Computing in Musicology

A Directory of Research

1989

Edited by

Walter B. Hewlett

Eleanor Selfridge-Field

Center for Computer Assisted Research in the Humanities
Menlo Park, CA
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Preface

Computing in Musicology is the successor of the Center's four previous *Directories of Computer Assisted Research in Musicology*. It is addressed principally to musicologists seeking current information about research in progress, discussion of that research, and practical examples of applications.

This year's volume is divided into sections concerned with current events, special research topics, music printing, text applications, analytical applications, and address lists of individuals, agencies (including journals), and businesses mentioned in the text. We provide these addresses to enable readers to be in touch with one another. Please note that electronic addresses are listed separately from street addresses. The news and applications items are provided directly by persons involved, but occasionally we lack individual addresses for participants in projects cited.

Music printing remains a dominant interest for many readers. *Computing in Musicology* has provided readers with the opportunity to see output of the same music from a host of programs for three years. It has also frequently featured output of unusual notations relevant to scholarly endeavors. Many of the software developers who contribute to this publication have acknowledged their indebtedness to our readers for their valuable comments. This year's contribution was larger and of higher quality than ever before. Edmund Correia Jr. is chiefly responsible for its arrangement and display.

As a gesture toward summing up the research reported over these past five years, we have provided a cumulative index. Valiantly prepared by Steven Rasmussen, the index is in four separate sections that attempt to disentangle people from machines and publications from programs. The human touch seemed to be essential in providing a user-friendly arrangement of what proved to be a remarkably compendious listing.

For their continuing effort to keep us in touch with a global community we are especially indebted to Lelio Camilleri and his associates, also to Nicholas Carter, Antonio Camurri, Helmut Schaffrath, Arvid Vollsnes, and Thomas Walker. We extend our cordial thanks also to Frances Bennion, who oversees distribution, to Steve Rasmussen for his help in preparing the applications section, and to Ed Correia for his matchless multilingual proofreading. Our many contributors are a constant source of enlightenment and encouragement, and we convey our cordial thanks to them collectively for the many fine letters and documents they have sent over the past year, all of which enrich in some way the publication you see before you.

Menlo Park, CA
September 30, 1989

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Current Events

Meetings

AAAI

See *Special Topics*.

ACOM

As the home of numerous bibliographical projects organized under the umbrella-title of Archivio Computerizzato Musicale Veneto (A.CO.M), the Fondazione Levi in Venice provided an appropriate setting for a three-day workshop on computer systems for transcription, editing, performing, and printing traditional musical scores. The workshop took place between December 15 and 17, 1988. Further information about these projects is available from Sele Sistemi, Palazzo Giustinian Lolin, S. Vidal 2893, 30124 Venezia.

CATH

An annual conference on Computers and Teaching in the Humanities is held in the UK. In December 1988 it was held at the University of Southampton. Organized by the Office of Humanities Communication in conjunction with the Association for Literary and Linguistic Computing and the Computers in Teaching Initiative Support Service, CATH poses many probing questions about the changing definition of the humanities and the changing context of humanities research.

CTISS welcomed a new head, Jonathan Darby, in the autumn of 1988. It published a bimonthly bulletin of activities in the UK.

COLLEGE MUSIC CURRICULUM

The University of Minnesota will host a conference on "College Music Curriculum and Current Technology: Models for Application" on August 2 - 4, 1990. Enquiries may be sent to 10 University Drive, Duluth, MN 55812-2496.

CMR

Queen's University, Belfast, will host the second Computers in Music Research conference on April 7-10, 1991 (the first conference was held at Lancaster University in April 1988). The conference will be organized by Alan Marsden, who is now at Queen's.

ICCH

With the title "The Dynamic Text" the ninth International Conference on Computers and the Humanities took place in Toronto from June 5 to 10. Two sessions were devoted to music. Lelio Camilleri, Jim Kippen, and Helmut Schaffrath spoke in a session on "Models and Analysis." Camilleri's talk discussed different computational models for music and potential interactions between analysis, theory, and cognition. Kippen's paper was concerned with the methodology of studying North Indian tabla drumming. Schaffrath's paper described relations between performance, encoding, and analysis of traditional music.

In a session on "Tools and Analytical Methodologies" John Morehen reappraised "The Methodology of Musical Authorship Studies" in connection with his own work on William Byrd. Francesco Giomi and Marco Ligabue described their "Tool for the Study of the Jazz Idiom." Alan Marsden, in a paper entitled "Tools for the Musical Programmer," addressed needs related to data structures and time dependency.

[Report submitted by Lelio Camilleri and Francesco Giomi]

ICMC

At the fourteenth International Computer Music Conference, held in Cologne from September 20 to 25, 1988, sessions on music representation and music workstations were held, although the main emphasis was on contemporary computer music.

The next ICMC will take place at Ohio State University in Columbus from November 2 through 5, 1989. Notable items in a long agenda are a panel discussion of music representation chaired by Guy Garnett, a report from the ANSI music information processing standards (MIPS) committee, a paper by Andranick Tanguiane concerning "An Analytical Approach to Performance Interpretation" (see the report in the 1988 *Directory* on p. 39), and Perry Cook's presentation on artificial singing, which is based on research currently in progress at Stanford University.

ICMPC

The first International Conference on Music Perception and Cognition was to be held in Kyoto, Japan, in mid-October 1989. The secretariat is at the Department of Music, Kyoto City University of Arts, Kitsukake, Ohi Nishiyo-ku, Kyoto 610-11, Japan. The meeting was to be co-chaired by Diana Deutsch, the editor of *Music Perception*.

ICTM

Edinburgh University hosted the Study Group of the International Council on Traditional Music from September 28 to October 2, 1988. Presentations were given on a variety of subjects including music representation (Rosa Michaelson, Michael Harris, and Geraint Wiggins), transcription of repertories outside the boundaries of common music notation (Ioannis Zannos, Kathryn Vaughan), input, storage, and retrieval of folksongs (Barbara Jesser, Helmut Schaffrath), and printing and sound tools (Eric Foxley, Emil Lubej). James Kippen and Bernard Bel demonstrated a program for the automatic generation of rhythmic patterns associated with the tabla.

This year's meeting of the group, a joint gathering with the Study Group on Analysis and Systematisation of Folk Music, took place in July in Schmalding, Austria. Papers presented included those of Iannos Zannos on "Modelling Modal Systems on the Computer: An Approach based on the Greek, Turkish, Japanese, and Chinese Modal Systems," Shen Qia on "Mathematical Models of 'Hinqiang' in Chinese Traditional Music," and Emil H. Lubej on an "Ethnomusicological Package (EMAP) on the PC AT for Monophonic Coded Musical Information."

IMS

A study group on musical databases and other aspects of electronic scholarship has been organized under the auspices of the International Musicological Society. The group, chaired by Walter B. Hewlett and Eleanor Selfridge-Field, currently consists of about 20 members drawn from a broad international spectrum. An assessment of needs related to the furtherance of the subdiscipline is being prepared by the group for eventual distribution. Local activities are also being encouraged by members. Comments and queries may be addressed to the conveners at CCARH.

MUSIC AND INFORMATION SCIENCE

Talks on "Style Analysis with Computer Aids" by Makoto Ohmiya, on the study of musical performance using analysis-by-synthesis by Johan Sundberg, and on music typography using small computers by Leland Smith were given in an international symposium on Music and Information Science held on March 28, 1989, in Kyoto, Japan. Ohmiya is the co-author, with Jan LaRue, of a two-volume study in Japanese called *Methods and Models for Comprehensive Style Analysis*.

MUSIC ORIGINATION

A one-day seminar entitled "Music Origination by Computer: Quality and Standardization" took place at the University of Surrey on May 19, 1989. The seminar, which was a joint venture between the University of Surrey and Oxford University Press, was attended by about 100 delegates from diverse backgrounds. The speakers included Andrew Potter, director of the music publishing division of OUP, Michael Rowe, a freelance music originator, and the composer Trevor Wishart. The main topics of discussion concerned the changing role of the publisher and the prospects for data interchange. The afternoon was set aside for product demonstrations [see *Music Printing*].

[Condensed from a report by Nicholas Carter]

Publications

ACH

Goffreddo Haus will edit a special music issue of the yearbook *Advances in Computing and the Humanities*, under the general editorship of Ephraim Nissan. The book will cover topics from the perspectives of musicology, electronic music, and experimental research in modelling and cognition. It is due to appear in 1990.

CMJ

The *Computer Music Journal* is now edited by Stephen T. Pope. Submissions may be addressed to P.O. Box 60632, Palo Alto, CA 94306 or parkplace!computer-music-journal@Sun.com. Contributions to the new calendar of events are especially welcome but should be sent 18 months in advance if possible.

CMR

An annual publication concerned with *Computers in Music Research* is scheduled to make its first appearance late this year. It will treat such topics as computer-aided analysis, computer-assisted instruction, computer-aided theory development, and work in perception and cognition. Book and software reviews will also be included. The editorial office will be maintained at the University of Wisconsin in Madison, where the journal will also be produced. The members of the editorial board come predominantly from the ranks of the Society for Music Theory.

COGNITIVE FOUNDATIONS OF PITCH

Carol L. Krumhansl and her colleagues in the Department of Psychology at Cornell University are completing a book on *Cognitive Foundations of Musical Pitch*. In progress since 1978, the book will be published by Oxford University Press. Knowledge of pitch structures in Western tonal music is correlated with pitch structures in the music itself.

COMPUTER ANALYSIS OF MUSICAL STYLE

David Cope is the author of *Computer Analysis of Musical Style*, a forthcoming book from A-R Edition, Inc.

HCY

A report on computing activities in music and musicology by Lelio Camilleri and Eleanor Selfridge-Field will appear in the second *Humanities Computing Yearbook* for 1989 edited by Ian Lancashire and Willard McCarty. The volume will be published by Oxford University Press in 1990. *HCY* contains useful lists of facilities and publications of particular value in interdisciplinary endeavors.

HUMBUL

Although entries concerning music are rare, the HUManities BULletin board maintained at Leicester University in the UK is easy to browse and quick to provide full documents when desired. It currently serves more than 2300 readers.

HUMBUL is accessible to users of JANET, EARNNET, and BITNET. The addresses for requesting files are:

LISTSERV@MAIL.RL.AC.UK (BITNET)
LISTSERV@UKACRL (EARNNET)
LISTSERV@UK.AC.RL MAIL (JANET)

The subscription command is SUB HUMBUL <your name>. Contributions of information for distribution may be sent to:

HUMBUL@MAIL.RL.AC.UK (BITNET)
HUMBUL@UKACRL (EARNNET)
HUMBUL@UK.AC.RL.MAIL (JANET)

INTERFACE

Interface, a journal initiated in 1972 in the Netherlands, publishes material concerning music in relation to physical and human sciences. Vol. 18, Nos. 1 - 2, is a double issue that explores cognitive musicology and artificial intelligence applied to music. Among the contributions are articles by Mira Balaban on AI and music, Marc Leman (the editor) on symbolic information processing, Alan Marsden and Anthony Pople on listening, David Cope on linguistic-based composition, and Lelio Camilleri on cognition. One recent article the Roumanian scientists Cosmin and Mario Georgescu proposed an approach to musicology based on General Systems Theory. A special issue on music and dynamic systems is now in preparation. Copies may be obtained by writing to Klaus Plasterk, Swets Publishing House, 347b, Heerweg, NL-2160 Ah Lisse, The Netherlands.

JMACS

The Japan Music and Computer Science Study Group, which was established in May 1985, meets every two months for presentations and lectures and holds a three-day summer workshop every year. It also issues a bimonthly bulletin (in Japanese). The Group includes computer music specialists, engineers, musicologists, ethnomusicologists, and publishers. At present the membership numbers about 200.

Topics of special interest to the group include automated performance, score transcription, score printing, automated arrangement, sound synthesis, sound recognition, perception, traditional musicology, and computational musicology.

The subscription fee is 2000 yen for individuals, and 3000 yen for overseas members. For further information please contact Keiji Hirata, NTT Software Laboratory, 3-9-11 Midori-cho, Musashino-shi, Tokyo, 180 Japan.

MARSDEN AND POPLE

Alan Marsden and Anthony Pople are editing a volume of selected papers from the Lancaster conference of 1988 entitled *Computer Representations and Models in Music*. Publication by Academic Press, London, is anticipated in 1990. The contents cover research in computer-assisted instruction, acoustics, composition, perception, and cognition.

MLA-L

An electronic mail distribution list for the Music Library Association and topics related to its interests has been established at Indiana University. The moderator is A. Ralph Papakhian. The subscription command is SUBSCRIBE MLA-L <full name>, and the electronic address is LISTSERV@IUBVM.

MRD

The Music Research Digest continues to be distributed electronically via Bitnet and related networks. MRD, now in its third year of operation, distributes queries and opinions concerning a wide range of topics, many unrelated to the research interests reflected in this publication. MRD also maintains file copies of detailed documents. An index of these documents can be obtained by sending the message "index doc" to the electronic address archive-server@bartok.sun.com.

MUSIKOMETRIKA

Musikometrika is the title of a new series of publications concerning the mathematical analysis of music. Initiated by Moisei Boroda of Tbilisi Conservatory in Georgia, USSR, the issues will form a subset of a series of publications on quantitative linguistics published in Bochum, West Germany. Of the twelve articles in the first issue, which appeared late in 1988, nine are in English, two in German, and one in French. A number of the contributors are from the USSR. The articles in English include translations of some of Boroda's most important work. Arthur Wenk writes on "Parsing Debussy: A Proposal for a Grammar of his Melodic Practice" and also provides a review of the proceedings (1984) of the Modena conference (1982) on *Musical Grammars and Computer Analysis*, edited by Mario Baroni and Laura Callegari. Other contributors include John Rahn (on Ars Antiqua motets) and Otto Laske (on cognitive musicology). The current price of *Musikometrika* is DM 44.80 and supplies are limited. Orders may be placed with Studienverlag Brockmeyer, Querenburger Höhe 281, 4630 Bochum 1, FRG. The ISBN is 3-88339-678-8.

NOTE AND TONE

Note and Tone: A Semantic Analysis of Conventional Music Notation is a formal study of knowledge representation in common music notation by Kari Kurkela of Helsinki University. It was published in 1986 by the Musicological Society of Finland.

PSYCHOMUSICOLOGY

Computer assisted studies in musical cognition have been reported in *Psychomusicology*, a biannual publication initiated in 1982 and published somewhat irregularly. The editor is David Brian Williams, Illinois State University, Normal, IL 61716.

Research Units

BERKELEY

A Center for New Music and Audio Research has recently been established at the University of California, Berkeley. The Center will be located at 1750 Arch Street, Berkeley. Richard Felciano is the director. David Wessel, who joined the enterprise this year, is offering classes on certain aspects of computational musicology.

BLOOMINGTON, INDIANA

Gary Wittlich and colleagues at Indiana University are attempting to develop a set of tools for the study of twentieth-century music on the NeXT. The aim is to create a "music hypertext" environment in which a student can call up a musical score from the digital library, display it on the screen, select segments to be played, call up literature on the work, and pursue study procedures such as pitch-class set transformations.

BRADFORD, UK

The Microcomputer Music Research Unit within the Department of Computing at the University of Bradford, England, lists as its current areas of research computer representation of music information, musical databases, synthesis techniques, sound analysis, instrument design, and psychoacoustics. The unit has existed for fifteen years and is well-known for its development of the Bradford Musical Instrument Simulator, which is used by computer organ manufacturers.

ESSEN, FRG

Essen University's Gesamthochschule has placed in the public domain its MAPPET software for playin, playback, and analysis of its ESAC code. The analysis component is tailored to tasks useful in the analysis of gamelan music. For further information contact Helmut Schaffrath (JMP100@DE0HRZ1A.EARN).

The Hochschule's music resources and staff are scheduled to be consolidated with those of Folkwang Conservatory in 1993. It is anticipated that this consolidation may severely restrict the effectiveness of its current research program, led by Professor Schaffrath, of computer applications in ethnomusicology. Letters in support of a continuation of the music research program may be addressed to Frau Minister Anke Brunn, Voelklinger Str., D-4000 Düsseldorf 1, FRG.

LANCASTER, UK

Andrew Fenton has set out to build an intelligent tutoring system for teaching harmony to first-year undergraduates at the University of Lancaster. The system, in C, runs on IBM PC compatibles and is one element of the research program being carried out at the Centre for Research into the Applications of Computers to Music. The director of CRACM is now Anthony Pople.

Lancaster has also been designated as Centre for Music in the British chain of units involved in the Computers in Teaching Initiative. The Centre's mission is to provide information on the use of computers in teaching to music departments in British institutions of higher education. Lisa Whistlecroft is the research associate.

In line with this initiative, the CTI Centre for Music will publish twice annually a journal, *Musicus*, featuring articles and reviews by "experts who use computers regularly in their musical work." Distribution will be free to music academics within the UK. The external subscription rate is 10 pounds sterling. Material for review should be sent to Dr. Pople.

MARSEILLE, FRANCE

Software for similarity analysis and for the implementation of temporal grammars, the former in Pascal for the Macintosh and the latter in PROLOG III for the Sun, is being developed at the Laboratoire Musique et Informatique de Marseille. The "order and chaos" group at the laboratory is exploring strategies for automatic composition that involve the analysis of existing musical idioms followed by the evaluation of decisions.

Some of the work of the group is oriented toward the study of improvisation. The bol processor, developed at LMIM in 1982 by Bernard Bel, enabled Jim Kippen in his study of tabla playing to transcribe the onomatopoeic syllables (bols) recited by tabla players in building an expert system to capture the dynamic aspects of this art. The elaboration of a grammar of rhythmic patterns was a central part of this work.

LMIM hosted a colloquium on musical structures in computer-aided music analysis in June 1988.

OTTAWA, CANADA

William McGee (music) and Paul Merkley (electrical engineering) are collaborating in a three-year project in realtime transcriptions of music at the University of Ottawa. Their aim is to distinguish individual notes in polyphonic music. Their work is being carried out on an IBM PC.

Courses of Study

NORTHWESTERN UNIVERSITY

Northwestern University in Evanston, Illinois, has been offering a master's degree in "Computer Studies in Music" for several years. The curriculum, directed by Gary Sandell, requires coursework in electrical engineering, psychology, perception, and music.

NOTTINGHAM, UK

The University of Nottingham offers both a B.A. and an M.A. in Computer Studies in Musicology. The graduate program is now five years old, the undergraduate program ten. The course concentrates on computer-assisted storage, retrieval, and analysis of music and musical notation and is suited to the interests of those intending to engage in research related to analysis, historical and stylistic studies, editorial work, cataloguing and bibliography. Enquiries may be sent to Professor John Morehen, Department of Music, University Park, Nottingham, NG7 2RD, UK.

John Roeder has introduced a course on Computational Models of Music at the School of Music at the University of British Columbia. Formal representations of harmony, counterpoint, and other musical processes are considered.

Theses

* Javier Alvarez is investigating the relation between rhythmic structure and the perception of musical time and form in a doctoral thesis at City University, London. A brief description, "Rhythm as Motion Discovered," appears in the *Contemporary Music Review* 3/1 (1989).

* At Boston University Don Cantor is developing a cognitive model for listening described in "A Knowledge Acquisition System for Segmentation in Music". He is using LISP programs with HyperCard software on a Macintosh Plus.

* Nicholas Carter's thesis on "Automatic Recognition of Printed Music in the Context of Electronic Publishing" was completed at the University of Surrey in the spring of 1989 (see *Special Topics*).

* Phillip Conrad is reported to be preparing a master's thesis at the University of Delaware that provides a prototype for the typesetting of music notation using the document formatting language TeX.

* Shane Dunne anticipated the submission of a master's thesis concerned with certain aspects of music printing in the winter of 1989. His work, which was especially concerned with a mark-setting prototype for eventual distribution in C, was carried out at the University of Western Ontario, London, Ontario, Canada.

* Matthew Fields has designed an exploratory study of analogies between formal languages and tonal musical structure at the University of Michigan. He is especially interested in analogies between constraint logic programming and musical thought.

* Victor Fuks, a graduate student in anthropology at Indiana University, uses commercial software in studies intended to demonstrate how musical parameters are used according to patterns and priorities defined by cultural processes.

* At the Hochschule für Musik in Essen, FRG, Barbara Jesser completed a Ph.D. thesis on "Interaktive Melodieanalyse: Methodik und Anwendung conputergestützter Analyseverfahren in Musikethnologie und Volksliedforschung" in May 1989. The LIED (4178 German folksongs) and BALL (1174 German ballads) databases with which her work was concerned have now been placed in the public domain.

* The DARMS-related research of Bruce McLean is reported in his doctoral dissertation, "The Representation of Musical Scores as Data for Applications in Musical Computing," which was completed at the State University of New York at Binghamton in 1988. Copies may be ordered from University Microfilms International in Ann Arbor, Michigan.

