1984. Their release of Fontographer in early 1986 marks the first commercial Bézier-based font editor that could produce PostScript fonts (**fig. 5.62**). Previously, Altsys had launched Fontastic, an editor of the native bitmap font format on the Macintosh (**fig. 5.63**). Hooked up with Metamorphosis (another programme by Altsys), users could import and adjust fonts in existing formats.[171] With the availability of personal computers such as the Macintosh, digital type design tools no longer consisted of a coherent system of interdependent hardware and software components, but all ran on the same operating system, making the term 'type design system' somewhat obsolete in favour of 'font editor'. This shift may also have favoured the every-day use of 'fonts' over 'typefaces' from thereon.[172]

168 See Walter Isaacson, *Steve Jobs,* New York City: Simon & Schuster, 2011.

169 See Leslie Berlin (ed.), *Make something beautiful: Steve Jobs in his own words*, <https://book.stevejobsarchive.com/> (last visited 13 April 2023).

170 Seybold 1984, p. 366. In 1989 Xerox filed a lawsuit against Apple on alleged copyright violation of its user interface. *The Seybold Report on Desktop Publishing,* vol. 4, no. 5, 15 Jan. 1990, p. 24.

171 Boag 1990, p. 18.

172 Kinross suggests that the traditional use of the term 'font' for 'a set of characters in any one size and style' broke down with the ability to numerically generate multiple styles and sizes from 'a single set of master characters'. Kinross 2010, p. 168 f.

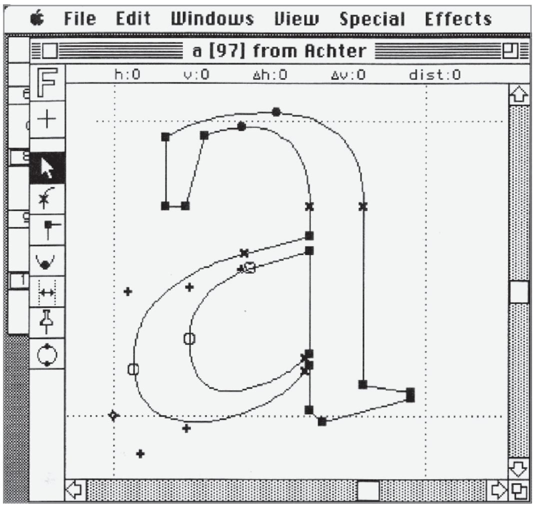


Fig. 5.62 Editing window in Altsys Fontographer. Reproduced from Maag 1989, p. 3.

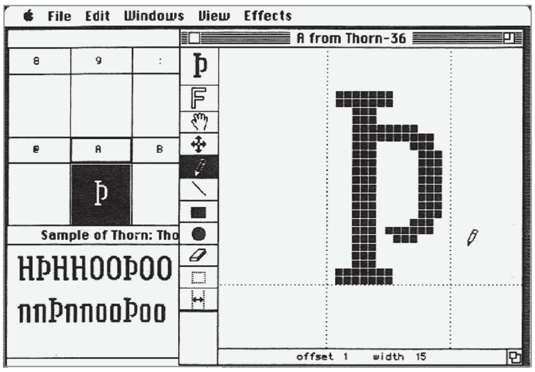


Fig. 5.63 Icelandic character ‘thorn’ designed in bitmap format in Altsys Fontastic. Reproduced from Michael Johnson, ‘Zeitgeist’ in *Typographic,* no. 40, August 1990, p. 9.

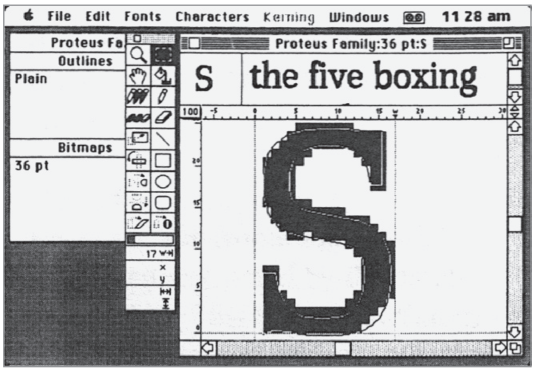


Fig. 5.64 In Letraset’s FontStudio a family of related fonts is accessible in outline and bitmap formats simultaneously, while a preview of sample text is always available. Seen here at the example of Freda Sack’s ITC Proteus. Reproduced from Boag 1990, p. 19.

