HANDBOOK OF COMPUTER-AIDED COMPOSITION

ARTHUR H. PHILLIPS

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Preface

The concept of computer-aided composition dates from the Bafour, Blanchard, and Raymond patent application in France in March 1954, and sample work on the BBR system was produced by Bafour at the Imprimerie Nationale in November 1958. These efforts were followed by those of Michael Barnett at MIT in 1961 and by Bozman and Corliss at the U.S. National Bureau of Standards and C. J. Duncan at Newcastle University in 1962. According to which date is accepted as the invention of computer-aided composition, its silver jubilee was 1979 or the end of its second decade 1981. If it were the practice now to head each chapter with a quotation, as it was when Legros and Grant wrote *Typographical Printing-Surfaces* in 1916, we would quote Samuel Butler's *Erewhon* of 1872: "The more highly organised machines are creatures not so much of yesterday as of the last five minutes, so to speak, in comparison with past time." Thus computer-aided composition represents but one hour in the 500-year day of printing from movable types.

The introduction of the computer to printing has caused more disruption than the invention of mechanical composition at the turn of the century; Monotype and Linotype entirely replaced the hand compositor for text setting or "solid dig" but these innovations were limited to the four walls of the printing office. The introduction of machine-readable text records has destroyed the conventional boundaries of the author's, publisher's, and printer's worlds.

Mechanical composition brought a generation of "keyboard operators" into existence, leaving display setting, page makeup, and the stonehand's imposition to the hand compositor; it involved new concepts and training for apprentice compositors at the end of the First World War. But there is a very great difference in learning to understand mechanical composing devices and computer systems; the operation of the former can be *seen* to be working, the matrices fall into the assembler of the linecaster and the "clunk" of the Monotype matrix case as each character is brought into position over the mold is all too audible. The VDU and photosetter have invisible microprocessors and buffers full of equally invisible characters. It calls for a great deal more imagination to understand what is happening in an automated newsroom than to watch a Linotype operator at work and a form being molded. Hot-metal composition brought back typecasting to the printer after it was lost to the typefounder; CRT photosetters have returned type design to printers as assuredly as if they were employing sixteenth century punchcutters, but unfortunately without the discipline of the punchcutter's manual skill. The exploitation of characters adjustable in set width and height in increments of 0.1 point and with variable side-bearings, the choice of oblique angle, and CRT-generated bold face could produce some appalling results without proper aesthetic judgment.

John Seybold, in his introduction to *Fundamentals of Modern Composition,* remarks that the means available to the author affect, for better or for worse, the quality of the work. Many authors must dictate their manuscripts and subsequently edit the typescripts prepared by their secretaries, others type their own manuscripts. John Strawhorn, commenting on the preparation of *Improving the Dissemination of Scientific and Technical Information,* explains that the text was first dictated into a cassette recorder, then transcribed onto magnetic cards, and finally updated on a word-processor terminal to pass on to the printer as a magnetic tape for photocomposition. This involves the inclusion of typographic command codes, making it quite clear that whatever method independent authors use to prepare their manuscripts, the institutional author must now be aware of computer editing and composition systems.

This present book, it is hoped, will prove of value to authors, publishers, and printers in providing some background to the present state of the art of computer-aided composition and some details of the equipment which will enable the reader to acquire a perspective view and a technical vocabulary.

What is perfectly clear technical English to one person may appear jargon to another; I would define jargon as "the use of poorly defined terms to create an impression of familiarity with a technical subject," but technical terms cannot be avoided if a descriptive text on a technical subject is to be concise.

Some historical background, if that can be said of events twenty years ago, has been included in order to help an understanding of this transitional period between hot-metal composition and computer-controlled editing and photocomposition. It is unfortunate for the manufacturers of photosetters and copy-processing systems that the pace of development is so fast that a device can become outdated between the drawing board and the demonstration room before equipment is delivered to the user. New designs are subject to market research before manufacture, which means asking users what they want, but like democracies and governments, some users only know what they do not want and others specify the unobtainable. It is hoped that all present and future users of computer-aided composition will find in this book some assistance in deciding what they do want, or at least have sufficient background to discuss the matter with technical sales personnel.