* Christoph Micklish is preparing a doctoral thesis on uses of MIDI in secondary music education at the Hochschule für Musik in Essen.

* Stephen Page's thesis, "Computer Tools for Music Information Retrieval," was completed at Oxford University in the autumn of 1988. An interactive, non-procedural query system is proposed and a high-level architecture, incorporating a database subsystem, is presented. Extensive discussion of prior efforts in the field and a substantial bibliography are also included. Copies may be ordered from the Bodleian Library, Oxford, England.

* John Schaffer completed a thesis at Indiana University in 1988 on "Developing an Intelligent Music Tutorial: An Investigation of Expert Systems and Their Potential for Microcomputer-Based Instruction in Music Theory."

* Michel Wallet is developing a graphics-based program for the creation of editions as part of a university thesis project at ERATTO in Paris. His program, *Euterpe*, for the Macintosh is designed to interface with musical transcription programs already operating at ERATTO.

* Stephen Wu, a graduate student in computer science at the University of Hong Kong, is writing a thesis on rhythmic segmentation of melodies. His emphasis is on deterministic (as opposed to heuristic) methods of analysis and his orientation is toward the automatic arrangement of popular music.

Additional graduate research is reported in the applications listings.

Special Topics

Music Software for the Visually Impaired

Efforts to enlist the help of the computer in enabling blind musicians to read music date back some considerable time. Braille codes for music actually pre-date, as best we are aware, all schemes for machine encoding for computer applications, and in this respect blind musicians have already played an important role in the evolution of music encoding. Braille codes for music vary somewhat from country to country, but all can be described as alphanumeric.

National dialects of Braille are recognized in a system for the creation of Braille music editions that has been developed at the Centre TOBIA of the Université Paul Sabatier in Toulouse. Originating in 1982, the programs now run on an IBM PC. Input differentiates score-specific information (clef, time signature, etc.) from performance-specific information (pitch, duration). A non-formatted Braille music document is created. From it, an edition can be requested in either the French dialect (fragment by fragment) or the American (bar over bar). Further information may be obtained from M. Truquet or N. Baptiste at 118, route de Narbonne, 31062 Toulouse Cédex, France. See also p. 34.

The Ohteru musical robotics group at Waseda University in Tokyo seems also to have invested a substantial amount of time in an effort of this kind. A conversion of its Standard Musical Expression (SMX) code to Braille has been in place for several years. The representation scheme used in the Braille music system was shown in the 1987 *Directory* in Illustration #3.

Another approach to the production of musical editions for the visually impaired is the creation of large-print scores. Leland Smith's SCORE program has produced hundreds of very-large-print editions through a project supported by the Library of Congress. The prevalence of scalable fonts makes this an increasingly practical option for many printing programs.

Among recent efforts, Mark Glover is developing a system designed to translate automatically an ink-print representation of a musical score into the Braille equivalent. His work is being carried out at the Royal National Institute for the Blind in Peterborough, England, on an IBM PC compatible.

The corollary need of the blind to generate conventional scores for sighted musicians is not specifically addressed in any software of which we are aware. MIDI music entry offers some possibility of this kind to blind users but fails to provide an effective way of editing the output. At the University of Oslo some macros have been written to enable a blind student to write and listen to theory exercises using *Finale*.

Artificial Intelligence and Music

One of the most rapidly growing interfaces between music research and technology is that linking music with artificial intelligence. Three workshops on artificial intelligence and music were held during 1988 and more are following in 1989.

The American Association for Artificial Intelligence has held, in the context of its annual meetings of 1988 and 1989, a one-day workshop on music and artificial intelligence. Some of the topics covered in the August 1988 meeting in St. Paul, Minnesota, were "An Expert System for Harmonic Analysis of Tonal Music" (H. J. Maxwell) and "Issues of Representation in the Analysis of Atonal Music" (John Roeder). This is a small sample drawn from a list of 19 papers. The meeting was attended by more than 40 researchers from Belgium, Canada, Israel, the UK, and the US. For the AAAI, it was the first time "research carried out within a humanities context" received formal attention. The meeting of August 20, 1989, was held in Detroit.

Copies of the 1988 workshop proceedings, which are separate from the main body of conference proceedings, are available for US $20 plus $2.40 for shipping from the AAAI, 445 Burgess Drive, Menlo Park, CA 94025, USA (some items are in press in scattered publications). Those interested in interacting with the group in future workshops may contact any of the following: Mira Balaban (Ben Gurion University), Kemal Ebcioglu (Thomas J. Watson Research Center), Marc Leman (University of Ghent), or Linda Sorisio (Los Angeles). Please see the address lists at the back of this volume for further particulars.

An entirely independent First International Workshop on Music and Artificial Intelligence was held in St. Augustin, FRG, on September 15 and 16, 1988. It was organized by Christoph Lischka under the auspices of the Gesellschaft für Mathematik und Datenverarbeitung. Its purpose was to identify AI techniques of possible value in musical applications and to suggest possible directions for future research. The participants included Mira Balaban, Antonio Camurri, David Cope, Mark Leman, and John Rahn.

On June 22 and 23, 1989, a European Workshop on Artificial Intelligence and Music took place in Genoa, Italy. Jointly sponsored by the Italian Computer Music Association (AIMI) and the computer music laboratory at the University of Genoa, the workshop included presentations on cognitive musicology, expert systems, neural networks, knowledge representation, and compositionally oriented topics.

Finally, a session on artificial intelligence and music was held as part of an electronic music conference in Sorrento, Italy, from October 28 to 31, 1988. Christoph Lischka described a neural network for harmonization in the style of J. S. Bach, while Kurt Hebel and Carla Scaletti of the University of Illinois discussed the Kyma and Javelina systems and their relationship to musical composition.

Some papers from these sessions have recently been published by the *Computer Music Journal*. Others are being collected in a book to be published by MIT Press.

Musical Information Processing Standards

The proliferation of software programs to print music has engendered increased interest in musical notation itself. The British Standards Institution has considered revising its *Recommendations for Presentation of Music Scores and Parts* of 1982. This document, created under the auspices of the Documentation Standards Committee, gives succinct advice about the grammar of musical notation. In the US two groups for the reform of musical notation have been convened. The Music Notational Modernization Assocation is at PO Box 241, Kirksville, MO 63501. The other, which is concerned with the representation of electronic and other modern music, is informally organized in Northern California.

Meanwhile, the work of the Musical Information Processing Standards committee seated by ANSI in 1986 continues, with three one-week meetings a year being the norm. Diverse locations are chosen, to facilitate interaction with different constituencies. The committee met in San Diego in February, in San Jose in July, and was scheduled to have a meeting coincident with the International Computer Music Conference in Columbus, Ohio, in November 1989.

Over the past year the sound aspect has been strongly emphasized, partly in response to the Computer Music Association's having solicited funding for two positions on the committee. The funding bodies are the Yamaha and Xerox Corporations. Attendance at the meetings is frequently sparse, but corresponding members of the committee continue to be numerous and vocal.

In addition to representatives of the music industry, the MIPS membership includes Garrett Bowles, representing the Music Library Assocation, and Craig Harris, representing the Computer Music Assocation. Both provide regular reports to their sponsors.

The standard being pursued is provisionally called Standard Music Description Language (SDML). It is described in the Journal of Development, which is edited by Alan Talbot of New England Digital. The Journal is divided into three parts, one dealing with objectives and methodology, one with time-based events, and one with technical descriptions and formal definitions.

Periodic discussions of the mission of the committee surface. Dorothy Gross has authorized reproduction of the material shown on the following pages, which encapsulates the multifaceted nature of the task of creating a standard for musical information.

Musical Information Processing Standards:

Requirements for visual and aural expression of musical attributes

In this chart, prepared by Dorothy Gross for the Musical Information Processing Standards committee, the diverse aural and visual representations of several musical attributes (structure, time, pitch . . .) are reviewed in relation to the specific requirements of different kinds of applications (publishing, education . . .).

Use	Structure	Time	Pitch	Timbre	Lyrics	Others
Publishing:						
Music	V	V	V	B	V	V
Nonmusic	V	V	V	B	V	V
Education:						
Music	R	R	R	R	R	R
Nonmusic	A	B	B	B	B	B
Student	B	B	B	B	B	B
Research:						
Music	R	A	A	A	B	A
Nonmusic	B	B	B	B	B	B
Library	B	B	B	B	B	N
Creation:						
Composer	R	R	R	R	R	R
Arranger	R	R	R	R	R	R
Copyist	V	V	V	B	V	V
Recording:						
Music	B	A	A	A	A	A
Media	A	A	A	A	A	A
Applications:						
Business	A	A	A	A	B	A
Sound	A	A	A	A	A	A
Hobby	B	B	B	B	B	B

Key --

A = extended aural set needed
B = only the basic set needed
N = none needed
R = range of needs
V = extended visual set needed

Dr. Gross comments:

The real world is more complex than this chart indicates, with interaction among the different categories of use. But the chart serves to illustrate different kinds of uses for computer applications to music.

First, the direct uses are for software tools that interface between the standard representation and more user-friendly forms. Designers and developers of these tools come into direct contact with the SDML [standard markup language], and may or may not be musicians. People involved with direct use are apt to be software professionals.

After the direct uses comes the use of the tools for musical purposes. This use involves computers but does not require direct contact with the standard itself. However, the intermediate user is concerned with a specific musical application.

The final level, the end use, consists of the music applications themselves. People involved at this level may not use computers at all. For example, an end user might be a person listening to a computer-generated recording.

Since the intermediate level combines computer literacy and musical intentions, this level is the target MIPS use . . . . It is assumed that the target users consider input from both software developers (what can be done) and music consumers (what should be done).

These levels are differentiated in the following table:

Use of MIPS	Publishing	Education	Research	Creation	Recording	Applications
Direct use	graphics tools	educational tools	database tools	music tools	digital sound	general tools
Target use	publications	CAI	databases	scores	disks & tapes	background music
End use	reading	learning	analysis	performance	music listening	other listening

Musical Data Acquisition by Optical Character Recognition

Research into techniques for automating the process of musical data acquisition through the use of optical scanning has been stimulated in the past few years by the easy availability of digitizing hardware. The difficult task of decoding bit-mapped images of music into useful information about musical content is one that has been pursued for approximately twenty years. A comprehensive review of earlier work in the field can be found in "Acquisition, Representation and Reconstruction of Printed Music by Computer" by N. P. Carter, R. A. Bacon, and T. Messenger in *Computers and the Humanities* **22** (1988), 117-136.

We reported on current projects and principles of optical scanning in the 1987 *Directory* (pp. 84) and 1988 (pp. 38-40). Among the efforts previously mentioned, the Waseda and Osaka University groups demonstrate the greatest level of sophistication and the highest degree of accuracy. The Inokuchi group at Osaka is attempting to create "playable" information from a printed page; they quote accuracy rates for nineteenth-century piano music in the range of 90% to 95%. The Ohteru group in Tokyo uses the acquired musical information for diverse purposes in the context of robotics.

The objective of the projects mentioned below is to capture data from either printed or handwritten sources and then to decode it into intelligent information sufficient to support new editions and other uses.

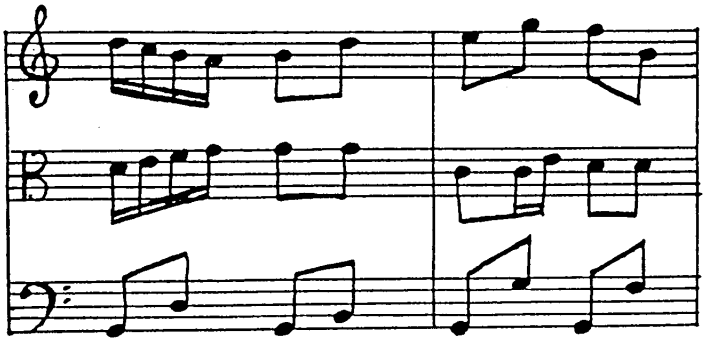
At the University of Surrey, Nicholas Carter and his colleagues continue their work in the UNIX environment. The project has migrated to a Sun workstation. Data acquisition occurs in a UNIX environment; printing is done with DOS. The conversion of handwritten music to printed music via the generation of Leland Smith's SCORE code is shown in the accompanying examples. Carter's thesis was completed in March 1989; the project continues through 1990 on a grant from the Leverhulme Trust.

At the Mathematics Institute at the University of Cardiff, Wales, Alastair Clarke's work with an IBM PC continues. His system is able to recognize single-line melodies with about 90% accuracy where the content is limited to whole, half, quarter, and eighth notes, rests corresponding to these values, accidentals, and clef signs. The work is reported in "Using a Micro to Automate Data Acquisition in Music Publishing" in *Microcomputing and Microprogramming* **24** (1988), 549-54.

Research in Optical Scanning

Contributor: Nicholas P. Carter
Place: University of Surrey, Guildford, England
Input environment: UNIX (Sun workstation)
Output environment: DOS

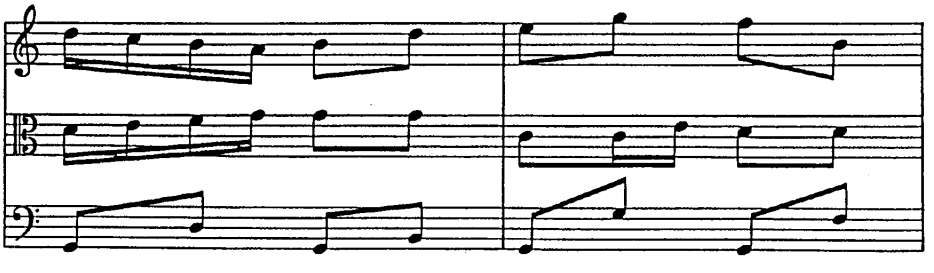
(a) A short handwritten musical example :



(b) A SCORE data file created by processing the image:

```
IN 1
0
M3/BA/G2/D3/G2/B2/M3/G2/G3/G2/F3/M3;
8/8/8/8/8/8/8/8;
;
1 2/3 4/5 6/7 8;
;
IN 2
SP 1
AL/D4/E4/F4/G4/G4/G4/C4/C4/E4/D4/D4;
16/16/16/16/8/8/8/16/16/8/8;
;
1 4/5 6/7 9/10 11;
;
IN 3
SP 1
TR/D5/C5/B4/A4/B4/D5/E5/G5/F5/B4;
16/16/16/16/8/8/8/8/8/8;
;
1 4/5 6/7 8/9 10;
;
```

(c) Reconstruction of the score from the data shown in (b):



At McGill University in Montreal, Bo Alphonce leads a group of researchers intending to "develop a system for fully machine-implemented optical score recognition" on a Sun workstation. They are using a Datacopy 730 scanner. Their work was reported in "Optical Music Recognition: A Progress Report," a paper presented at the Eighth Symposium on Small Computers in the Arts, which occurred in Philadelphia in November 1988.

In its preliminary stage, this work concentrated on clef signs, half- and quarter-notes, flagged and beamed notes, accidentals, and dots of prolongation in monophonic examples. In contrast to other efforts that attempt to disentangle overlapping symbols through bounding boxes and feature extraction, the McGill team uses a projection profile for initial differentiation of large elements. The technique was described in the M.A. thesis of one of the team members, Ichiro Fujinaga. It was entitled "Optical Music Recognition Using Projections." A near-perfect accuracy rate was achieved with training samples.

William McGee's project in the Department of Electrical Engineering at the University of Ottawa attempts to translate from musical manuscript to DARMS code. An IBM PC and Hewlett Packard ScanJet are used for input; Stephen Dydo's Note Processor provides output. McGee is also working on real time transcription of polyphonic music.

Christian Fluhr and Joseph Abouassly are working on pattern recognition programs to facilitate optical scanning of printed music at the Institut National des Jeunes Aveugles in Paris.

Databases of Musical Information

Research at CCARH

DATABASE DEVELOPMENT

The creation of databases containing complete machine-readable transcriptions of the major repertories of classical music is one of the main goals of the Center for Computer Assisted Research in the Humanities. At the present time, the Center's primary focus is on works of the eighteenth century.

The works are encoded in such a way as to permit multiple uses. These range from simple retrieval for display, searching, and playback to manipulation for editing, arranging, printing, analysis, and synthesis. Extensive study has been devoted to encoding systems in an effort to develop a representational scheme of optimum clarity and comprehensiveness.

Data entry is accomplished in two stages. The first stage involves the entry of pitch and duration information. Each part is entered separately from an electronic keyboard by one of the Center's data specialists. Other kinds of information, such as text underlay, tempo, dynamics, instrumentation, articulation, and ornamentation, are encoded alphanumerically in the next stage.

Visual and aural data verification routines are utilized at several points. Draft prints of encoded parts are checked visually against the source after the first stage of input. Data entered in the second stage is verified by careful examination of the printed score.

SOURCES, HARDWARE, SOFTWARE

The sources on which data entry is based include unedited manuscripts and early prints as well as out-of-copyright editions and modern transcriptions of early works. Each of these kinds of sources requires slightly different approaches to the creation of a complete machine-readable transcription. Elements of information that originated with a composer, scribe, or editor are differentiated from one another, and access to these individual layers of information is supported by the encoding.

The software for entry, storage, and printing has been developed by Walter B. Hewlett from 1983 to the present. Extensions and refinements continue to be made. The IBYCUS operating system, designed by David Woodley Packard, has been employed for the development of the data entry and storage systems, which use a Hewlett Packard 1000 minicomputer. Work is currently in progress to implement these systems on a UNIX workstation.

The databases are system-independent. Application programs can be written for any computer environment. It is anticipated that the first sample diskettes of data will be made available in the later part of 1990. Eventual distribution via a mass storage medium, such as CD-ROM or Digital Audio Tape, is intended. Documentation of the representational system and file structure employed is currently in preparation.

MACHINE-READABLE REPERTORIES

In the summer of 1989 the contents of the Center's databases included the following works:

J. S. Bach: *The Well-Tempered Clavier*, Books I and II, the French and English Suites, the Brandenburg concertos, the orchestral suites, works for violin and harpsichord, miscellaneous works for harpsichord solo, the chorale harmonizations, the passions (including both versions of the St. John), the B-Minor Mass, and approximately six dozen cantatas. These machine-readable transcriptions are based primarily on the Bach Gesellschaft edition.

Corelli: the 60 sonatas from Opp. 1 through 5 and the 12 *Concerti grossi*, Op. 6. These transcriptions are based on seventeenth-century printed sources from Rome and Amsterdam and on the Augener edition.

Handel: the sonatas, overtures, and concertos found in Opp. 3, 4, 6, and 7; miscellaneous keyboard and instrumental works; one opera (*Radamisto*) and one oratorio (*Susanna*). The longer works are based on Handel's autograph scores. Chrysander edition provides the basis for the transcriptions of the instrumental works. *Susanna* was professionally performed and recorded from scores and parts produced at the Center in September 1989.

Telemann: the sonatas, overtures, and suites of the *Tafelmusik*, approximately half of the 72 cantatas in the *Gottesdienst* of 1731/32, the recently discovered serenata *Deutschland grünt und blüht im Friede*, edited by Wolfgang Hirschmann, and the newly attributed opera *Orpheus*, edited by Peter Huth. The *Tafelmusik* and cantata encodings are based on eighteenth-century prints. The serenata has been newly edited by Wolfgang Hirschmann.

Many of the Center's projects are pursued in collaboration with cooperating institutions and performing organizations. The Telemann Database, for example, is organized as a collaboration between the Center and the Magdeburg (GDR) Telemann Zentrum. Other collaborators include the University of New South Wales (Australia) and Philharmonia Baroque Orchestra.

The Center provides archiving facilities for other large bodies of encoded musical data. All surviving data from the Josquin project maintained at Princeton University in the 1960's and 70's have been read into its system.

The SCRIBE Database of Fourteenth-Century Music

An array of projects is associated with the program listed as SCRIBE in the following section of this book. Several linked databases store information about source locations, discographies, descriptions of performances, iconographical evidence, and so forth. A bibliographical database lists 3058 works of the fourteenth century in 5720 locations. More than 1000 descriptive documents and more than 500 paintings are cited.

A very substantial quantity of music has also been encoded. It is estimated that 95% of all monophonic chant (3453 works, as of early 1989) has been encoded. In entry of this material, neume names are assigned. Gaps separating neumes can also be represented. In analytical routines neume names can be stripped out, facilitating the comparison of diastemmatic notation of the fourteenth century with non-diastemmatic notation of the tenth.

Data can be converted to a compacted pseudo-ASCII code and exported to a structure database. There are separate file structures for sacred/monophonic and secular/polyphonic pieces. Facsimiles of monophonic music can be output to a plotter. Since no rhythmic values are assigned, scores cannot currently be created. [See also p. 53.]