Fig. 5.65 Aldus PageMaker on a Mac II. Photograph by Tilman Schwarz, reproduced from Erik Spiekermann, *Studentenfutter,* Nuremberg: Context, 1989, p. 122.

With the exception of Ikarus M (used with a tablet and digitizer, see 5.2.1), font editors on the Macintosh simply made use of a mouse and keyboard. URW first became aware of Fontographer at the 1986 Seybold conference in San Francisco, during which von Ehr visited the URW booth; as Karow recalls, 'after all these years, IKARUS now had a competitor for the first time' (he also refers to Fontographer as von Ehr's 'little IKARUS').[173] Users and critics of both font editors perceived 'two kinds of type design': Ikarus M as the appropriate solution to digitise analog drawings and Fontographer as the tool for free-hand work directly 'on screen'.[174] While Fontographer was considered easy to handle, because Bézier curves could create shapes in fewer points, the use of Ikarus M was considered less comfortable, yet praised for its precision.[175] Ultimately, key characteristics of both programmes were rooted in the underlying curve description: Ikarus M data had to be converted to PostScript, but Fontographer produced the native format.

More competition arrived when Letraset threw their hat into the ring in 1990: with FontStudio the former manufacturer of dry-transfer lettering launched a font editor that could import files, create outlines, edit bitmaps and offered kerning facilities, therefore combining many talents of the font editors mentioned above in one product.[176] In terms of its GUI, FontStudio followed the standards of those previous programmes (**fig. 5.64**). On a side note, according to Boag, FontStudio had been under development 'for some time' under the working title 'Fred Font Machine',[177] however, the use of the same name of the Xerox Alto Font Design system (see 4.2.3) may be unrelated. Nevertheless, Fontographer appears to have remained the dominant programme until it was displaced by FontLab (1993, of the company of the same name, who eventually acquired Fontographer).

The collective success of Fontographer et al. is manifested in the arrival of software for 'desktop publishing', a term that is said to have originated with Paul Brainerd, president of the software developer Aldus.[178] Fonts produced in all of the programmes mentioned above could be used in the design of documents with Aldus PageMaker, launched in July 1986 — like the font editors before it, its success was rooted in the native support of PostScript (**fig. 5.65**).[179]

The quadriga of PostScript, Apple's Macintosh and LaserWriter, and third-party software did mark another turning point: designers could design letterforms on computers that displayed those letterforms quite reliably and in real time, while

173 Karow 2019, p. 129.

174 Van Rossum 1990, p. 39. This critique is based on Fontographer version 3.0.

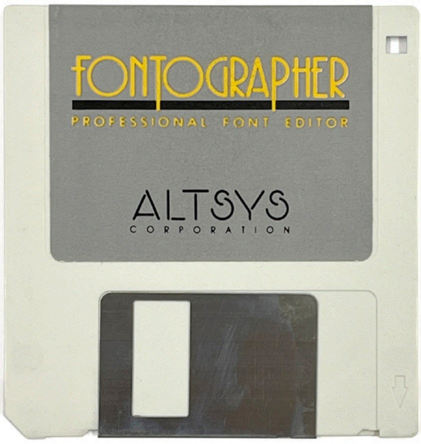
175 Ibid.

176 Boag 1990, p. 18.

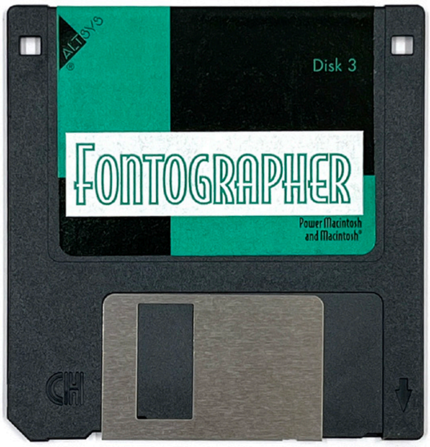
177 Ibid.