Printing colleges can provide instruction in computer-aided composition, but there is not a very large corpus of technical literature on the subject which the student can take home and study; he or she becomes dependent upon articles in technical journals which must be studied in the libraries and are fragmentary in the field they cover.

The electronic engineer applies his or her knowledge to the development of hardware, the systems engineer employs that hardware and requires software for its application to a specified purpose involving the practices of author, editor, and compositor. Computer-aided composition may have trivial applications, but in principle it has a wide-ranging potential in the information media. To appreciate this one must acquire a perspective of what has been achieved and a vision of what might be achievable. This book hopes to contribute but a small quota of information to that end.

In writing a technical work of this sort one is acting as author, compiler, and editor; as author in writing from one's own personal experience, as compiler in presenting brief summaries of equipment, and as editor in discarding and selecting information from the very wide range of available data. Self-critical authors are never satisfied with the result of their efforts; there is always something that could have been added, something that could have been expressed more lucidly. I have tried to provide some background material to computer-aided composition and an assay of the present state of the art which is now almost solely concerned with the application of electronic processing to photocomposition. The technology is moving too fast for it to be complete, it can only hope to be a guide.

Author, publisher, and printer now have to live with, and use, the products of modern electronic technology in the field of information processing and publishing media. Any project to apply electronic technology, or indeed any technology, requires confidence that the end has been defined and is obtainable. This calls for great efforts of goodwill and cooperation between the persons involved, and knowledge of the technical potential, if not the detail of its means of achievement. The present state of the "information explosion" has sometimes been likened to the tower of Babel; it might be relevant to quote Daniel Defoe* on this matter; "The building of Babel was a right project; for indeed the true definition of a project, according to modern acceptation, is, as said before, a vast undertaking, too big to be managed, and therefore likely enough to come to nothing." The number of bankruptcies and withdrawn computer-typesetting applications is more than adequate to justify Defoe's definition of 1692, which may owe something to his mentor Charles Morton who was later to become Vice President of Harvard College. All who have been involved in computer-typesetting projects know the difficulty of avoiding the Babel result; I have tried to help toward this avoidance.

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**An Essay upon Projects,* Daniel Defoe's first book published in 1697 but written in either 1692 or 1693.

Acknowledgments

As a technical author I am indebted to many of my friends for the help they have given me, not only in providing information for this monograph, but for the patience they have shown in the past in explaining the functions of equipment and various systems. For many years I have been given information and encouragement from E. R. Lannon, former Director, Office of Advanced Systems, Department of Health, Education and Welfare, who has made a personal contribution to the development of Electronic Composing economics.

I have to thank Ronald McIntosh for many helpful discussions over some fourteen years on the operation of CRT phototypesetters. Terence Soutar of Her Majesty's Stationery Office, as Deputy Director of Technical Services Division, now has the computer-typesetting responsibilities I had before my retirement, and I am grateful for his continued help as I am also for the help of Kay Jordan whose experience of word-processing equipment is invaluable.

It would be impossible to make any progress in the writing of a monograph such as this without the cooperation of equipment manufacturers, all of whom have treated my requests for information with courtesy. I would like to make special mention of Lawrence Wallis of AM International, E. S. Emery of Linotype-Paul, John Latham of Monotype International, Brian Mulholland of Shefra Graphics, and Tim Coldwell of Xenotron, and I would also like to thank Harris Systems, Itek Composition (Dymo Graphic Systems), and Autologic for their help.

All who have been involved in computer-aided composition know the contribution made by John Seybold and his organization in the publication of *The Seybold Report* with its content of accurate and detailed information and systems understanding. I am indebted to John's generosity in many ways. I have also maintained contact with Arthur Gardner, whose CIS Newsletter Surveys provide statistics of the early days of computer typesetting.