SCRIBE software is currently being used at the University of Heidelberg for management of the Cappella Sistina project, a large multi-faceted database project concerned with Renaissance music for the Vatican. In addition to Helmut Hucke and Adelbert Roth at Heidelberg, users of SCRIBE include Andrew Hughes at the University of Toronto and Howard Brown at the University of Chicago.

The Center hears regularly from publishers and scholars reporting on the use of the computer in the production of collected editions. Although we did list such projects in 1985, 1986, and 1987, we have discontinued the practice. Many widely respected publishers are producing editions by computers. The programs they use are of interest if they are generally available to the public. Most firms with computer-produced output work in the first instance from hand copy.

Groups of scholars adopting a single piece of software for music printing are creating databases of musical information which we would be happy to list if we can be pursuaded that the data is available for uses other than printing. Commercial programs often intend their codes to be opaque. This has the virtue of safe-guarding trade secrets, but it limits the usefulness of the data encoded.

We would especially encourage editorial bodies contemplating involvement in such schemes to negotiate with software providers for assistance in creating searchable files of musical information unencumbered by the printing and formatting commands. These could be used far into the future for answering questions that the availability of an electronic score is likely to stimulate.

Music Printing

Update for 1989

In its first directory, the Center showed eight examples of computer-generated music printing from several highly diverse systems, simply to show that it was possible to print music by computer. Since that time a large number of programs have appeared.

The 1986 directory carried a review article on programs to print music, pointing out the broad range of motivations that led to the development of such programs. At that time several of the most highly evolved programs were in research environments. Plotter output was prevalent. A few proprietary systems were producing high quality copy with laser phototypesetters. In the intervening three years microcomputer programs have become widely available. In the majority of cases they produce output for both dot matrix and desktop laser printers.

At this writing laser printers and phototypesetters seem increasingly to dominate the market, while plotter programs are in eclipse. Some programs that have come onto the market in recent months issue from the computer-aided design sphere of activity.

By 1987 we had recognized the need for a uniform basis on which to compare the output of different systems. To this end we distributed six months prior to publication a set of three musical examples--a four-voice Bach chorale with two verses of text underlay and a figured bass, a keyboard prelude by Bach, with rhythmically independent inner voices, and a passage from Mozart's clarinet quintet. Different sets of examples, probing diverse aspects of musical notation, were distributed in the winter of 1988 and the winter of 1989. The set pieces for 1988 were a six-voice Tallis motet on three staves and an excerpt from a Beethoven string quartet with unusual subdivisions of the beat in combination with slurs and ornaments.

The examples distributed in 1989 were a Binchois chanson, a Haydn quartet, a keyboard piece by C. P. E. Bach, and the beginning of one of Brahms' *Liebeslieder.* The Brahms example is the most difficult because of multiple problems of simultaneity. The Binchois also poses a range of problems including transposition cues at the start, brackets in the music, editorial accidentals, multiple meters and so forth. The Haydn example involves traditional problems of space allocation, clef changes within the stave, and varying subdivisions of the beat. The rococo ornamentation of C. P. E. Bach's "La Buchholtz" combined with the ever-changing distribution of notes between staves and complex rhythmic figures (one of which was erroneous in the example distributed) creates a treacherous combination of details to accommodate. Nonetheless, a very gratifying number of computer engravings was received.

The example sets are distributed to all software developers (about 75 of them) whose names are recorded in our office. Most have been eager to submit at least some of the examples in some years. A few have regularly set all the examples every year. A few have consistently avoided setting any of the distributed examples, substituting free choices in their place. Two years ago we set a limit of one free choice per firm.

Some special capabilities that have been shown in previous years (*) or which have been verified by other means include the following:

Gregorian chant [square notation] (ALPHA*, A-R, MusScribe*, SCORE*, THEME*)

Guitar tablature (Finale, MusicPrinter Plus, Note Processor, SCORE*)

Ligature indications (A-R*)

Lute tablature (ERATTO*, MusiKrafters*, SCORE*)

Mensural notation (Darbellay*, FASTCODE*, MusPrint*, SCORE,* SCRIBE*, Subtilior Press*)

Neumes (ALPHA*, SCRIBE)

Percussion figures (SCORE*)

Piano reduction of polyphonic music (Darbellay Music Processor*)

Polymetric music (Note Processor*, SCORE*)

Shape notes (MusiKrafters*, Oberon Music Editor)

Style brisé [unmeasured] (Darbellay Music Processor*)

Underlay of multiple verses of text (Dal Molin*)

The Center does not publish information about prices, hardware requirements, or range of capabilities. Prices vary widely place to place; hardware requirements and software capabilities also change from month to month. *The Musician's Music Software Catalogue*, published by Digital Arts and Technologies (P.O. Box 11, Milford, CT 06480) and sold for $5 in the US and $10 overseas, provides an extensive listing of MIDI products including music printing programs and font sets. It provides many detailed specifications. Its order prices are for the US market highly competitive.

Listings and reviews of music software are coming to be included in a wide range of scholarly journals. Robert Skinner is coordinating software information and reviews for *Notes: The Journal of the American Music Library Association*. Reviews of music printing software for the IBM PC by Garrett Bowles for *Notes* and by Nicholas Cook for *Current Musicology* are in press.

Special exhibits of music printing software are increasingly common. In the US the Music Publishers' Association has held a one-day workshop in New York in June for each of the past three years. The programs demonstrated in 1989 were Finale, the Note Processor, NoteWriter, SCORE, and the Synclavier Music Engraving System.

In the UK, a one-day exhibit of music printing software was held at the University of Surrey on May 19, 1989. The programs demonstrated included The Copyist, Finale, Graphic Notes Music Publisher, HB Music Engraver, NoteWriter, and SCORE. A concurrent seminar entitled "Music Origination by Computer: Quality and Standardization" addressed the diverse aims of users and user issues [see p. 12].

Current and Recent Contributors

This lising concentrates on systems that have been represented by illustrations (#) over the past three years. Some now dormant systems are cited in the 1987 *Directory*, pp. 27-34. Music printing programs advertised in popular music magazines are not listed here unless they have a demonstrated capability for handling classical music.

The work of some contributors represented this year has also been shown in previous years; illustrations in previous directories are indicated only for those programs for which there is no current illustration. Past illustration numbers are given in square brackets. Company locations are given after product names. Complete company addresses are given in the Business Address list.

A-R Editions, Inc.. Madison, WI. In addition to publishing many scholarly editions of music and producing academic journals, A-R supplies musical examples for other publishers. Its music printing system, originally developed by Tom Hall, has been ported over to a Sun workstation. Music input is done alphanumerically with a modified version of DARMS. A Linotron L-300 with PostScript is used for output. A version of this software intended for commercial distribution is under development. See Illustrations #10, #20, and #33.

Adagio is a musical code developed by Roger Dannenberg of Carnegie Mellon University as part of the CMU Toolkit. Pitch and octave representation are the same as in CCARH code (shown in the 1987 *Directory*) and duration representation is roughly the same as in DARMS (Q = quarter, E = eighth, etc.). The Toolkit is available with documentation for IBM PC XT and AT machines at a very modest cost from the Computer Science Department at CMU (Pittsburgh, PA 15213).

Alpha/TIMES. St. Gall, Switzerland. An integrated system for the Apple Macintosh line. TIMES stands for Totally Integrated Musicological Environment System. An unusual input method (voice recognition device with light pen) permits accurate reproduction of non-common notation. The system incorporates graphics editors, a font editor, and a communication system. It supports certain analytical tasks. Christoph Schnell is the developer. Illustrated [#9] in 1988 and previous years. No submission provided in 1989.

Amadeus Music Software GmbH. Munich, FRG. This product, originally developed by Kurt Maas, is commercially available by license for the PDP-11/73 and the Atari Mega ST4. Both alphanumeric and MIDI input are supported, the latter facilitating acoustical playback. Most data are stored as ASCII files. Output (for dot matrix and laser printers, plotters, and phototypesetters) is scalable to a resolution of 1000 dots per inch. The examples shown here were produced by the Amadeus ECRM lasersetter, a device that combines raster image processing with laser image recording. See Illustrations #7, #17, and #28.

Beethoven [from Samson Technologies]. Hicksville, NY. This program has been announced as one for the Atari and the Macintosh. It accepts MIDI input, permits the creation of custom fonts, and creates output for the Atari laser printer and the Hewlett Packard Desk Jet. Its attraction for musicologists is that its graphics library includes medieval neumes. However, the product has not yet been released and no sample was obtainable.

CCARH. Menlo Park, CA. The Center's music representation system supports the development of electronic transcriptions and editions of a large quantity of musical repertory, chiefly from the eighteenth century. Input is from an electronic keyboard; alphanumeric code is used to provide non-acoustical information. A corollary music printing system, developed by Walter Hewlett, was used to produce a performing score and parts for Handel's oratorio *Susanna* in September 1989 and for two Telemann serenatas scheduled for performance early in 1990. CCARH's input code was shown in 1987: #6.

The Copyist [from Dr. T's Music Software]. Chestnut Hill, MA. Three versions of this commercial program for Atari, Amiga, and IBM PC compatibles are offered by Dr. T's. "DTP" is the most comprehensive version. Alphanumeric and MIDI input and output are supported. Files can be converted to TIFF and EPS formats. Output supports PostScript and Ultrascript printers as well as the Hewlett Packard LaserJet Plus and plotters. The Copyist interfaces with a number of popular sequencer programs. The developer is Crispin Sion. See Illustrations #8 and #30.

Dai Nippon Music Processor. Tokyo, Japan. This dedicated system for the production of musical scores was announced two years ago. An illustration [#43] was provided in 1988. File interchange with the research system in use at Waseda University (Tokyo) is supported. The system was originally proprietary; a commercial version has now been released.

Dal Molin Musicomp. Miami, FL, and Oyster Bay, NY. Armando Dal Molin has spent a lifetime in the effort to make music printing more efficient. More than 500,000 pages of music have been printed using equipment of his design. Examples were shown in 1988 [#6-8, #32] and the internal code was indicated in 1987: #4. Dal Molin's Musicomp terminal is used by Belwin Mills Co.; a DOS version utilizing an auxiliary keypad for pitch entry is part of a larger package tailored to individual needs of existing users. The developer remains in contact with the Center and is eager to exchange ideas about computer music notation with other programmers but was unable to provide a contribution for this year.

Darbellay Music Processor. Geneva, Switzerland. This academically oriented input and printing system for IBM PC compatibles has been under development for several years by Etienne Darbellay. It was illustrated [#26-#27] in 1988 and previous years. Although outputting only to dot matrix printers and not commercially available at present, it has the ability to represent and reproduce plain chant, mensural notation (black and white, ligatures), and the unmeasured *style brisé* as well as many subtle and intricate problems of music printing. The keyboard is fully user definable. An interface with the ADLIB sound driver exists. Commercial development is intended. See Illustration #23. Automatic reduction of five voices to a two-stave score is shown in 1987's Illustration #22.

DARMS is an encoding system that originated in the 1960's. In various dialects it has been used in several printing programs including those of A-R Editions, the Note Processor, and systems developed at the State University of New York at Binghamton by Harry Lincoln (1986: #15) and at the University of Nottingham, England, by John Morehen (1986: #14).

Deluxe Music Construction Set [from Electronic Arts]. San Mateo, CA. This software program for the Macintosh line of computers produces PostScript files. Developed by Geoff Brown, it was shown in 1987 (Illustrations #39 and #40).

ERATO Music Manuscriptor, a product of the ERATO Software Corporation (Salt Lake City, UT), operates as part of an integrated workstation for composition and orchestration. Setup requires an IBM PC compatible microcomputer, a digitizer tablet, and special graphics boards supporting a resolution of 800 x 1000 pixels. Pitches are entered as MIDI data; rhythmic assignment is automatic. The program

has been used to set David Newman's score for the silent film *Sunrise*. Pattern storage (1000 slots) is provided for composition. Text underlay is available. Lines and pages can be justified automatically. A Breitkopf und Härtel font is available. This product is compatible with two desktop publishing programs, Ventura Publisher and PageMaker. Two laser printers, the Canon LBP8-11 and the Hewlett Packard LaserJet II, are supported. See Illustration #44.

ERATTO. Parisian research center in which the encoding, printing, and analysis of lute music have flourished for many years. Transcription and conversion capabilities for German lute tablature to staff notation were shown in 1988 as Illustrations #47 and #48. Bernard Stepien has developed software for the projects of Hélène Charnasse. Michel Wallet is now developing a music printing program called **Euterpe** to interface with ERATTO's musical data.

ETH. Zurich, Switzerland. Giovanni Müller and Raffaello Giulietti, who work at the Eidgenössische Technische Hochschule in Zurich, have been attempting to define a class of naturally parameterizable formatting operations in the continuing development of a high-quality music printing system at their institute. Examples focussing on particular complex aspects of music representation have been shown at conferences. No contribution was received this year. See 1987: #44.

EZ-Score Plus. This commercial product for the Atari 1040ST, shown in 1988 [#20], was previously sold by Hybrid Arts in Los Angeles, CA. Its distribution is now managed by a different firm, which we were unable to locate. Tom Bajoras developed the original product.

FASTCODE. An encoding language of the 1970's developed at Princeton University for white mensural notation. An example of plotter output was shown in 1985.

Finale from Coda Music Software, a subsidiary of Wenger Learning Systems in Bloomington, MN, supports music printing and MIDI playback. It provides immediate screen transcription of two-handed music. Four-part works played in two-stave arrangements may be "exploded" into four parts. Conversely, multi-voice music can be "imploded" to a piano reduction. A version for the Apple Macintosh is currently available and others for the IBM PC and NeXT are under development.

Data may also be entered alphanumerically. *Finale* is being used to produce the complete works of Giuseppe Verdi. There are numerous means of editorial control. PostScript printers are supported. Coda offers several music fonts--Petrucci for conventional notation, Rameau for subscripted chord names and basso continuo figures, Seville for guitar tablature, and Newport for jazz and percussion notation. Phil Ferrand developed the original program. Tim Herzog contributed this year's Illustrations #25 and #34.

Graphic Notes Music Publisher [#10-#11]. Adelaide, Australia. This program, developed by Trevor Richards for the Apple Macintosh, requires the use of a separate "presto pad" for input. It provides output for PostScript printers and typesetters. Examples were shown [#10-#11] in 1988. No contribution was received in 1989.

Gregory's Scribe. A printing program for the Apple II designed to produce Gregorian chant. In use at the University of Michigan in the mid-1980's, it was rendered obsolete by hardware discontinuations.

HB Music Engraver. Orem, UT. This printing program, distributed by HB Imaging, Inc., runs on the Apple Macintosh. Input is alphanumeric and utilizes redefinition of the QWERTY keyboard. HB output is for PostScript printers; a custom font called "Interlude" is available from the company. This program can convert files originated by another program, Mark of the Unicorn's Professional Composer. No contribution was received in 1989. Advertising copy and copyright-restricted materials only were submitted in 1988.

Hybrid Technology of Cambridge, England, developed an ASCII music notation system called AMPLE for the BBC microcomputer, a 6502 Acorn machine available in the UK. AMPLE is a complete programming language similar to *forth*.

IML-MIR. Linked languages for musical description and retrieval developed at Princeton University in the late 1960's.

Interactive Music System (IMS). Urbana, IL. This extensive system has been under development at the University of Illinois since the early 1970's. It is based on the PLATO system, although extensions for the Macintosh and other microcomputers have been made in recent years. Music can be input from an alphanumeric code or from a synthesizer. The IMS was recently used to create a score and parts for Vivaldi's opera *Orlando furioso*. Its printing capability was last shown in 1987: #46; its input and intermediate codes were shown in 1987: #5.

Laboratorio Informatica Musicale. The LIM printing system, under development by Goffreddo Haus, Luigi Finarelli and associates at the University of Milan, utilizes an Apple Macintosh. The system is designed to accept data in several codes and formats and its printing has been shown at conferences. No contribution was received in 1989.

la mà de guido [Guido's Hand]. Barcelona, Spain. Music printing software for the IBM PC XT and AT. An alphanumeric input system uses a redefined QWERTY keyboard (shown in 1988 on p. 48). Playback and analysis are supported. Graphic output is by plotter. The developer is Llorenç Balsach. These benchmarks were provided: for Haydn the input time was 7 minutes, the output 13 minutes; for C. P. E. Bach, input and output took 15 minutes each. See Illustrations #11 and #21.

Masterscore [from Steinberg Jones]. Northridge, CA. This transcription program accepts MIDI input and outputs to various dot matrix printers by the firms Atari, Epson, NEC, and Star. It runs on an Atari ST. See Illustration #41.

MTeX is a set of fonts for music typesetting with the TeX document description language. They were developed by Angelika Schofer and Andrea Steinbach at the Rheinische Friedrich-Wilhelms-Universität in Bonn. The set is available for DM 25 at Wegler Strasse 6, D-5300 Bonn, FRG.

MUSED. Oslo, Norway. This research system under development at Oslo University. supports interactive analysis and music printing. Programs currently run on a VaxStation II. Examples of its representation and in-house printing system were shown in 1988 as Illustrations #51-54. Commercial programs for music printing are also now in use.

MUSICADD [from T & S Enterprises]. Bellevue, WA. MUSICADD is a score assembly program that works with Generic CADD Level 3. It provides a menu of more than 170 musical symbols. It was added to our list too recently to request a printing sample.

MusicPrinter Plus [from Temporal Acuity Products, Inc.] Bellevue, WA. A manufacturer of interactive systems for rhythmic drill and other music teaching products, TAP's music printing program has evolved from one originally designed by Jack Jarrett for the Apple II to one for MS DOS machines. Version 3.0 permits MIDI entry of data; previous versions relied on graphic assembly of a score on the

screen. The playback choices are quite sophisticated and extend to much subtlety of articulation. Playback can be in realtime or steptime, which can be forwards or backwards. Dot matrix printers are supported. See Illustrations #18, #29, and #39.

Musicwriter II. Boulder, CO. This method for printing musical examples, developed by Cecil Effinger, requires an IBM Wheelwriter (Illustrations #4 and #42). The setup can also be used as an output device for an IBM PC compatible running the Oberon Music Editor (Illustration #13). Music is represented alphanumerically. Slurs are added by hand.

MusiKrafters. Lexington, KY. This software company offers special-purpose products for musical excerpts and unusual notations for the Apple Macintosh. Data are entered alphanumerically; it may be edited on the screen. PostScript files are produced. Robert Fruehwald is the developer. Its shape-note and tablature capabilities were shown in 1988 (Illustrations #45-46). See Illustrations #5 (music printing) and #45 (musical information management).

MusScribe. See NoteWriter.

MUSTRAN. This alphanumeric code was developed at Indiana University by Jerome Wenker in the 1960's. Music printing capabilities were extended by Don Byrd; music encoded in MUSTRAN has been used for analytical programs by Dorothy Gross, Gary Wittlich, and others.

Nightingale. Menlo Park, CA. Don Byrd's program for music notation for the Apple Macintosh is soon to be released by Opcode Systems. Provisional examples of output are shown in this year's Illustrations #1, #12, and #43.

The Note Processor. Brooklyn, NY. Stephen Dydo's program for for IBM PC compatibles accepts both alphanumeric and MIDI input; data can be edited either through code revisions or by using a mouse. The input code is a slightly modified version of DARMS; an example was shown in 1987: #1. Numerous dot matrix printers as well as the Hewlett Packard DeskJet and LaserJet printers are supported. The Note Processor is being used in East and West Germany for data entry in conjunction with the International Telemann Database Project and in several Italian bibliographical projects [see Integrated Text and Music Applications.] See Illustrations #3, #14, and #24.

NoteWriter [from Passport Designs]. Half Moon Bay, CA. This commercial product for the Apple Macintosh is the heir of *MusScribe* (1988: #12-14) and has been developed by Keith Hamel of Richmond, BC. This year's Illustration #38 (*MusScribe*) was contributed by a MusScribe user, Philip Downs, who has organized a large chamber music transcription project that uses the program. NoteWriter is used to typeset the musical examples in *Perspectives of New Music* and in the popular music publications of the GPI Corp. in Cupertino, CA. Hamel describes his approach to music printing, "Software Based on Notational Syntax," in the Winter 1989 issue of *Perspectives*.

Oberon Music Editor. Boulder, CO. This program for IBM PC compatibles is available as a stand-alone product or on a license basis. Entry is alphanumeric and supports printing only. A custom font, Callisto, and a multi-size font set called Publisher Series are available. A shape-note version of the Editor is also available. Output devices supported include the Hewlett Packard DeskJet and LaserJet series as well as various 9- and 24-pin dot matrix printers. A driver for MusicPrint Corp.'s latest electronic music typewriter has recently been written [see Musicwriter II, above]. Oberon makes a data-archiving service available to users. Illustrations #2, #13, and #22 were contributed by Nancy Colton.