178 Kinross 1990, p. 169.

179 In 1987 an update to PageMaker supported PostScript fonts that were built into the Apple LaserWriter Plus.



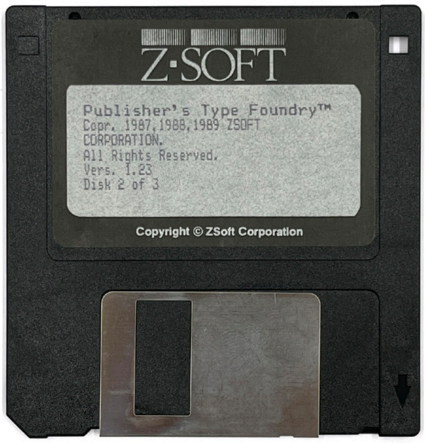
A



B

C

D



E

F

Fig. 5.66 [DTGC]

A Fontographer, Altsys, 1986

B Fontographer, Altsys

C Fontastic Plus, Altsys

D FontStudio, Letraset, 1990

E Publisher's Type Foundry, ZSoft, 1989

E Ikarus M, URW, 1989 [ES]

All photographs by the author.

printer devices provided proofs in the same office space — without consulting digital punch cutters and remaining independent of font manufacturers. Kinross explains that with this transition the grip of the 'old companies' was finally broken,[180] a process that has been described as an act of 'liberation' and as the 'democratisation' of type.[181] The discourse in digital type technologies continued, but it had matured: the availability of multiple competing solutions to designing type in mostly Béziers (but also Ikarus curves) supports the notion that the outline model was the most sustainable solution to numerical letterform description. While the community had agreed on a certain vocabulary (significant exceptions remained), the discussion shifted to different dialects of the same language (see below). The overview of digital type tools presented here is far from complete (**fig. 5.66**). In consideration of font editors that are in use today, it would be worth researching further, tracing their lineage starting in the mid-1980s, while considering the changes of interaction, user-interface and employment by different parts of the industry.[182]

The 'Font Wars'

Despite the notion of 'liberation' and 'democratisation' among independent designers, i.e. users of font software, competing PostScript-based formats and standards sparked a period of conflicts between manufacturers in the late 1980s and early 1990s, the most prominent of which has become known as the 'Font Wars'. Although PostScript was free to use by software developers for new applications, Adobe's font format Type 1 initially remained proprietary; manufacturers of personal computers and printers had to pay lisence fees for using fonts on their devices.[183] What's more, Adobe published the open PostScript format 'Type 3', which did not rasterise as well as Type 1, according to experts.[184] Kinross suggests that the conflict was rooted in an 'area of intersection' between the interests of manufacturing companies that deliver products and users of those products:

> The history of the PostScript page description language […] has demonstrated this pattern: from protection through code-encryption of typefaces and non-disclosure, and then to publication of this information, under pressure from commercial rivals.[185]

While some merely saw a business decision in this, Karow blames Adobe of having caused the 'so-called "Font War"'.[186] 'Pressure' came from Apple and Microsoft

180 Kinross 2010, p. 169.
181 'Liberation' is Kinross's term, 'democratisation' is assigned to Matthew Carter. Boag 1990, p. 3.
182 Although FontLab is still in use, the majority of type designers have shifted to Glpyhs, while a smaller, but not inconsiderable community uses the Python-based Robofont.
183 Wang 2013, p. 144.
184 Ibid.
185 Kinross 2010, p. 166 f.
186 Karow 2019, p. 110.

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TypeWorld®

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THE ONLY NEWSPAPER FOR WORD PROCESSING, TYPESETTING AND GRAPHIC COMMUNICATIONS

Hampstead Computer Graphics PC typesetting software for Compugraphic users

East Hampstead, NH — A new series of typesetting software programs, called PC-TS, has recently been announced by Hampstead Computer Graphics of Hampstead, NH. Designed to be fully compatible with a complete range of Compugraphic typesetting systems, the PC-TS software programs allow users of IBM or equivalent personal computers to turn them into low-cost typesetting input terminals with full-function composition capabilities.

PC-TS personal computer typesetting programs are *currently available to operate the Compugraphic 8600,* 8400, 8200, UniSetter, EditWriter and MCS typesetting systems. The programs allow personal computers to interface directly with the typesetter. Alternatively, PC-TS software can create a compatible diskette for insertion into the type-

Line endings and hyphenation appear on the screen in the same position as they will appear on output.

PC-TS software provides the same composition flexibility available in the Compugraphic typesetting systems it is designed to operate. Composition features include: 60 font width tables on-line, line length remaining in picas and points, depth count in picas and points and inches, tabular composition including typewriter, floating and automatic tabs, indent and cut-run-around capabilities, character compensation, automatic, manual or discretionary hyphenation and automatic or manual line justification with word and letter space controls.

The flexibility of the PC-TS typesetting systems permit IBM or equivalent personal computers to be used in a wide variety of

WAR!