I thank all those manufacturers who have provided line or tone diagrams and illustrations of equipment and have given permission for them to be included in my text; acknowledgment of the source has been given with each figure. I have also been given permission to include the following diagrams from *Computer Peripherals and Typesetting* published by Her Majesty's Stationery Office: Figures 2.19, 3.10, 3.11, 3.14, 3.15, 3.16, 4.5, 4.9, 4.11, 4.12, 4.14, 4.15, 4.25, and 7.4. The following figures have also been reproduced with the permission of the Controller of Her Britannic Majesty's Stationery Office: 2.6, 2.34, 5.9, 7.1, 7.3, and 7.7. Finally, I must acknowledge my debt to Providence for giving me the opportunity of writing this book and to my wife's care for me, without which I would not have had the time.

Illustrations

1.1 Linasec II Hard-Wired Composition Computer 2
1.2 Computer-Processed Page from *Patent Attorneys and Agents* (1963) 7
1.3 Intertype Monarch Linecaster Used in Relay I Experiment 8
1.4 Intertype Fotomatic TTS-Driven Phototypesetter 10
1.5 Keyboard of the Photon 540 Filmsetter 11

2.1 Comparison of Old Face and Modern Typeface Design 34
2.2 Comparison of Transitional and Venetian Typefaces 35
2.3 Alphabets of Monotype Gill Sans Series 262 and 275 35
2.4 Eight Typefaces in the Same Point Size Illustrating Different x-Heights 36
2.5 *Ciceronis Orationes cum Commentariis:* a Sixteenth Century Example 37
2.6 Sloped Roman Generated on the Linotron 505 Phototypesetter 38
2.7 Linotype Pilgrim; an Example of Hot-Metal Sloped Roman 38
2.8 Seven Sizes of Verona Enlarged to Show Comparative Design 39
2.9 Comparison of the 8-pt., 12-pt., and 18-pt. Type Masters of the V-I-P 40
2.10 Intertype Century Bold in Half-Point Type Size Increments 5–18 pt. 41
2.11 Characters Generated by Vertical CRT Scan 42
2.12 Characters Output on the CRT from Digital Store 43
2.13 IBM Composer Univers Medium 44
2.14 Photon Univers Medium 45
2.15 An Example of Five Text Sizes from William Caslon's 1734 Type Book 46
2.16 The Measurements of Printer's Type 47
2.17 Comparison of Alphabet Lengths of Intertype Lectura 50
2.18 Linecaster Matrix and Spaceband 50
2.19 A Typographic Basic Font 51

Contents

Preface viii
Illustrations xiii

1 **Defining the Problem 1**
Definition of Computer-Aided Composition 3
Aim and Development of Computer-Aided Composition 5
Categories of Composition 16
Functions of Typographer and Programmer 28
References 32

2 **Printer's Typefaces and Fonts 33**
Printer's Type Design 34
Printer's Measurements 40
Linecaster Type Font Measurements 49
Computer Accessibility of Type Fonts 50
Summary of Photosetter Font Facilities 65
References 70

3 **Monotype and Linecaster Mechanical Composition 71**
Line Justification 71
Monotype Justification 72
Linecaster Mechanism and Justification 78
Teletypesetting Tape and Code 82
Computer Control of the Linecaster 87
Summary of Computer-Aided Hot-Metal Composition 95
References 97

4 **Computer Text Input Keyboards 98**
Conventional and Improved Keyboards 98
Computer Input Codes for Text Processing 107

Keyboard Design for Computer-Aided Composition 114
Design Factors of Electronic Text Keyboards 116
Video Display Input Keyboards 124
Keyboard–Computer–Photosetter Interface 130
Keyboard Development Summary 133
References 138

5 Word Processing 139
Definition of Word Processing 139
Automatic Direct-Impression Equipment 140
Summary of Non-VDU Typescript-Oriented Word Processors 151
Video Display Word-Processing Systems 154
Summary of Video Display Word-Processing Systems 162
Word-Processing Interfaces 163
General Summary of Word Processing 165
References 167