Ohio State University. Extensive research project concerned with the development of a MusiCopy Language Processor terminated in late 1987. The project was headed by John Gourlay. Actual printing was oriented towards the Xerox 2700, a character-oriented laser printer. Dean Rousch's "Music Formatting Guidelines" (OSU-CISRC-3/88-TR10) is a systematic listing of the main graphic elements of common musical notation (CMN). The algorithm described in "Optional Line Breaking in Music" (OSU-CISRC-8/87-TR33) by Wael Hegazy and John Gourlay represents an effort to extend the line-breaking model developed by Donald Knuth for TeX.

Oxford Music Processor. Oxford, England. This provisional product for the IBM PC originally conceived by Richard Vendome was intended to interface with Epson dot matrix printers and HPGL plotters. It utilized alphanumeric input with keyboard redefinition. Development was suspended by Oxford University Press in 1988. See 1987: #43.

PARD. Milan, Italy. This music printing system, under development in 1988, was mainframe based, with plotter output. The developers were Walter Prati and Giorgio Ceroni. Examples of its work were shown in Illustrations #30 and #31 in 1988.

Personal Composer. Mercer Island, WA. This program by Jim Miller for the IBM PC line accepts MIDI input and outputs Postscript files. See 1987: #29. No contribution was received in 1988 or 1989.

Phil's Music Scribe (PMS). Cambridge, England. This program by Philip Hazel for the Acorn Archimedes workstation uses alphanumeric input and produces PostScript files for output. Acorn products are currently available in the UK and Europe. PMS, which is available by license only, has extensive capabilities for accommodating the needs of parts and scores derived from a common file. Staves can be overlaid, permitting four-part choral music to be shown on two staves, for example. Slur control is extensive also. Basso continuo figuration is supported. All characters found in PMS's music font are also available for use in text strings. See Illustrations #6, #15, and #26.

Plaine and Easie. This melodic input code was developed by Barry Brook and Murray Gould in the late 1960's. It has been widely used for thematic indexing projects, the most extensive of which is the manuscript cataloguing effort of the International Inventory of Musical Sources (RISM) coorindinated in Frankfurt, FRG. Diverse printing programs for RISM data have been written. One by Böker-Heil was shown as 1986: #16. An example of RISM's meta-code to facilitate printing is shown in the 1988 *Directory* on pp. 23-4.

Professional Composer [from Mark of the Unicorn]. Cambridge, MA. This commercial product for the Apple Macintosh has been poorly represented in previous years because of its failure to provide any material other than advertising copy. Its one contribution in 1988 was shown as Illustration #17; it provided no contribution in 1989.

SCORE [from Passport Designs]. Half Moon Bay, CA. Deriving from an academic research system at Stanford University, Leland Smith's SCORE program for IBM PC compatibles is now in use by major music publishers such as Schott and several performing organizations. SCORE generated the parts for a Munich performance of Wagner's Unfinished Symphony in E (WWV 35), which will be forthcoming in the

Gesamtausgabe. SCORE is also being used to produce the collected works of J.-B. Lully. Optically scanned musical data from the University of Surrey have been converted to SCORE data for printing. The input is alphanumeric and requires separate passes for pitch, rhythm, and articulation. Forty music fonts are available. There is a PostScript text font compatibility. See Illustrations #9, #31, and #35. The SCORE input code was shown in 1987: #2.

ScoreWriter [from Sonus Corp.]. Canoga Park, CA. This is a MIDI input transcription program for the Atari. No information on output devices was provided. See Illustration #40.

SCRIBE. Bundoora and Melbourne, Australia. The academic research system developed jointly by La Trobe and Melbourne Universities for fourteenth-century music is oriented mainly toward database management of musical repertories. It handles entry, display, retrieval, and analysis. Its capability for producing facsimiles of sources with any Hewlett Packard compatible plotter extends to colored notation (reduced to grey-scale reproduction in Illustrations #49 and #50 of the 1988 *Directory*). Neume type and text underlay are preserved. Single attributes (*e.g.*, pitch) may be searched. The program is available by license to both individuals and institutional sites and runs in IBM PC compatibles. The original software development was by John Griffiths; John Stinson is the head musicologist. The current software developer is Brian Parish.

Staatliches Institut für Musikforschung. West Berlin, FRG. Music printing programs written in FORTRAN in the early 1970's by Norbert Böker-Heil for IBM 360 input and output from a Digiset T 41 typesetter are currently under revision. The new programs will be written in C, will operate initially under MS DOS and later under the UNIX operating system, and will be PostScript compatible. The existing system has been used to produce scores for music publishers. Questions regarding its use may be directed to the firm of Satz-Rechen-Zentrum in Berlin. Some special uses of the system were shown in the 1988 *Directory*, pp. 122-5.

Subtilior Press. London, Ontario. David Palmer's Subtilior Press is a program for late-Medieval and Renaissance mensural notation that runs on a Macintosh Plus with Hypercard. Transcriptions are assembled on the screen from graphic elements. The price is extremely modest. See Illustration #46.

Synclavier Music Engraving System. White River Junction, VT. The Music Engraving System offered by New England Digital Corp. is designed exclusively for use with its Synclavier digital audio system. Information can be entered alphanumerically, via MIDI input, or by on-screen assembly. Scalable PostScript files are produced. Gregg Sewell, who created this year's NED contributions, recorded precise information on the time involved in his work. For Haydn, input required 12 minutes, editing 21 minutes, and output 38 seconds. For Bach the times were 26 minutes, 63 minutes, and 43 seconds. For Brahms they were 6 minutes, 47 minutes, and 50 seconds. See Illustrations #19, #32, and #36.

TELETAU. Pisa and Florence, Italy. TELETAU is an integrated system for musical data management initially developed at CNUCE in Pisa; it is now maintained jointly with the Florence Conservatory. It has a library of 800 encoded works and numerous analysis programs. Details of its encoding system were shown in 1987: #7.

THEME, The Music Editor. Charlottesville, VA. This commercial product, developed by Mark Lambert for the IBM PC, has been used extensively in certain academic settings. Its alphanumeric input system uses a redefined keyboard (shown in 1988 on p. 48). It has a provision for MIDI input and for conversion of alphanumeric files to MIDI output. Optimization of page layout is automatic. Binary-encoded data sets are available to users. THEME is being used to produce a collected edition of the works of Thomas Crequillon. See Illustrations #16, #27, and #37.

Toppan Scan-Note System. Tokyo, Japan. The Toppan system originated in Aarhus, Denmark, where it was developed by Mogens Kjaer. It is at present a proprietary system that accepts electronic keyboard input and prints music with a laser phototypesetter. Toppan Printing Co. Ltd. contracts with major music publishers and has produced some recent volumes of the *Neue Mozart Ausgabe*. Illustrations were shown in 1987: #8-12.

List of Musical Examples

Compiled by Edmund Correia, Jr.

These illustrations are presented alphabetically by composer, and alphabetically by contributor within each group. Free contributions appear in the last section.

Binchois: De plus en plus se renouvelle

#1 Don Byrd, Nightingale
#2 Nancy Colton, Oberon Systems Music Editor
#3 Stephen Dydo, Thoughtprocessors' Note Processor
#4 Cecil Effinger, Musicwriter II
#5 Robert Fruehwald, MusiKrafters' Examplekrafter
#6 Philip Hazel, Phil's Music Scribe
#7 Kurt Maas, Amadeus Music Software
#8 Crispin Sion, The Copyist
#9 Leland Smith, SCORE from Passport Designs
#10 Rolf Wulfsberg, A-R Editions, Inc.

Haydn: Quartet No.81, Movement 1

#11 Llorenç Balsach, La mà de guido
#12 Don Byrd, Nightingale
#13 Nancy Colton & Cecil Effinger, Oberon Music Editor
#14 Stephen Dydo, The Note Processor
#15 Philip Hazel, Phil's Music Scribe
#16 Mark Lambert, THEME, The Music Editor
#17 Kurt Maas, Amadeus Music Software
#18 Roger McRea, Music Printer Plus from Temporal Acuity Pr.
#19 Alan Talbot, Synclavier Music Engraving System
#20 Rolf Wulfsberg, A-R Editions, Inc.

C.P.E. Bach: La Buchholtz

#21 Llorenç Balsach, La mà de guido
#22 Nancy Colton, Oberon Systems Music Editor
#23 Etienne Darbellay, Music Processor
#24 Stephen Dydo, Thoughtprocessors' Note Processor
#25 Phil Farrand, Finale
#26 Philip Hazel, Phil's Music Scribe

#27 Mark Lambert, THEME, The Music Editor
#28 Kurt Maas, Amadeus Music Software
#29 Roger McRea, Temporal Acuity Products, Music Printer Plus
#30 Crispin Sion, The Copyist
#31 Leland Smith, SCORE from Passport Designs
#32 Alan Talbot, Synclavier Music Engraving Systems
#33 Rolf Wulfsberg, A-R Editions

Brahms: Liebeslied No. 7
#34 Tim Herzog, Finale
#35 Leland Smith, SCORE from Passport Designs
#36 Alan Talbot, Synclavier Music Engraving Systems

Free Contributions:
#37 Mark Lambert, THEME, The Music Editor--Gregorian chant
#38 Philip Downs, MusPrint--Boccherini: Quartet G.159
#39 Roger McRea, MusicPrinter Plus--Chopin: Prelude #20
#40 Sonus Corporation, ScoreWriter--Unidentified
#41 Steinberg Jones, Masterscore--Rimsky-Korsakov
#42 Cecil Effinger, Musicwriter II--Brahms Op. 118
#43 Don Byrd, Nightingale--music by David Gottlieb
#44 John Hawkins, Music Manuscriptor--music by David Newman
#45 Robert Fruehwald, Music Manager--screen displays
#46 David Palmer, Subtilior Press--Obrecht *et al.*

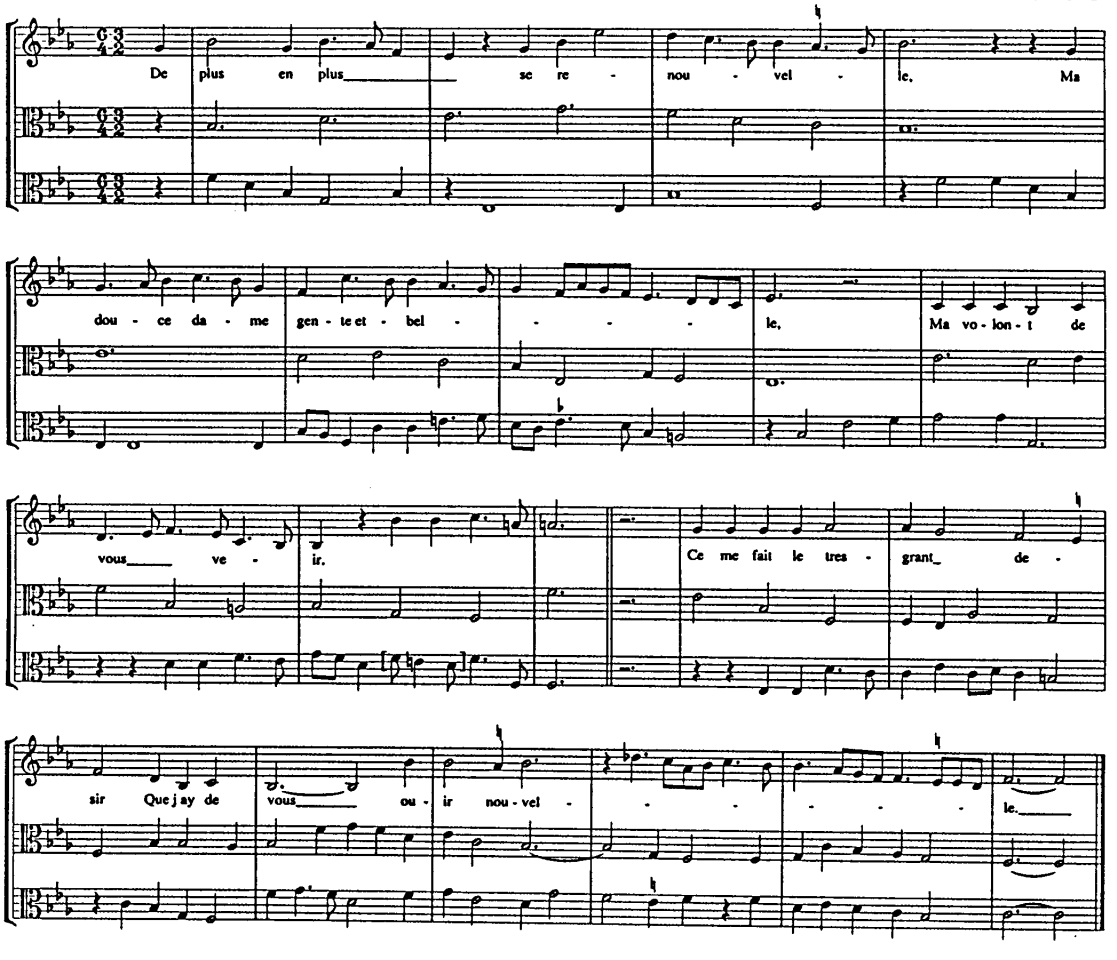
Illustration 1

Contributor: Don Byrd
Product: Nightingale
(to be released by Opcode Systems)
Running on: Apple Macintoshes

Output from: Linotronic L-300
Size as shown: 100% of original

De plus en plus se renouvelle

Binchois



Contributor: Nancy Colton
Product: Oberon Systems Music Editor
Running on: IBM PC compatibles

Output from: Hewlett Packard DeskJet
Size as shown: 78% of original

Binchois

De plus en plus se renouvelle

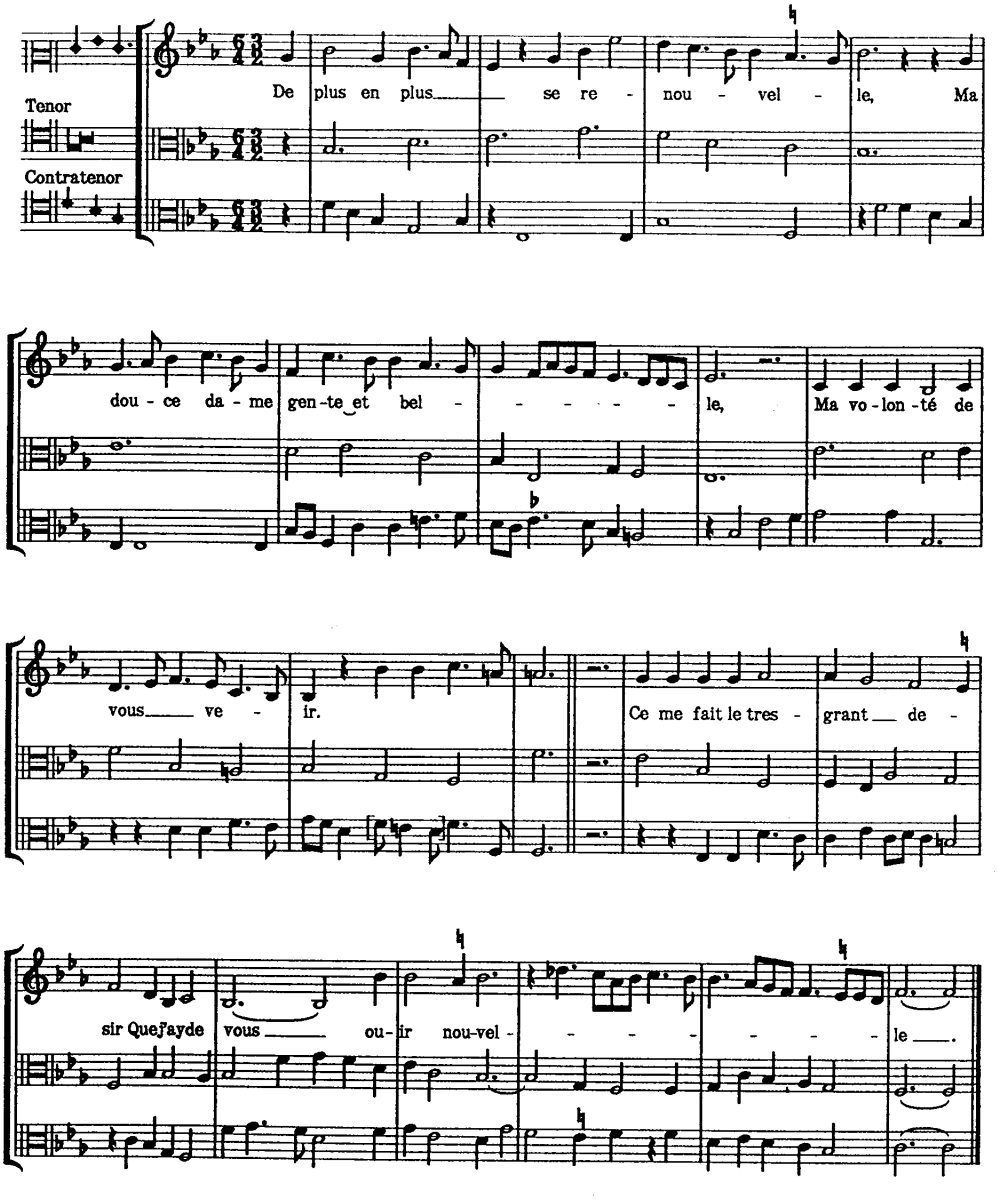


Illustration 3

Contributor: Stephen Dydo
Product: Thoughtprocessors' Note Processor
Running on: IBM PC compatibles