$7,000 printer with Mergenthaler Linotype (Allied) typefaces will affect traditional printing and typesetting industries

Cupertino, CA — Apple Computer, Inc. has announced the LaserWriter high-resolution laser printer. The new product allows business users to produce near typeset-quality text and art department-quality graphics from their personal computer workstations. The LaserWriter — printing such documents as newsletters, overhead transparencies, business forms, memos, brochures and reports — can be shared among a work group of up to 31 people using Apple Talk, Apple's low-cost personal network.

Fig. 5.67 Front page of *Type World* (vol. 9, no. 2, 15 Feb. 1985), announcing Apple's deal with Mergenthaler/Linotype fonts on license on the LaserWriter. Photographed by the author [MoP].

who no longer wanted to pay royalties for PostScript and began to develop their own font technology, initially code-named 'Royal', released as 'TrueType' in 1991.[187] In his detailed article about the 'font wars', Bigelow portrays a conflict that had been brewing since the emergence of the earliest digital type design systems and the different numerical font formats that they embodied, but then broke out during the 1989 Seybold conference, during which Microsoft co-founder Bill Gates on one side and John Warnock on the other, proclaimed their opposing positions.[188] The 'war' headlines were picked up by leading news platforms;[189] the same language had been used earlier in response to the launch of Adobe's 35 digitised fonts on the LaserWriter and Apple's agreement to integrate typefaces from the Mergenthaler/Linotype collection (**fig. 5.67**).[190]

With PostScript, Adobe had also introduced a new measuring unit: one PostScript point (or 'DTP point') made up a fraction of an inch (1/72, i.e. 0.3527 mm), thus opposing the Didot point that had been the typographic standard in most of continental Europe for two-hundred years. With companies on one continent determining those new standards, the founders of DIDOT, a European effort to address deficits in training of digital type design technologies,[191] concluded that 'the modern font market had turned to American hands' and as a result declared the intention to reclaim 'a more favourable position' in a quickly expanding market.[192]

Discussions about digital type continued to be marked by conflicts between different parties over new type technologies, formats and standards, some of which were going to be decided during the coming decade. It is hoped that this thesis can serve as a stepping stone for further research of that period and its discourse.

187 Wang 2013, p. 144. Initially, the new format (based on quadratic B-splines) was implemented in the fonts of Macintosh System 7, followed by Microsoft's launch of TrueType on the Windows 3.1 operating system in 1992. Bigelow 2020, p. 18.

188 Ibid., p. 7.

189 For example Lewis, 'The fallout from the font wars' in *New York Times,* 1 October 1989.

190 The front page of *TypeWorld* (vol. 9, no. 2, 15 February 1985) reads 'War! $7,000 printer with Mergenthaler Linotype (Allied) typefaces will affect traditional printing and typesetting industries' in response to the launch of the LaserWriter and Apple's agreement with Linotype.

191 DIDOT, an acronym for 'digitising and designing of type' and surely a recollection of the name of the famous French family of typographers, was a project that was funded by a programme launched by the European Economic Community (EEC).

192 *Didot Bulletin,* vol. 1, no. 1, 1991.

6. Conclusion

The aim of this thesis has been to explore the discourse around early digital type design technologies by mapping the key issues arising within new environments that emerged in response to new communities entering the field. These key issues are encapsulated in five digital type design systems that were demonstrated at the 1983 ATypI working seminar at Stanford University, which has been identified as a highpoint of this discourse. Through extensive investigation of previously overlooked and untouched primary records and by conducting an oral history with some of the key figures of that era, this thesis has revisited these five systems and the environments they were conceived in. Following a systematic analysis of evidence including published and unpublished reports, reviews and articles, but primarily drawings, proofs, correspondence, notes and non-textual sources, the systems were cross-interrogated in a thematic approach of categories and aspects. By doing so, this thesis has formalized an approach to the definition of a sustainable digital type design system, a scheme that can likely be extended to past and future type manufacturing technologies.

An important contribution to knowledge is a new methodology that has been elaborated and applied in this thesis. Due to a significant lack of existing secondary sources and challenges encountered in available archival material, it assesses a wide range of non-textual sources from disparate collections best characterized as a 'messy history' that would normally not be captured by traditional inventories. This methodology enables a reinterpretation of what is accepted in typographic research, in a transitional and digital context, beyond what is mormally represented in the canonical history of our field. While this approach has been employed in research looking at individual archives, it has not been tested in investigations across a field of activity, and with a digital subject focus.