6 Optical Character Recognition of Text 168
Optical Bar Code Readers 170
OCR Fonts 171
OCR Correction Methods 174
OCR Input to Computer-Aided Composition Systems 175
OCR Equipment 179
Summary of OCR Text Input Systems 185
Reference 187

7 Technical and Scientific Book and Journal Composition 188
Computer-Generated and Composed Tables 189
Use of Video Display Systems in Book Composition 195
General-Bookwork Tabular Composition 198
Computer-Aided Mathematical Composition 202
The Editorial Processing Center 206
Bookwork Page Makeup 209
References 212

8 Bookwork Correction, Editing, and Retrieval 214
Development of Automated Text Correction 215
Proof Stages in Computer-Processed Text Composition 216
Computer Batch Processing of Corrections 219
Video Display Systems for Text Correction and Editing 221
Dedicated Text Input Correction and Editing Equipment 229
Information Retrieval 238
Summary of Bookwork Correction and Updating Methods 242
Reference 243

9 Newspaper and Magazine Computer Systems 244
The Automated Newsroom 244
Wire Service Input 248
Development of Newspaper Composition Systems 249

Computer Manufacturers' Composition Software 251
Newspaper Systems from Composition Equipment Manufacturers 259
Editing and Composition Systems by Software Houses 270
CRT Terminals for Display Advertisement Setting 274
Line and Tone Illustration in Computer Composition 282
Facsimile Communications Systems 288
Newspaper and Magazine Page Makeup 290
Summary of Newspaper Computer Systems 293
References 298

10 Nonscanning Text Composition Photocomposers 299
Development of the Text Composition Photocomposer 299
Design Principles of the Nonscanning Photocomposer 302
Recorded Input Nonscanning Photocomposers 304
The Direct-Entry Photocomposer 341
Summary of Development Trends 358
References 360

11 The Scanned Image Photocomposer 361
Design of the CRT Photocomposer 361
Graphic Arts Laser Technology 394
Summary of Scanned Image Photocomposer Development 402
References 405

12 Perspective and Prospect 406
Automated News and Magazine Production 407
Database Composition 408
Computer-Aided Book Production 409
Prospects of Computer-Aided Composition 412
New Contestants for Information Media 419
Conclusions 423
References 424

Index 425

1
Defining the Problem

It has been said that there are no problems in evolution, only solutions; in computer-aided composition the equipment manufacturer provides the solutions, the user finds the problems. To be fair, the equipment manufacturer upon asking the printer to define his methods of composition has too often been told what the printer ought to have done or thought was done rather than the actual method. The shortest description of a digital computer would be "an electronic device capable of automatic calculation according to a set of stored instructions." Some would insist that a computer must have an addressable memory whereby the stored instructions, i.e., the program, can be changed to solve different problems, but the printing industry has from the outset of computer-aided composition been presented with hard-wired devices such as the Compugraphic Linasec (Fig. 1.1), described by Mergenthaler in 1964:

> The Linasec composition computers are relatively inexpensive high-speed computers designed specifically for type composition and for this purpose only.

The Linasec hard-wired logic which achieved line justification had only to add the widths of the keyed characters until the line came within a specified justification zone. It accepted a string of words as unjustified paper-tape and output a drive-tape for a linecaster with the line-end codes added by the hard-wired logic. When a word needed to be broken it was shown on the screen of a CRT and the operator could indicate the appropriate point at which to insert the hyphen. A change of type font