Output device: Hewlett Packard DeskJet
Size as shown: 64% of original

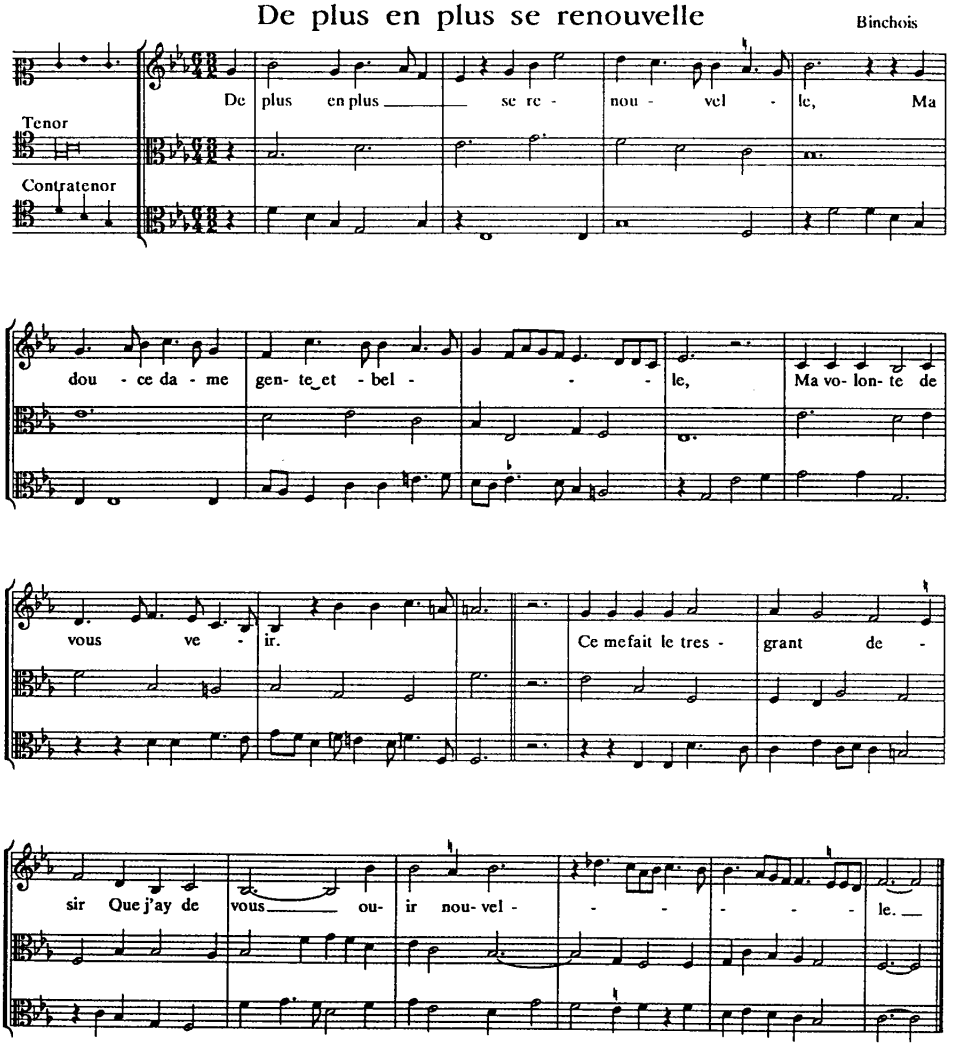


Illustration 4

Contributor: Cecil Effinger
Product: Musicwriter II

Output device: IBM Wheelwriter
Size as shown: 54% of original

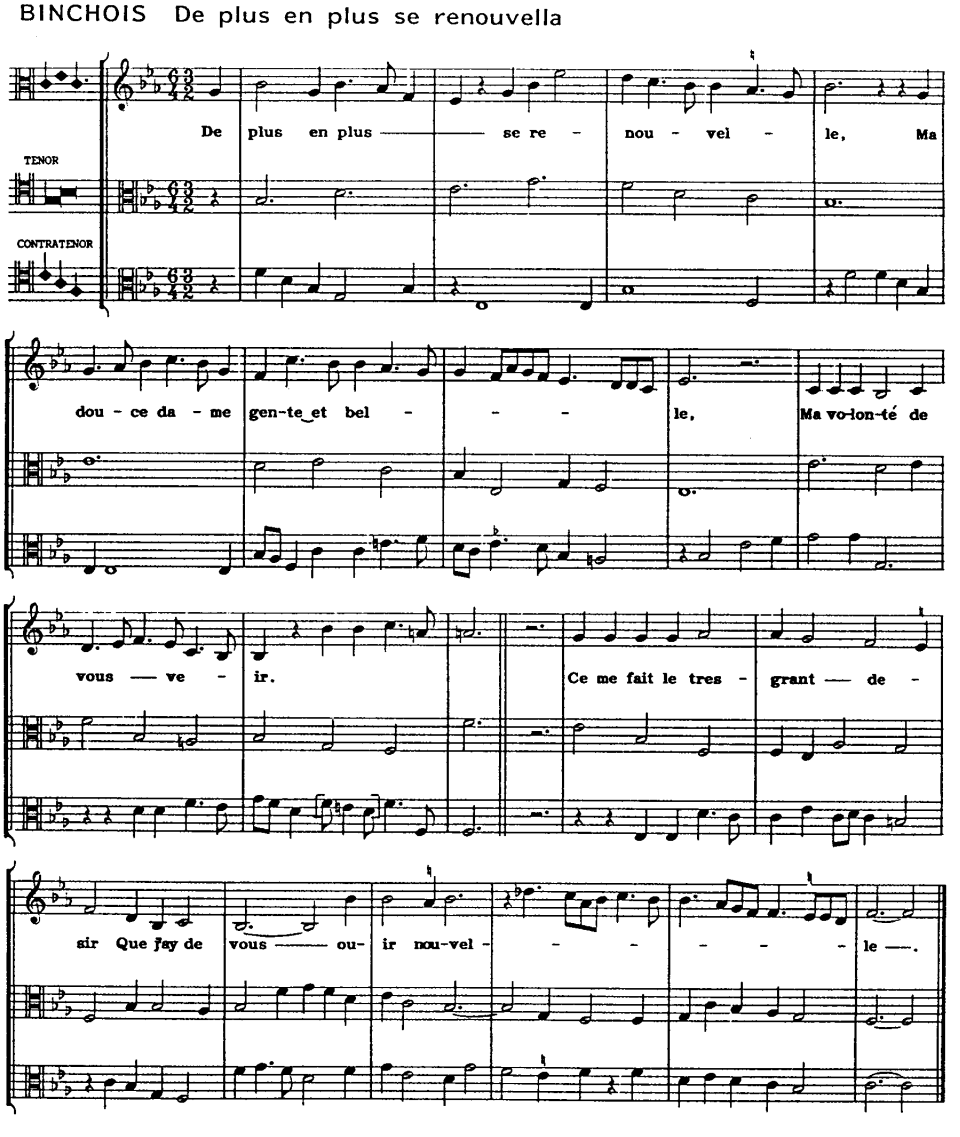


Illustration 5

Contributor: Robert Fruehwald
Product: Musikrafters' Examplekrafter
Running on: Apple Macintoshes

Output device: Apple Laserwriter
Size as shown: 100% of original

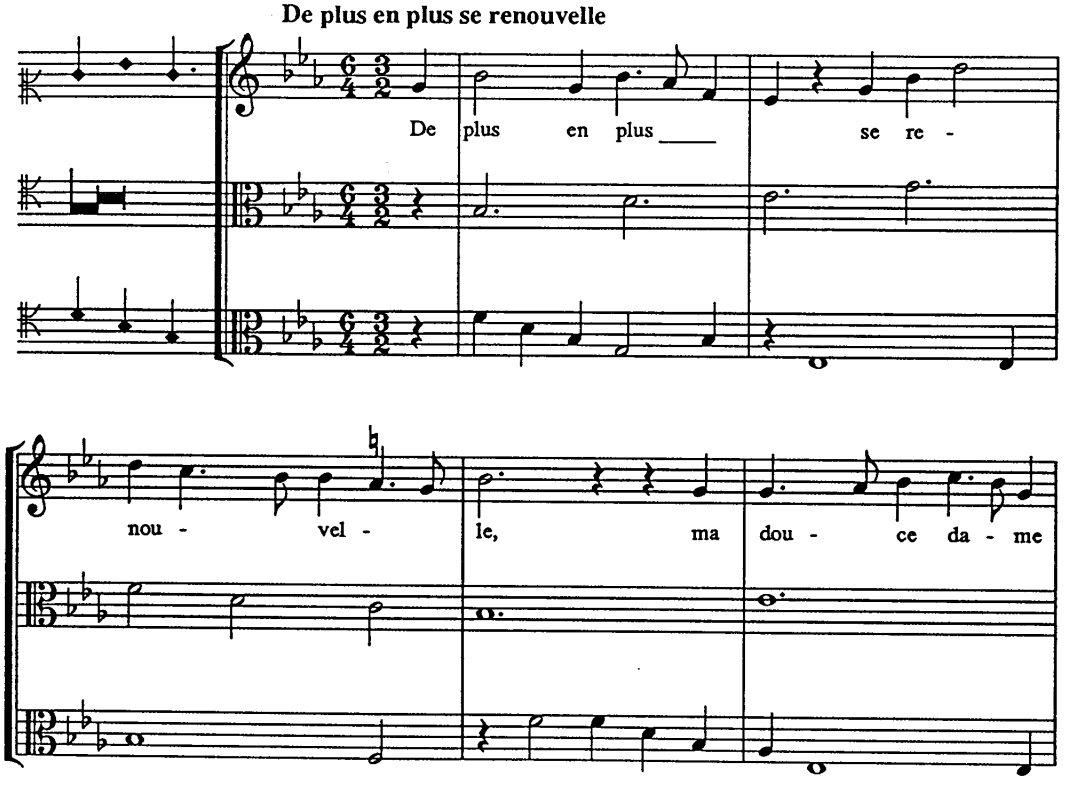


Illustration 6

Contributor: Philip Hazel
Product: Phil's Music Scribe
Running on: Acorn Archimedes workstation

Output device: Apple Laserwriter
Size as shown: 78% of original

Binchois

De plus en plus se renouvelle

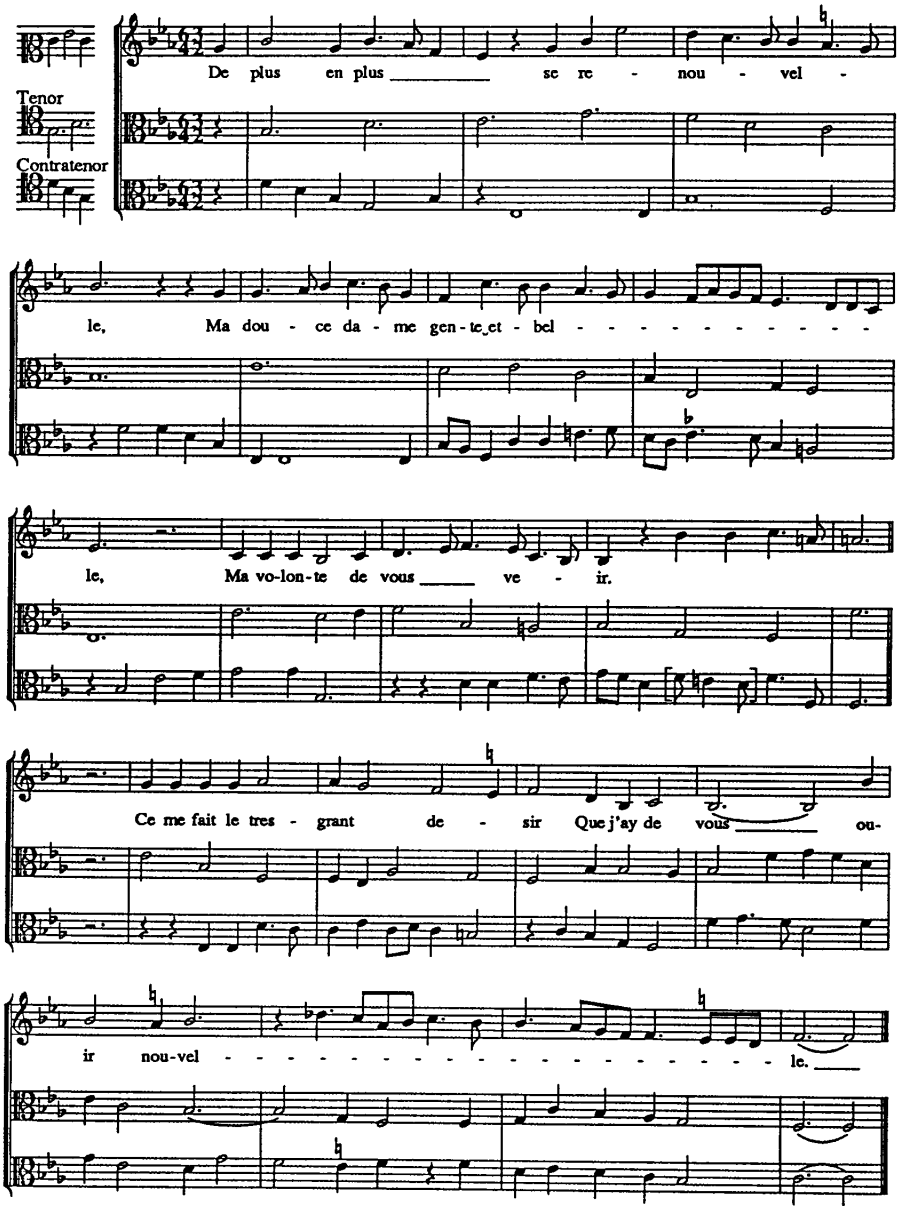


Illustration 7

Contributor: Kurt Maas
Product: Amadeus Music Software
Running on: a PDP-11/73; Atari Mega ST4

Output device: Amadeus ECRM Lasersetter (1000 d.p.i.)
Size as shown: 83% of original

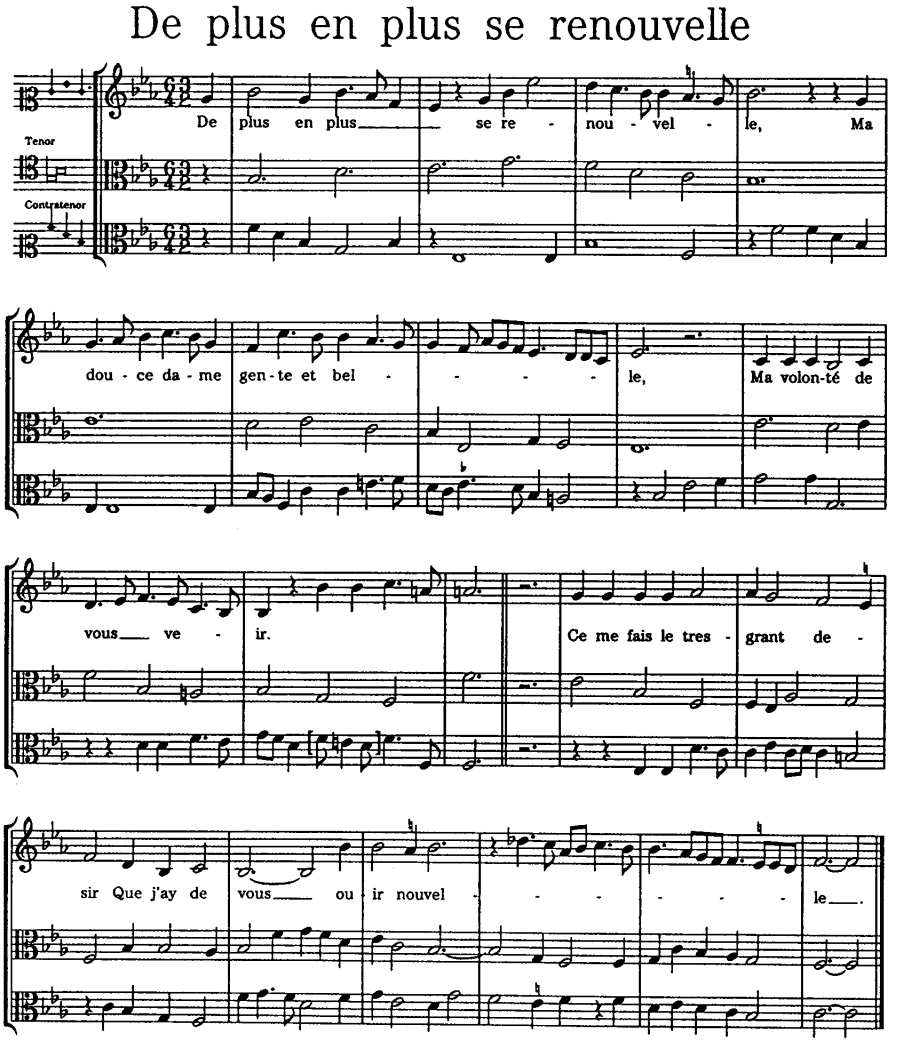


Illustration 8

Contributor: Crispin Sion
Product: The Copyist (DTP version)
from Dr. T's Music Software
Running on: Atari and Amiga microcomputers

Output device: Atari Laser Printer
Size as shown: 80% of original

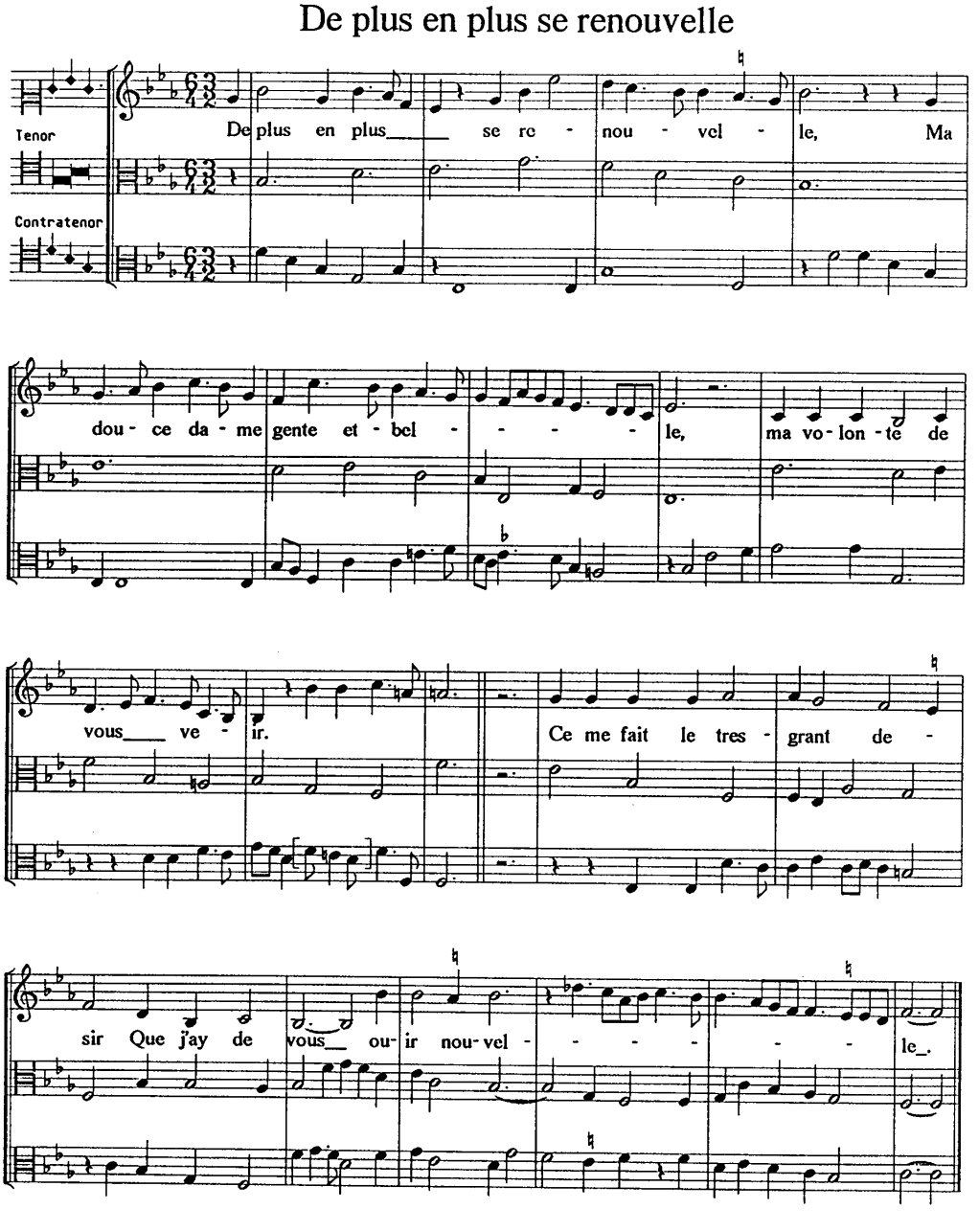
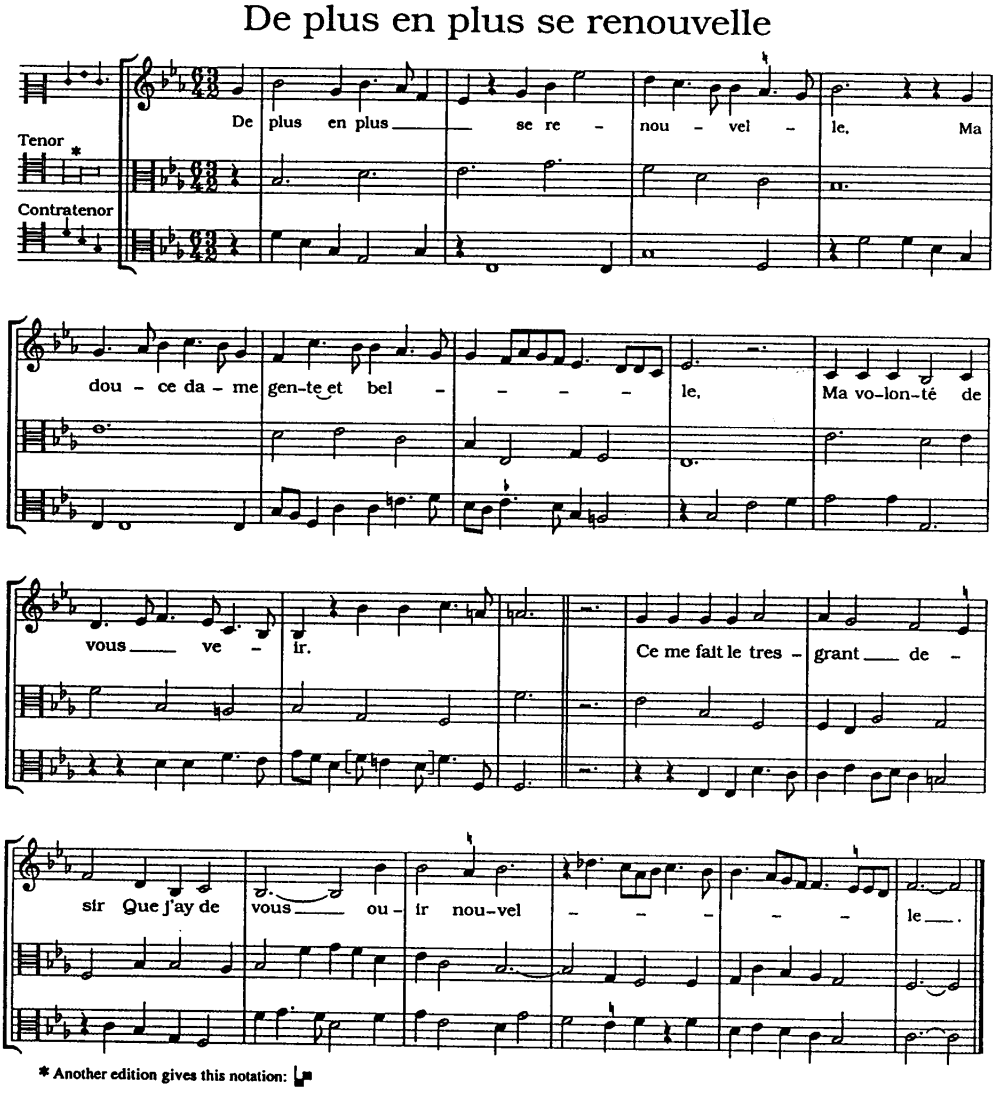