Discourse through new environments and communities

In response to a changing environment in which typographers expressed interest in research and computer scientists showed concern for letterforms, the discourse of a new community benefitted from the establishment of associations, in the reform of education and in emerging publication formats. This thesis identifies the ATypI, its interest in industry and education, and its conference formats as a key environment of this discourse and maps many of the developments through its changing community with a growing number in independent type designers who had no specific affiliation with the manufacturers that largely carried the Association. Through the ATypI, designers and manufacturers discussed the preservation of previous methods, while establishing new standards that served as benchmarks, constantly challenged by the emerging technological innovation of neighbouring disciplines in engineering and computer science. While the domains of type design

and computer science where largely disconnected at the time, the *Journal of Typographic Research,* later known as *Visible Language,* offered one of the few channels between the disciplines. Its launch in 1967 coincided with several emerging digital type design systems. It became the platform in which topics from both areas were discussed, including some of those systems — fifteen years later it became the scene of fierce debates between both camps when Metafont was introduced to the typographic community. In the same atmosphere, key figures of the ATypI in education, e.g. Michael Twyman and Gerrit Noordzij, called for the academization of typography, as the first computers arrived on their campuses in Reading and in The Hague. The ATypI working seminar series became the field where these ideas played out, a mutual ground for experimentation, discussions and hands-on experience; it is the environment in which a new generation of practitioners and design educators first came in contact with the digital type design systems explored in this thesis. These discussions became nurturing grounds and set the tone for the debates that culminated in the 1983 ATypI working seminar at Stanford University, the first event of the series where figures from all disciplines came together. 'Stanford 1983' is neither the beginning nor an endpoint, but a highpoint of this discourse in a long transition. By researching technical reports and manuals, ephemera, and the records of digital experimentations, this thesis offers a model for investigating interacting communities, the discourse that emerges while developing new solutions, and the emergence of a new field through the communities that are active in these transitional periods.[1]

Systems emerging from new environments

More than a dozen different approaches to numerical letterform description were available during the transitional period of early digital type. The five systems investigated in this thesis encapsulate the discourse around approaches to defining and developing digital type systems in this period. Beyond documenting their development, this thesis interrogates these systems thematically, and from the perspective of their sustainability at the time (for the conclusion of that analysis see 4.3). Building on a terminology and a scheme for assessing type design systems established by Richard Southall in the second half of the 1980s, this thesis extends its research methodology to consider a multitude of sources, and include intangibles such as collaborations and gatherings. By shedding light on the environments within which these systems were developed, this research connects the systems to the motivations and perspectives of their originators and developers.

As this study shows, the five type design systems did not deliver a unanimous response to the challenges that type designers and manufacturers faced at the time,

1 The point has been made that the same method could be applied to other similar events at another place and time, e.g. at the conference on *La manipulation de documents,* organized by Jacque André in Rennes, 4–6 May 1983.

but delivered very different approaches, each in their own right and within their own set of circumstances, and according to the relationships formed by their originators. The kind of interrogation applied in this thesis enables us to place systems development in a more rich and nuanced context.

As the interrogation shows, the needs of manufacturers, the emerging voices of type designers, and the effects of dematerialisation in an environment of rapidly changing technology interacted in a manner that looking at a single system could not explain. Indeed, we can see that the most sustainable, responsive and effective digital type systems were the ones that could adapt to those circumstances. By 1983, Elf and Fred were already out of the race, with Fred remaining a Xerox-internal tool. URW adapted to these changing circumstances over the longest period of them all, capitalising on their ability to provide a service to existing manufacturers entering digitisation of their analogue drawings. By building a business around Ikarus, URW were able to maintain a competitive commercial operation, until their model was eclipsed (not least by the cannibalisation of their main product by their own more affordable version of Ikarus). On the other hand, Parker and Carter at Bitstream had devised a business model first, before developing a type design system that served its needs. LIP was developed with input by both engineers and designers from the start, and attached to a clear business strategy. Carter and Parker had sounded out the market, analysed needs, had previous experience with Ikarus, and were familiar with its weaknesses, which informed their input into LIP. But by focusing on the business plan of 'type as a product', Bitstream was able to outlive LIP, by migrating to other systems. Similarly, Metafont was developed as a partner to Tex, to solve specific and well-established needs of scientific authors, therefore ensuring a demand (although it was free to users, its 'business case' was compelling for it to survive as a platform long into the next phase of digital typography). These observations underline the significance of considering the motivations and perspectives in evaluating type design systems.