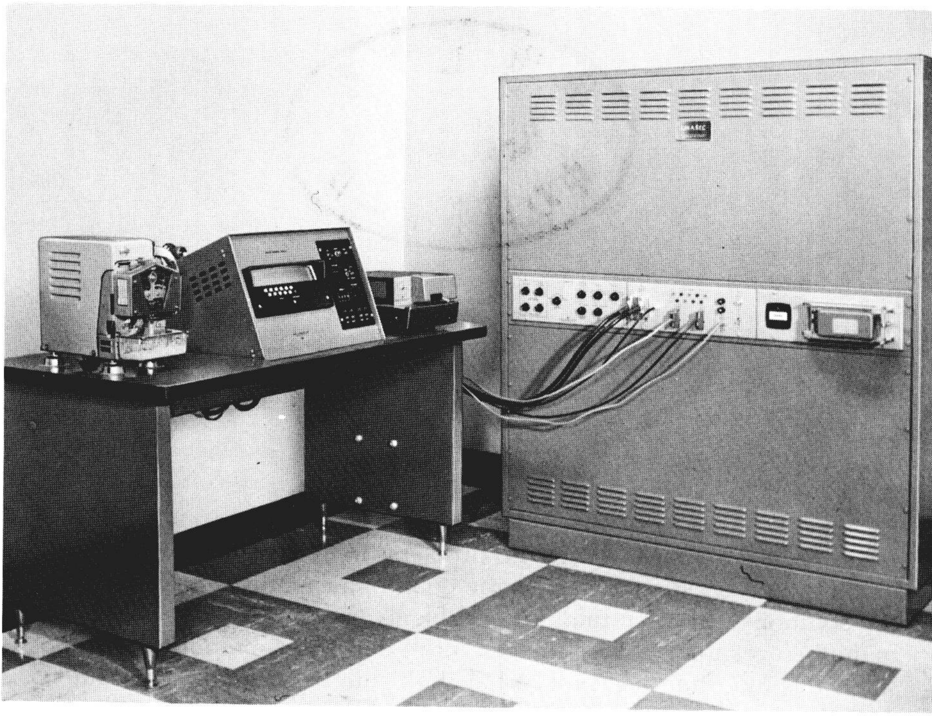

Figure 1.1 Linasec II hard-wired composition computer; TTS-coded tape without line-end codes was input at the reader on right. Justification was automatic until a word break was necessary when the word was displayed on the CRT screen for the operator to indicate the break point. This model had a line buffer permitting the word to be turned over and extra space matrices inserted. TTS tape to drive linecasters or the Linofilm Quick was output at the Teletype BRPE punch. A looped-tape system accepted input from multiple readers to output to up to 12 Linotypes. (Courtesy of Linotype-Paul Ltd.)

could mean different proportional widths of the characters. For a general-purpose computer the character width changes would be made by reading in a new look-up table; with the Linasec it was done by changing a "width plug" with 200 contacts wired to define the widths of each of the 90 characters in the linecaster magazine. Had the Linasec first been marketed in 1970, it would have been classified as an "intelligent terminal," admittedly with a rather restricted display of only one word! This is a rather trivial example of computer applications to printing but indicates that this use of the digital computer does not follow the conventions of computer processing for accounting, stock maintenance, market research, or management information. In computer-aided composition the CPU will appear in a diversity of forms and in unlikely places. Even if a general-purpose computer is used for text handling and is required to furnish a magnetic tape to drive a photosetter, then that tape is most unlikely to be in the code and format used for data normally written out to magnetic tape and read back for reprocessing by the same computer.

Definition of Computer-Aided Composition

Under the heading "computer-aided composition" there are several terms meaning the same thing, including "computer typesetting," "computer-aided typesetting," "electronic composition," "automated book composition," or the terms of slightly wider scope, "automated publishing" or "computer-aided printing and publishing." Possibly a new title will be discovered for each new book or conference on the subject. Whatever the title, the subject concerns the application of automatic digital processing to the handling of words which will be required to be printed in "graphic arts quality" in the style of hand set or mechanically composed printer's type. To achieve this it is required that the printed characters be equivalent in design to typefounder, Monotype, or linecaster fonts and should be arranged on the page as skillfully as if they had been made up by an experienced compositor.

The first application of the computer to printing was to process a tape which was then used to drive linecasters, but it had been used earlier to punch tabulator cards to drive an automatic typewriter, and then later to provide the text input to a great variety of photosetters. At one time it might have been reasonable to say that one was not computer-typesetting unless the text were justified, i.e., had a uniform right-hand margin. But it has now become the typographic vogue to set matter in unjustified lines when using conventional hot-metal composing equipment or phototypesetters.