Illustration 9

Contributor: Leland Smith
Product: SCORE from Passport Designs
Running on: IBM PC compatibles

Output device: Varityper (1250 d.p.i.)
Size as shown: 70% of original



Contributor: Rolf Wulfsberg
System: A-R Editions, Inc.
Running on: a Sun workstation

Output device: Linotron L-300 (1250 d.p.i.)
Size as shown: 83% of original

De plus en plus se renouvelle

Binchois

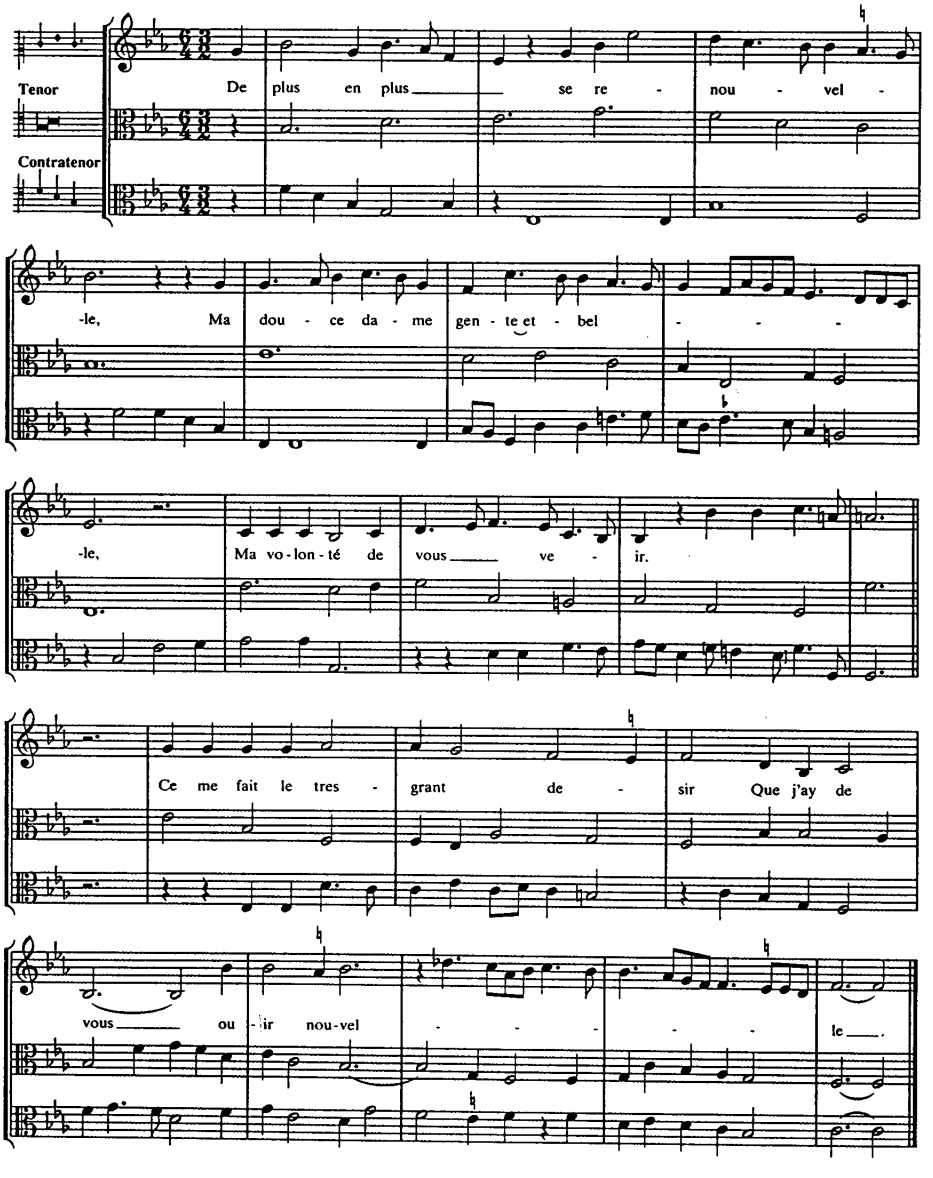


Illustration 11

Contributor: Llorenç Balsach
Product: La mà de guido
Running on: IBM PC compatibles

Output device: Hewlett Packard 7475 Plotter
Size as shown: 78% of original

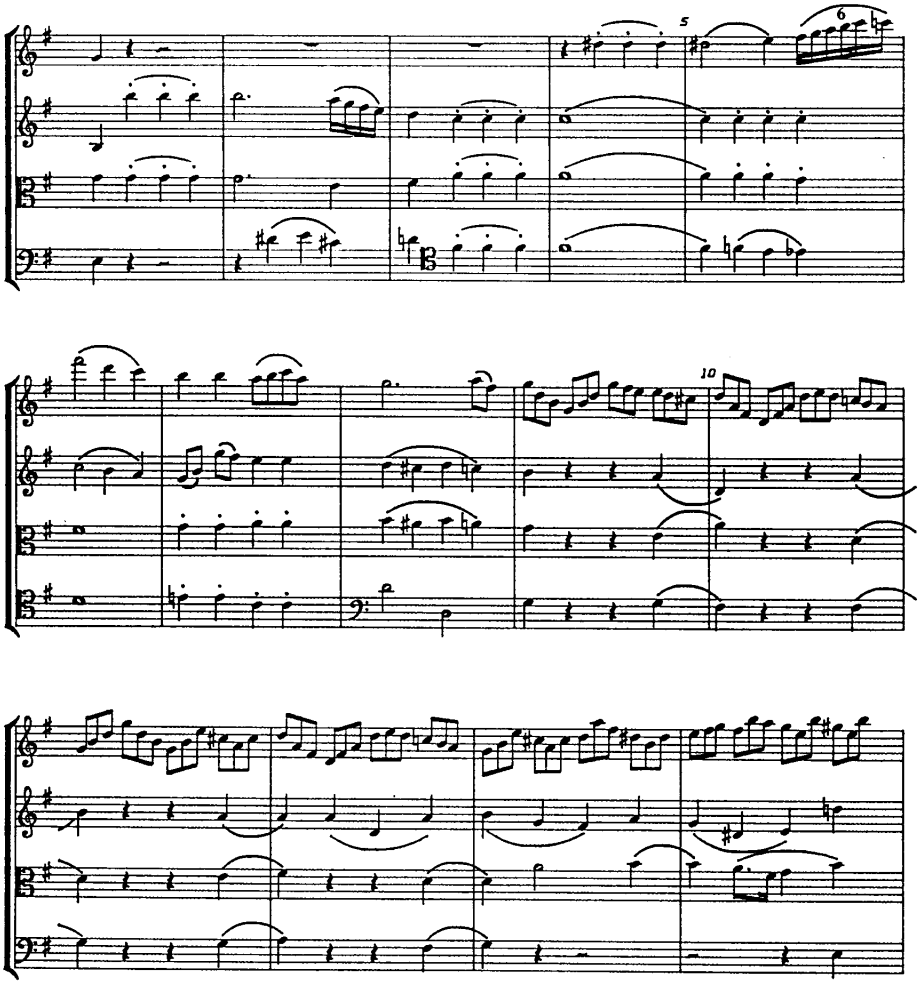


Illustration 12

Contributor: Don Byrd
Product: Nightingale
Running on: Apple Macintoshes

Output device: Linotronic L-300 typesetter
Size as shown: 82% of original

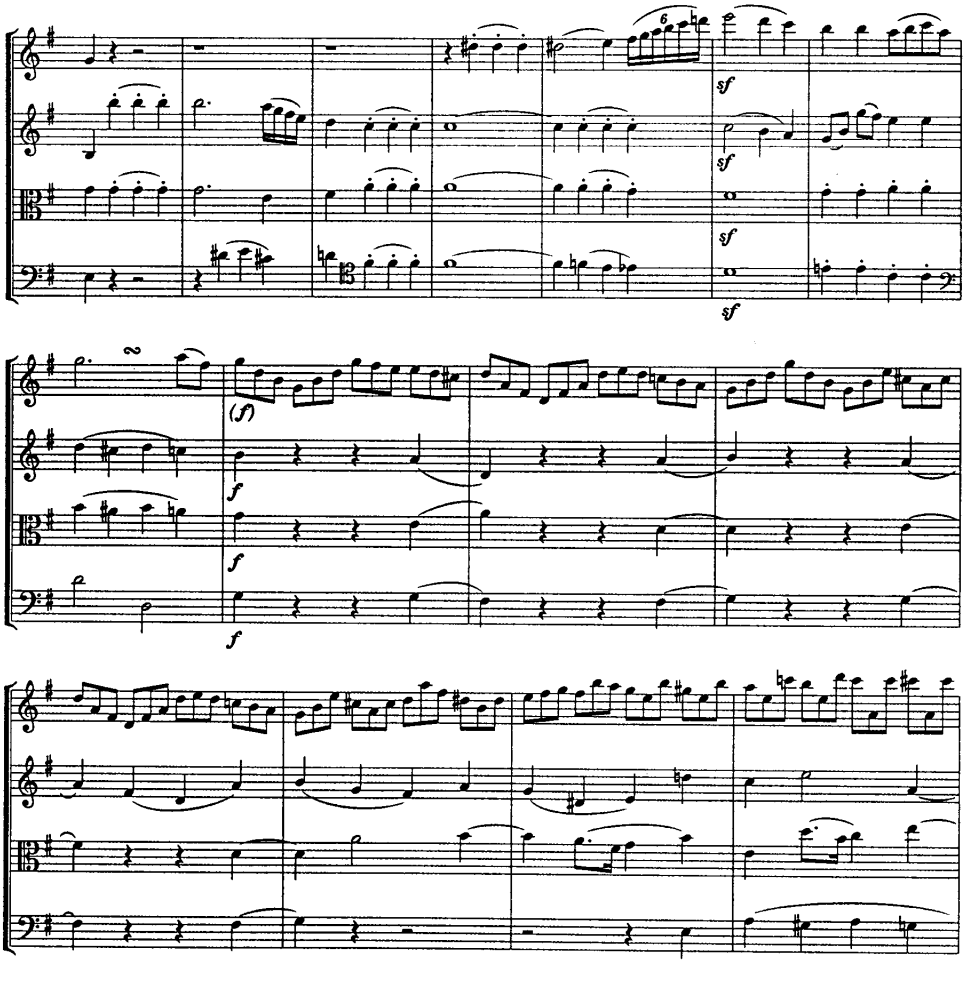


Illustration 13

Contributors: Nancy Colton, Cecil Effinger
Product: Oberon Music Editor with special driver
Running on: IBM PC compatibles

Output device: Musicwriter II
(Music Print Corp.; slurs added by hand)
Size as shown: 64% of original

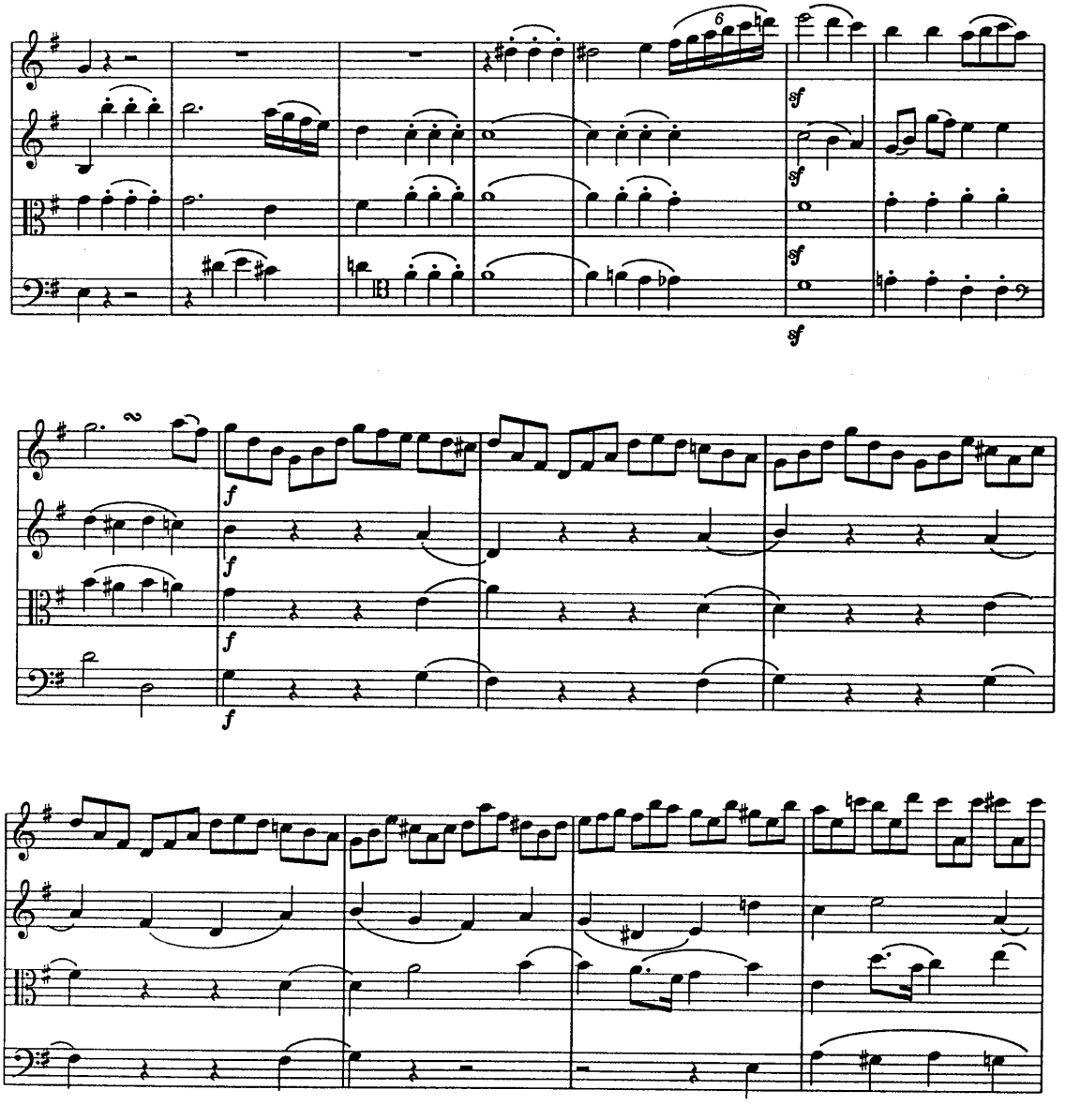


Illustration 14

Contributor: Stephen Dydo
Product: The Note Processor
Running on: IBM PC compatibles

Output device: Hewlett Packard DeskJet
Size as shown: 78% of original

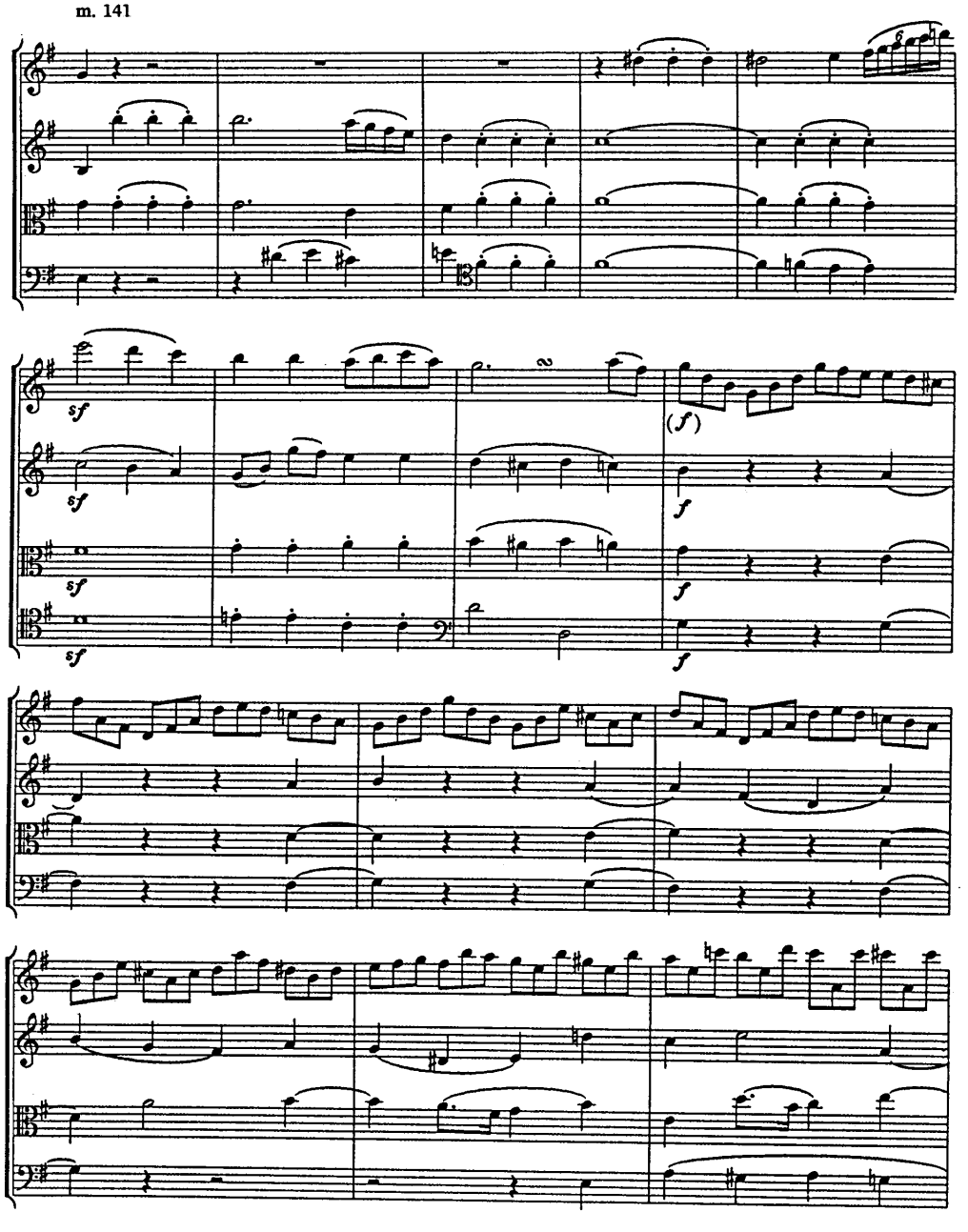


Illustration 15

Contributor: Philip Hazel
Product: Phil's Music Scribe (PMS)
Running on: Acorn Archimedes workstation

Output device: Apple Laserwriter
Size as shown: 78% of original

Haydn

Quartet No. 81, Movement 1 (Allegro Moderato)

Bars 141ff.

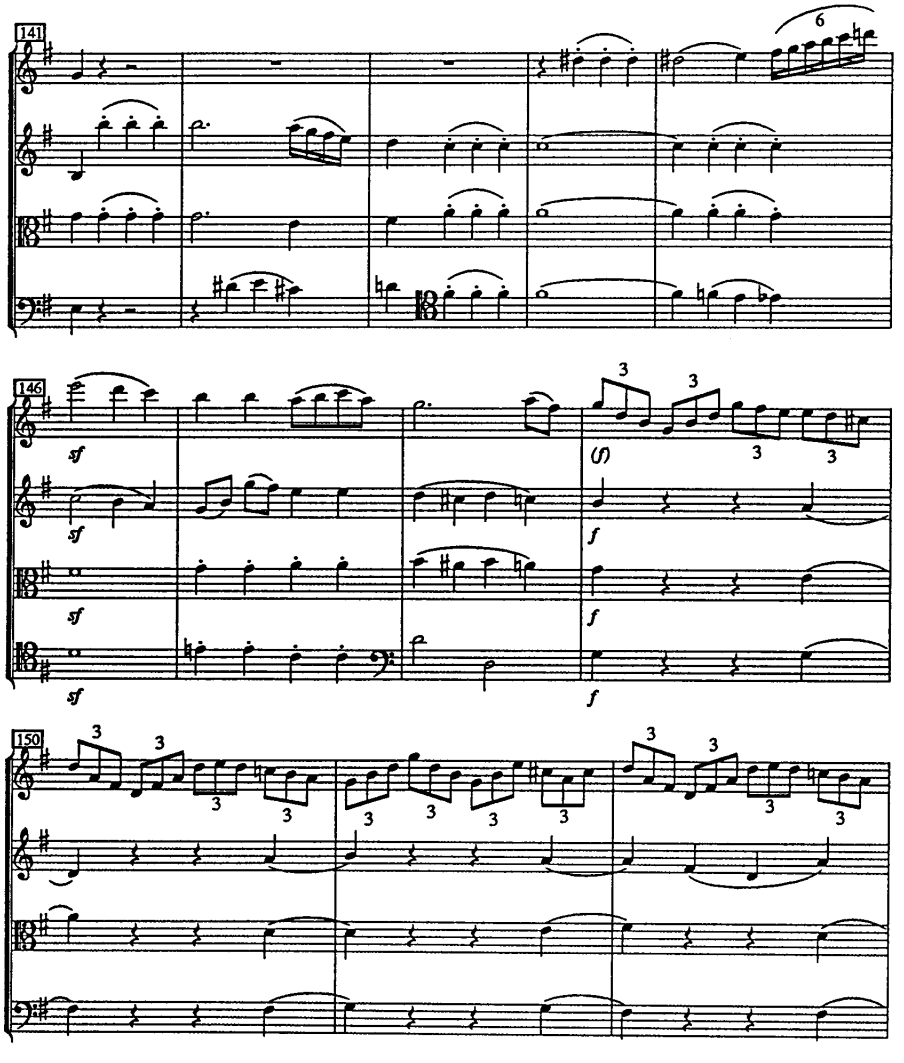


Illustration 16

Contributor: Mark Lambert
Product: THEME, The Music Editor
Running on: IBM PC compatibles

Output from: not identified
Size as shown: 45% of original

Haydn

Quartet No. 81, Movement 1 (Allegro Moderato)

Bars 141ff.