Contributions by type designers

One of the central questions of this study was aimed at the presence and contribution of type designers in shaping new tools for digital type manufacturing and at their redefined role during this transitional period. An investigation of some of the earliest models of numerical description of letter-like shapes in this thesis demonstrates contributions by electrical engineers and computer scientists, while the community of type designers and typographers was largely uninvolved in these developments. There is enough evidence to prove that in the second half of the 1960s it was engineers who demonstrated a curiosity in typography — not the other way around. Their desire to express scientific reports that include complex mathematical formulas is one of the recurring themes. Despite the absence of designers, some of the results by Mathews, Mergler and Hershey are representative

not only of technical details, but of typographic criteria such as optical sizes and aesthetic considerations.

At the same time, some of the examples demonstrate a lack of expertise and careless use of typographic terminology. Hell proves the exception in building a presence around accomplished and emerging designers in Zapf and Unger, who was just beginning his career. For about a decade, type designers assumed the role of advisors who made contributions to improving existing type design systems. This is illustrated in Zapf's advice in adjusting the virtual pen pressure of Metafont, while Matthew Carter's experiments with Ikarus showed Karow the weaknesses of interpolation. Type designers made contributions to the manufacturing process of type, but not to the foundations of the tools in use, leaving the collaboration between type designers and 'digital punchcutters' in a relationship of dependence. It was not until the beginning of the 1980s that type designers like Carter became involved in devising new type design systems from scratch. Petr van Blokland's attempts throughout the 1980s are the prime example of type designers developing their own tools. While type designers had previously (and for most of the twentieth century) watched the development of type design systems from the sidelines, this responsibility slowly returned to type designers towards the end of this transitional period. However, with every new tool, the relationships around it have to be thought out afresh, with a wide scope for the evidence that may be available to capture the process of development and evaluation.

Shortcomings and considerations for future research

The previous chapter has outlined and investigated several aspects and implications of early digital type design technologies, drawing on a wide and disparate range of primary sources. It can be expected that more material of this kind can be located, not least in private archives — especially so since we are within the potential life spans of contributors to such systems. It is certain, therefore, that this research is defined as much by its findings as by the potential to fill in gaps, and the nature of its lacunae, as discussed in chapter 2. It can never be known which collections have been overlooked until they are brought to light, but we can be reasonably confident that there is material still to be uncovered. Indeed, the growing attention for the subject (not least through this study) makes it all but certain that more private collections will be made publicly accessible in the coming years. However, since by their nature such archives are partial and represent an indirect personal curation, they will need to be contextualised and interrogated alongside existing material.

The same consideration applies to corporate archives, which have not been easily accessible so far. Fred in particular was a well-kept secret not generally known outside of the premises of Xerox PARC, and as a result also received far less coverage. However, the significance of the work taking place at PARC is well-established through other developments in the history of computing and digital

typography. We can therefore be hopeful that more records will surface, allowing further work in this area.

This research highlighted the importance of considering the environments of discourse and development when researching digital type systems. We can expect that this focus will be relevant in researching further into the development of digital technologies, and especially so as fewer conventional analogue records remain. More specifically, this thesis can become a stepping-stone for further research into the next transitional phase of digital type, inaugurated with the introduction of PostScript in 1984, as well as broader developments in digital typography. The page-description language completely changed the industry once again in providing greater independence from all devices in the composing room, which transformed into regular offices; yet the lessons that were necessary to provide this new environment had their roots in the previous two decades.

In this vein of research there is ample opportunity to revisit popular narratives about typographic dimensions in early operating systems (such as the often repeated connection between fonts on the Macintosh and calligraphy classes attended by a co-founder). More substantially, it would be worth to continue tracing PostScript, the programming language that enabled the Desktop Publishing transition and platform-independent fonts on PCs, through the direct connections between Sutherland, his former employees who went to Xerox PARC and then moved on to Adobe, traces of which have been brought forward in this thesis. Research on the period after 1984 will require methodologies like the one elaborated here even more so.

Furthermore, the period and products that this thesis concerns itself with sit squarely in the North-Western world, and Latin letterforms. Scripts of East Asian origin make an appearance in the exploration of approaches that utilize parametric algorithms, as exemplified in chapter 4, not least through Metafont and the available educational framework of Stanford. Tentative directions are provided there and in 4.2.6, systems for further research. However, it is important to consider the possibilities to conduct research further into parallel developments in other regions and for other scripts. Such work can look at the environments of development in other contexts, but also interrogate approaches in different scripts, spaces of collaboration, and market environments. From that point of view, this thesis can be seen as opening a wide strand of global research in digital type and typography.

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