In examining how the computer has been used in the first two decades of its application to typesetting, one must recognize that in this context the "computer" or automatic electronic digital calculator may be an IBM System 370/145 or a microprocessor chip in a photosetter used for:

1. Inserting line-end codes to achieve justification of a continuous string of text.
2. Breaking words by logic or dictionary look-up to achieve justification of a continuous text string that has no line-end codes.

3. Storing character widths of printer's fonts by hard-wired logic (firmware) or in core store or solid-state memory to permit line justification.
4. Extending the normal alphanumeric computer code to process text comprising the wide range of printer's characters for scientific, technical, and mathematical composition.
5. Recognizing typographic commands in the input string of text, or adding them by program and outputting those instructions in the format and code required for either hot-metal mechanical composing equipment or a variety of photosetters or direct-impression typewriters with typographic-quality output.
6. Storing text before or after composition in typographic form to permit corrections and updating by batch processing or on-line interactive terminal.
7. Arranging simple and complex tabular matter with column boxheads, type size change for different columns, automatic vertical alignment, and suppression of nonsignificant digits and cast-off to decide type size of tables in general bookwork.
8. Positioning the horizontal and vertical elements of displayed mathematical formulas.
9. Handling page makeup for bookwork by operator control of VDT and automatic page makeup by program including derivation of running heads and page index lines and folios and placing them in correct position on the page. Allocation of space between headings and type size change for headings and footnotes with automatic makeup of book pages to uniform depth with an acceptable typographic appearance.
10. Leaving space for illustrations and inserting tables in text and adjusting column depth on multicolumn text pages to obtain uniform page depth.
11. Displaying newspaper advertisements on a CRT screen with interactive programs that permit the operator to edit and change text size to fit specified areas on the photocomposed page.
12. Providing a visual display of the newspaper made-up page with interactive on-line operator control of the type size and position of copy.
13. Maintaining completely automated newsroom with editorial control by VDTs.

This list is not exhaustive but the object of this book is to describe some of the solutions to the complex problems which have been overcome in computer-aided composition projects. In any of the systems which have supplied the facilities described, the text handling and computer processing to the output stage of typographic-quality setting may have been executed in one room, or under one roof, or may have involved the text being transmitted from one seaboard to the other with composition taking place thousands of miles from the original text input to the computer. It is inevitable that new techniques will alter the meaning of existing technical terms and change the boundaries of their previous application. Thus Stanley Morison [1] in 1924 defined printing as the device of placing together movable pieces of metal (types), each piece having on its upper end a character in relief, which when inked and impressed upon a suitable material leaves a mark, or "print." This definition would completely exclude a litho print of photocomposed text, and although this new form of print is readily acceptable as such, the technical terminology of letterpress when applied to photocomposition is one of the causes of misunderstanding and labor difficulties.

Aim and Development of Computer-Aided Composition

It is no longer possible to exclude the direct-impression method of composition from the definition of a "setting in typographic style"; therefore, it is a debatable point as to whether the earliest attempts at computer control of typewriters should be included in the category of computer-aided composition. On March 11, 1953, the Royal Society Committee on the Printing of Mathematical Tables met under the chairmanship of Sir Charles Darwin to discuss computer processing of mathematical tables and their subsequent printing. The National Physical Laboratory had a tabulator card-driven IBM Electromatic typewriter and had programmed the ACE computer to output tables of *coulomb wave functions.* Similar typewriters were in use at this time by H. M. Nautical Almanac Office and the U.S. Naval Observatory. Tables prepared on this equipment were printed facsimile by photo litho and these efforts preceded the development of computer control of hot-metal composition and photocomposition, the table data being processed on electrical accounting machines (see Fig. 7.1).

Monotype and linecaster composition were established nearly 60 years before attempts were made to control this means of setting by computer. Fortunately, the linecaster was already provided with a punched-tape interface for direct control by the Teletypesetter (TTS)* perforator or via a communications link to a remote paper-tape punch;

*Teletypesetter is a trademark of the Fairchild Corporation.