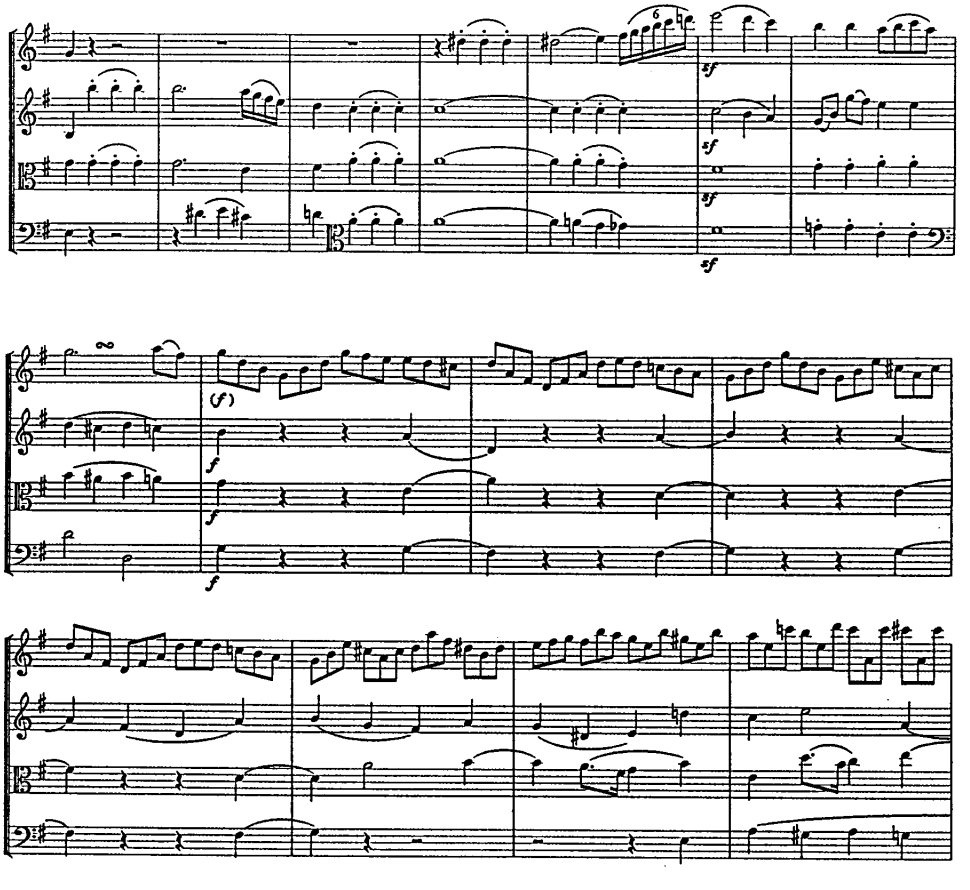


Illustration 17

Contributor: Kurt Maas **Output device:** Amadeus ECRM Laserwriter (1000 d.p.i.)
Product: Amadeus Music Software **Size as shown:** 90% of original
Running on: a PDP-11/73; Atari Mega ST4

Haydn

Quartet No. 81, Movement 1 (Allegro Moderato)

Bars 141ff.

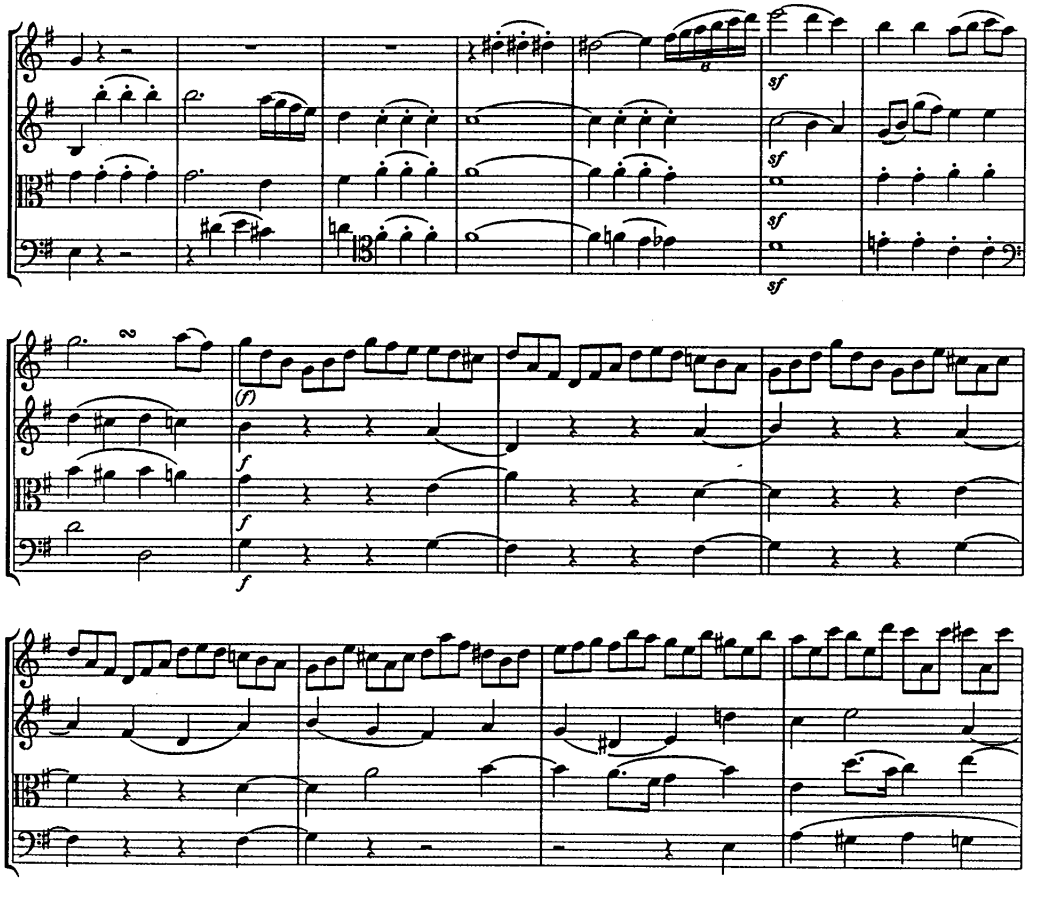


Illustration 18

Contributor: Roger McRea
Product: Music Printer Plus
from Temporal Acuity Products
Running on: IBM PC compatibles

Output device: Canon BJ-130 in 24-pin mode
Size as shown: 72% of original

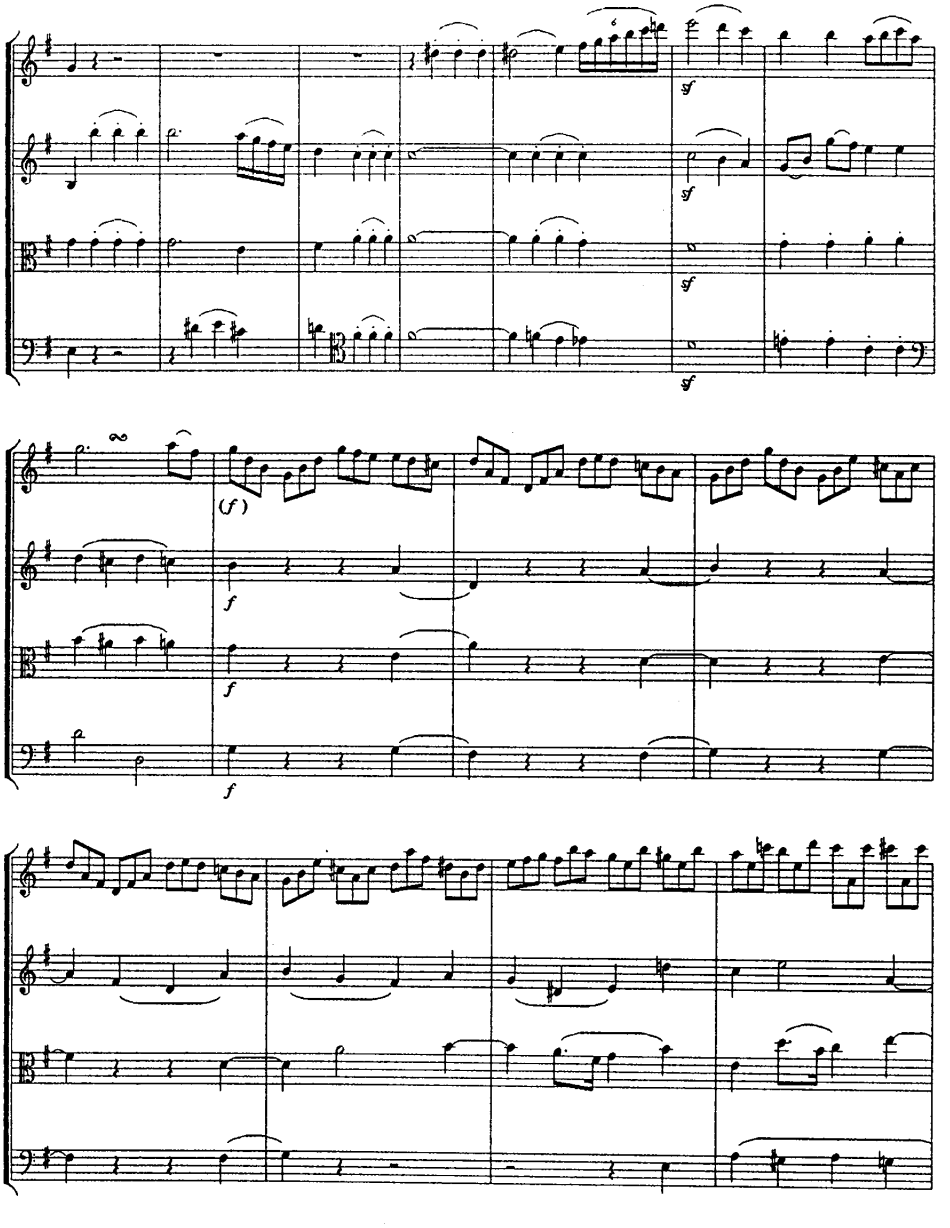


Illustration 19

Contributor: Alan Talbot
Product: Synclavier Music Engraving System
Running on: a Synclavier Digital Audio System

Output device: Linotronic L-300 typesetter
Size as shown: 78% of original

Quartet No. 81, Movement 1

Allegro Moderato, Bars 141ff.

FRANZ JOSEPH HAYDN

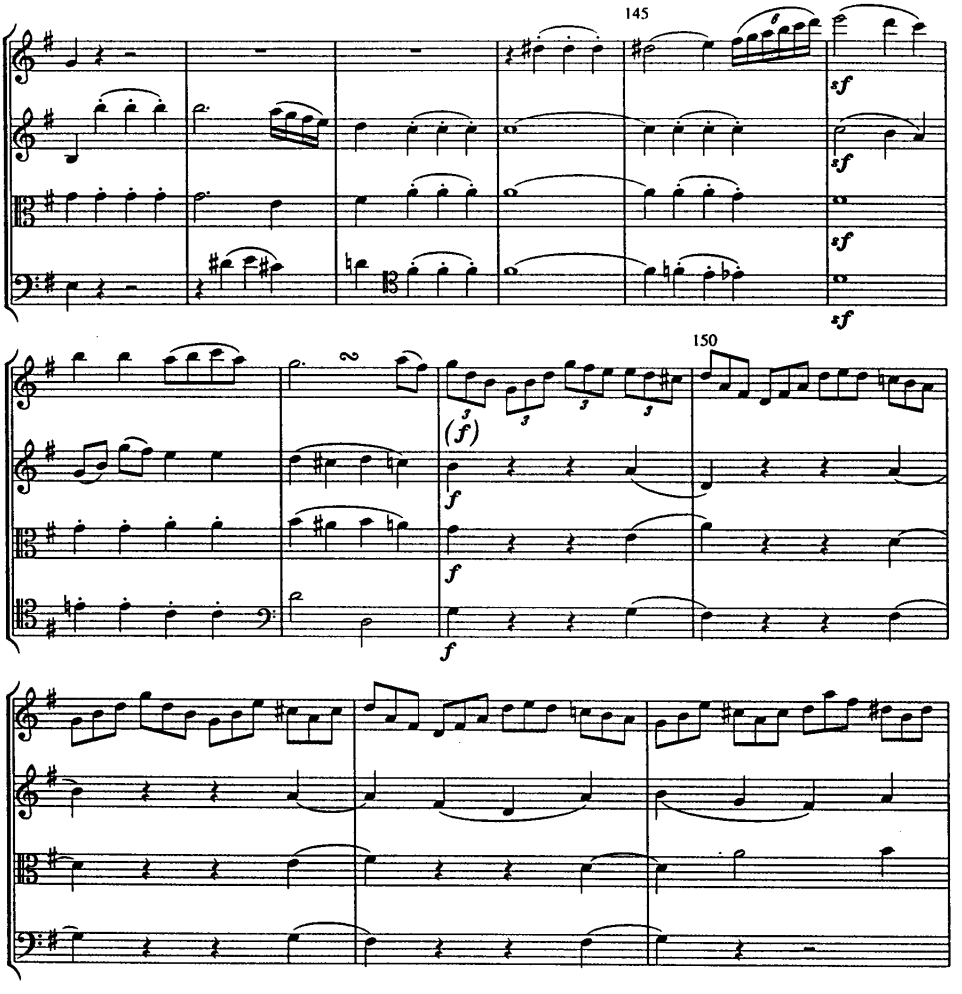


Illustration 20

Contributor: Rolf Wulfsberg
System: A-R Editions, Inc.
Running on: a Sun workstation

Output device: Linotronic L-300 typesetter
Size as shown: 86% of original

Haydn

Quartet No. 81, Movement 1 (Allegro Moderato)

Bars 141ff.

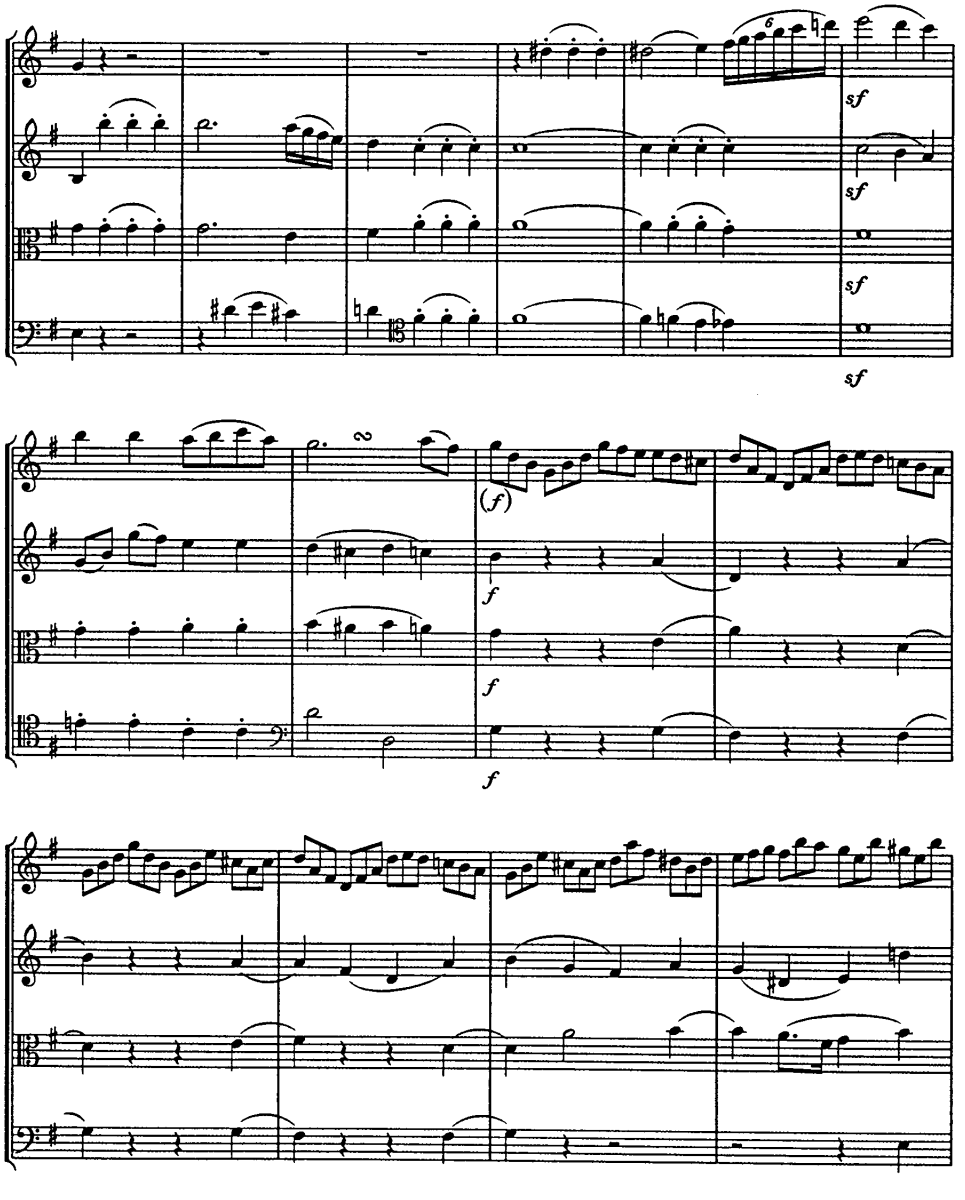


Illustration 21

Contributor: Llorenç Balsach
Product: La mà de guido
Running on: IBM PC XT and AT compatibles

Output from: Hewlett Packard 7475 plotter
Size as shown: 80% of original

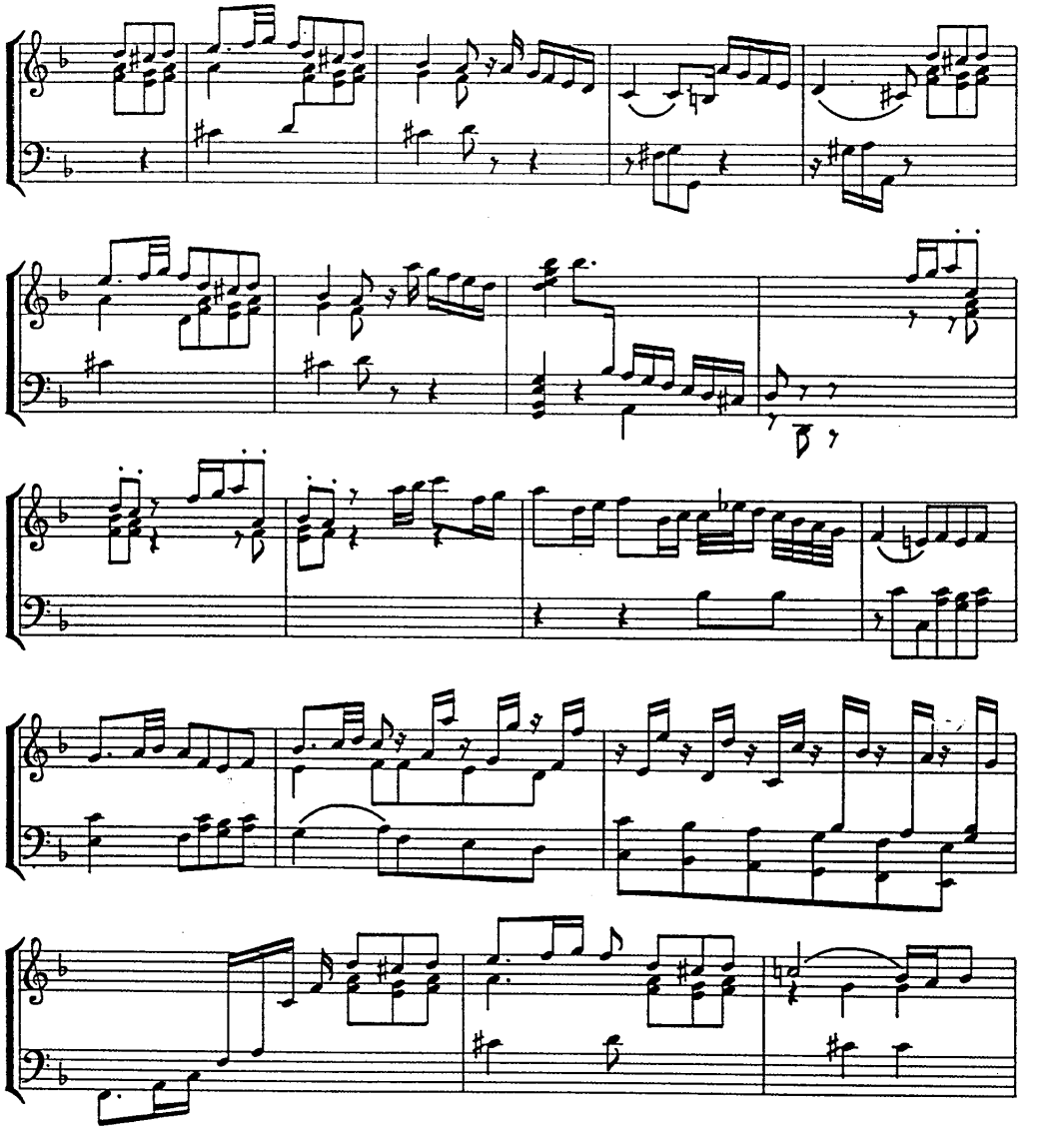


Illustration 22

Contributor: Nancy Colton
Product: Oberon Systems Music Editor
Running on: IBM PC compatibles

Output from: a Hewlett Packard LaserJet II
Size as shown: 78% of original

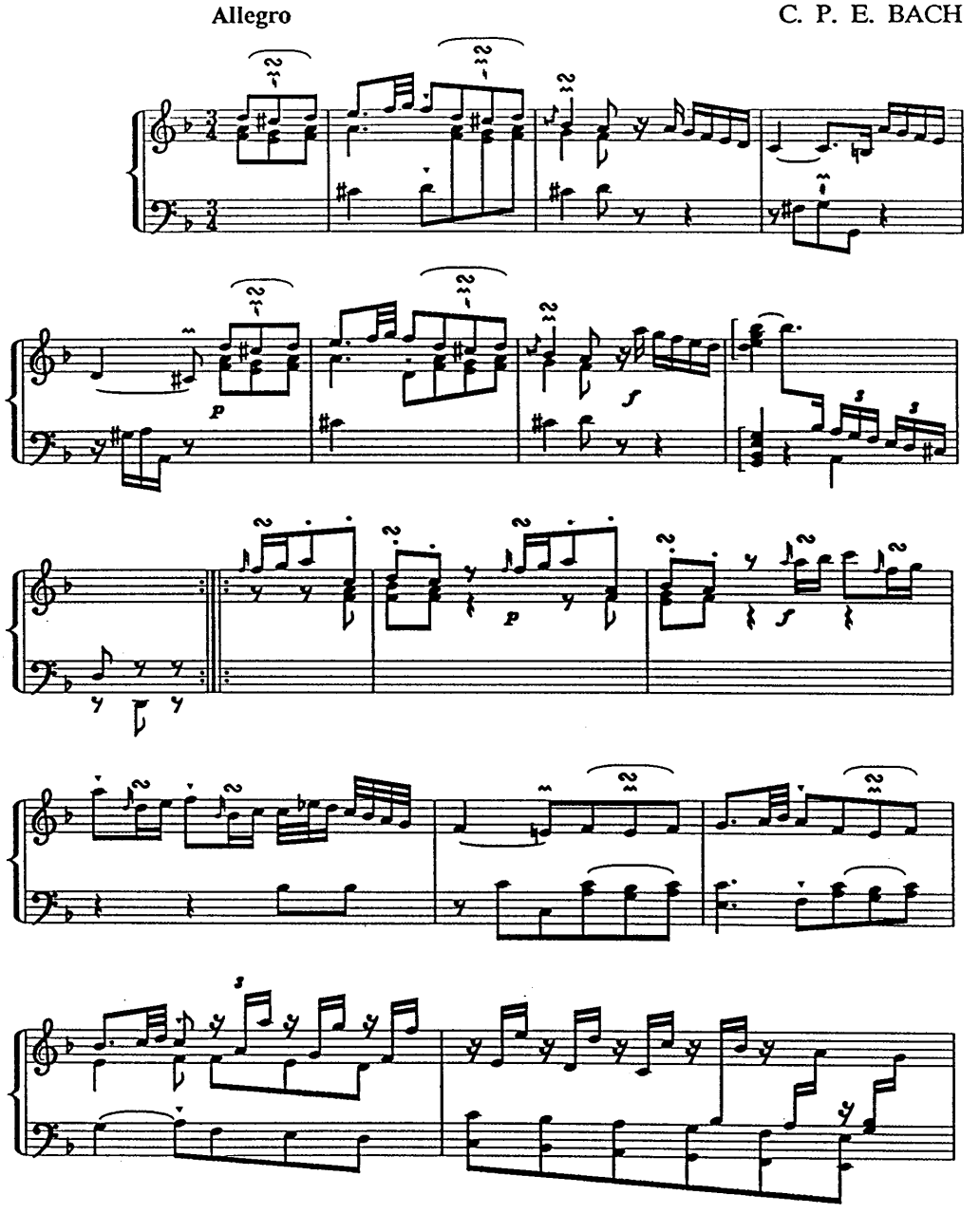


Illustration 23

Contributor: Etienne Darbellay
Product: Music Processor (under development)
Running on: IBM PC compatibles

Output from: IBM Proprinter X24
Size as shown: 80% of original

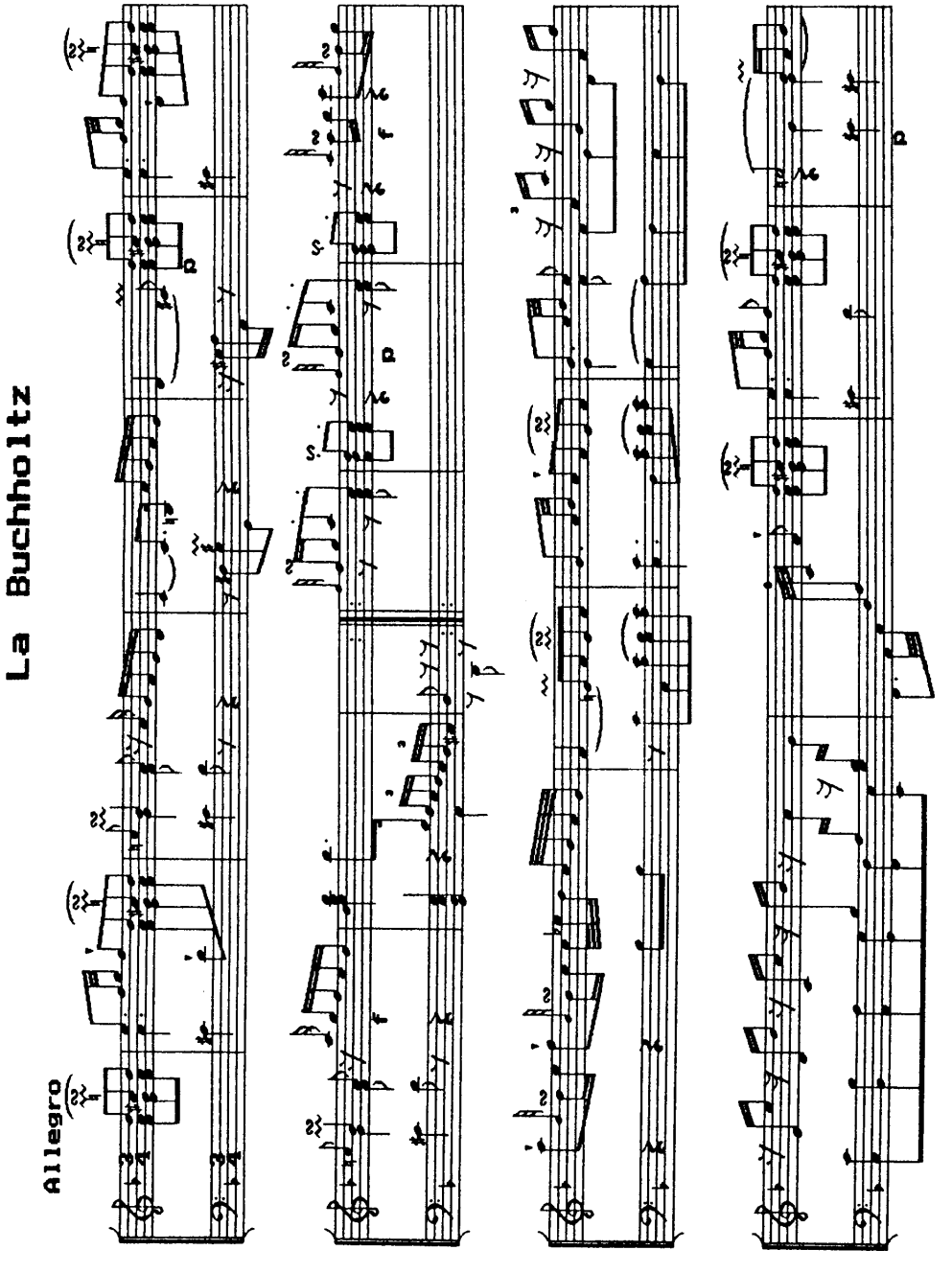


Illustration 24

Contributor: Stephen Dydo
Product: Thoughtprocessors' Note Processor
Running on: IBM PC compatibles

Output from: Hewlett Packard DeskJet
Size as shown: 74% of original

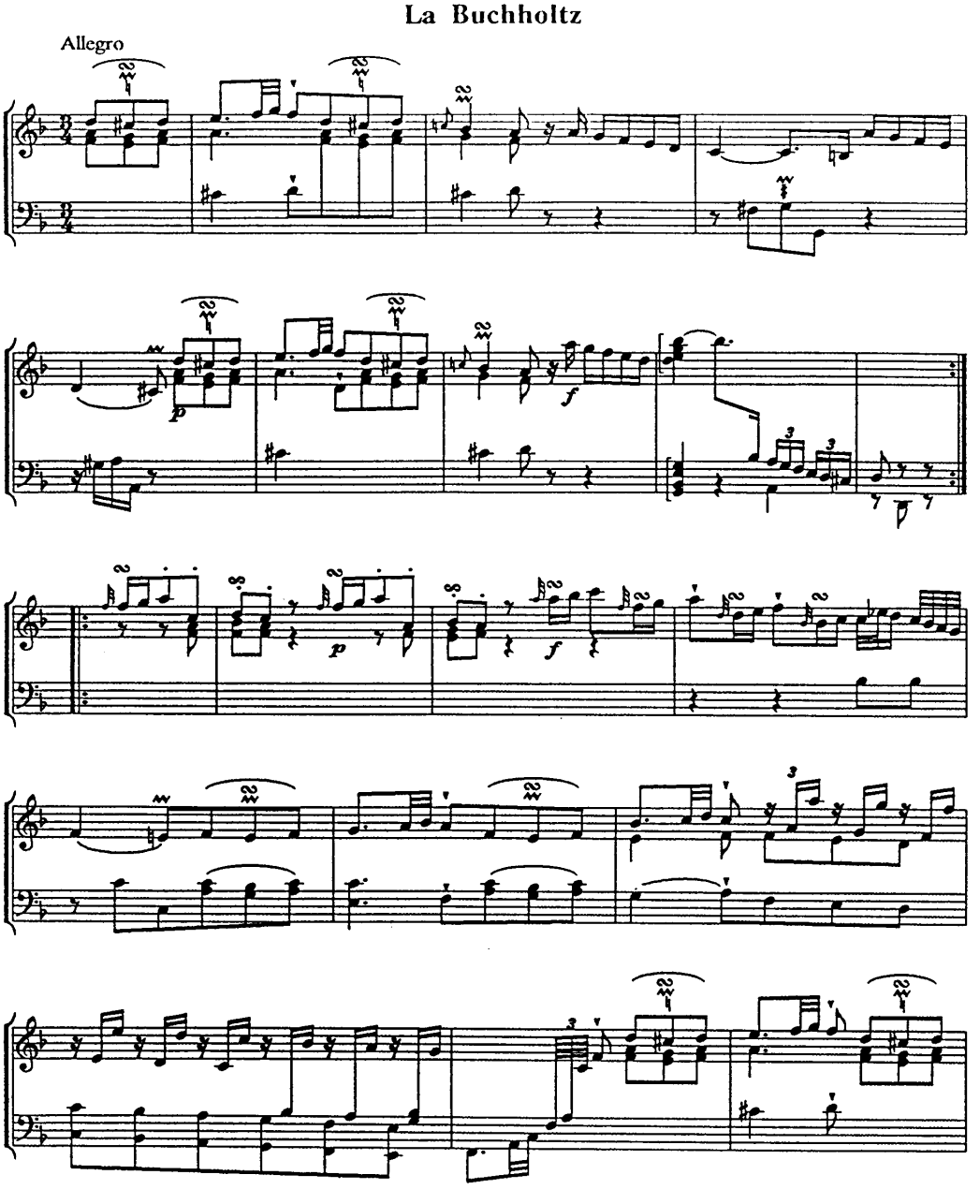


Illustration 25

Developer: Phil Ferrand
Product: Finale
Running on: Apple Macintosh

Output from: Apple LaserWriter IINT
Size as shown: 70% of original
Music font: Petrucci (from CODA)

La Buchholtz

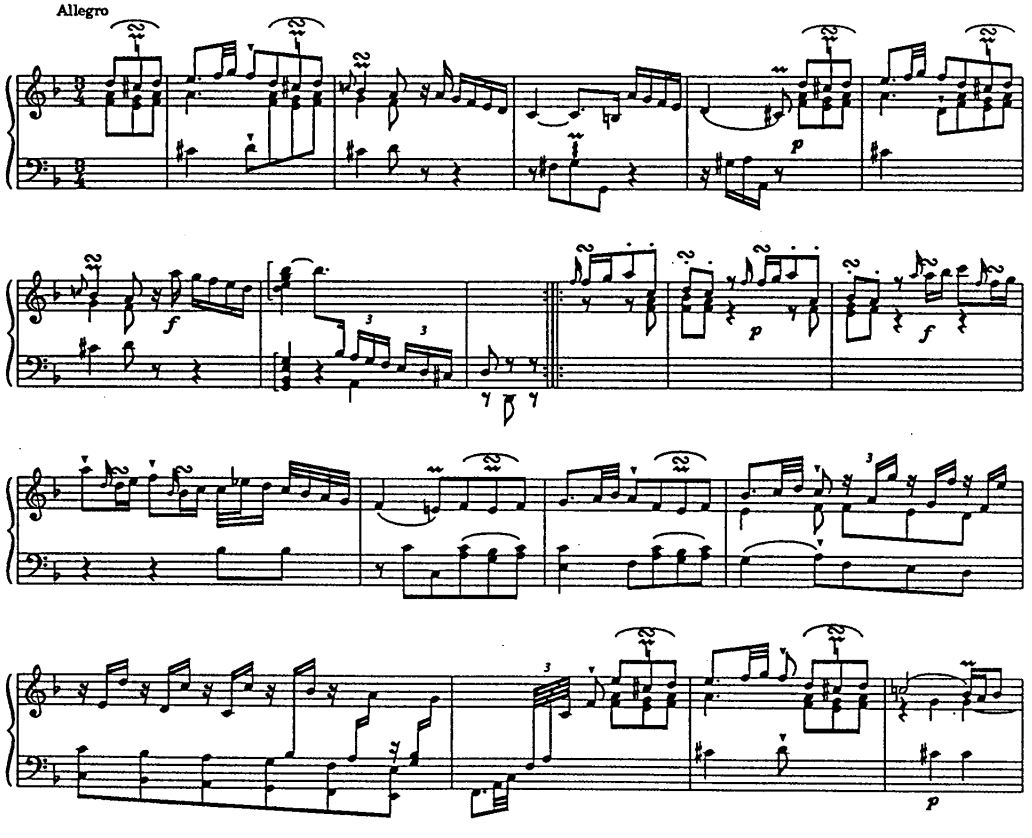


Illustration 26

Contributor: Philip Hazel
Product: Phil's Music Scribe
Running on: Acorn Archimedes workstation

Output from: Apple LaserWriter
Size as shown: 78% of original

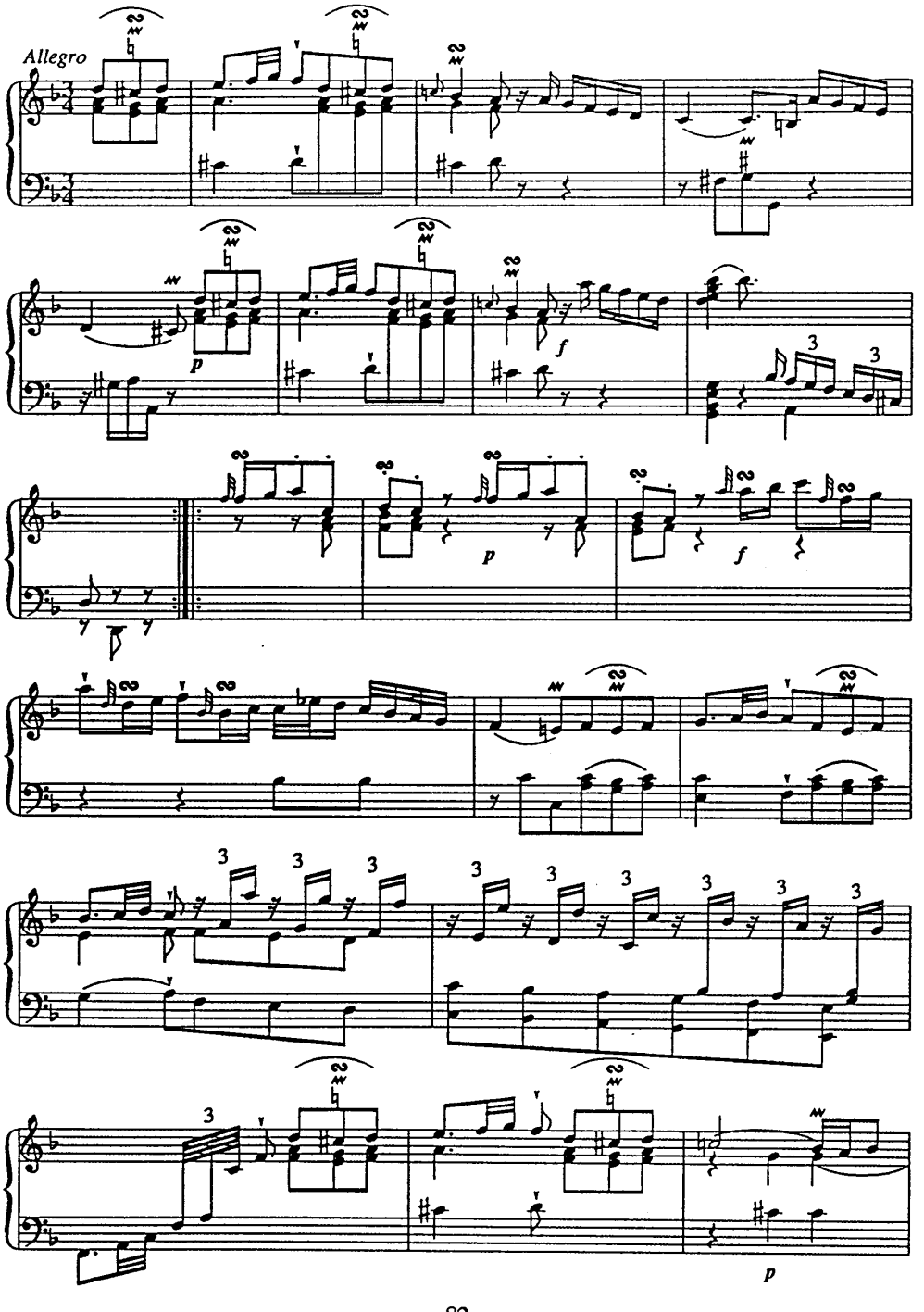


Illustration 27

Contributor: Mark Lambert
Product: THEME, The Music Editor
Running on: IBM PC compatibles

Output from: Hewlett Packard LaserJet II
Size as shown: 42% of original

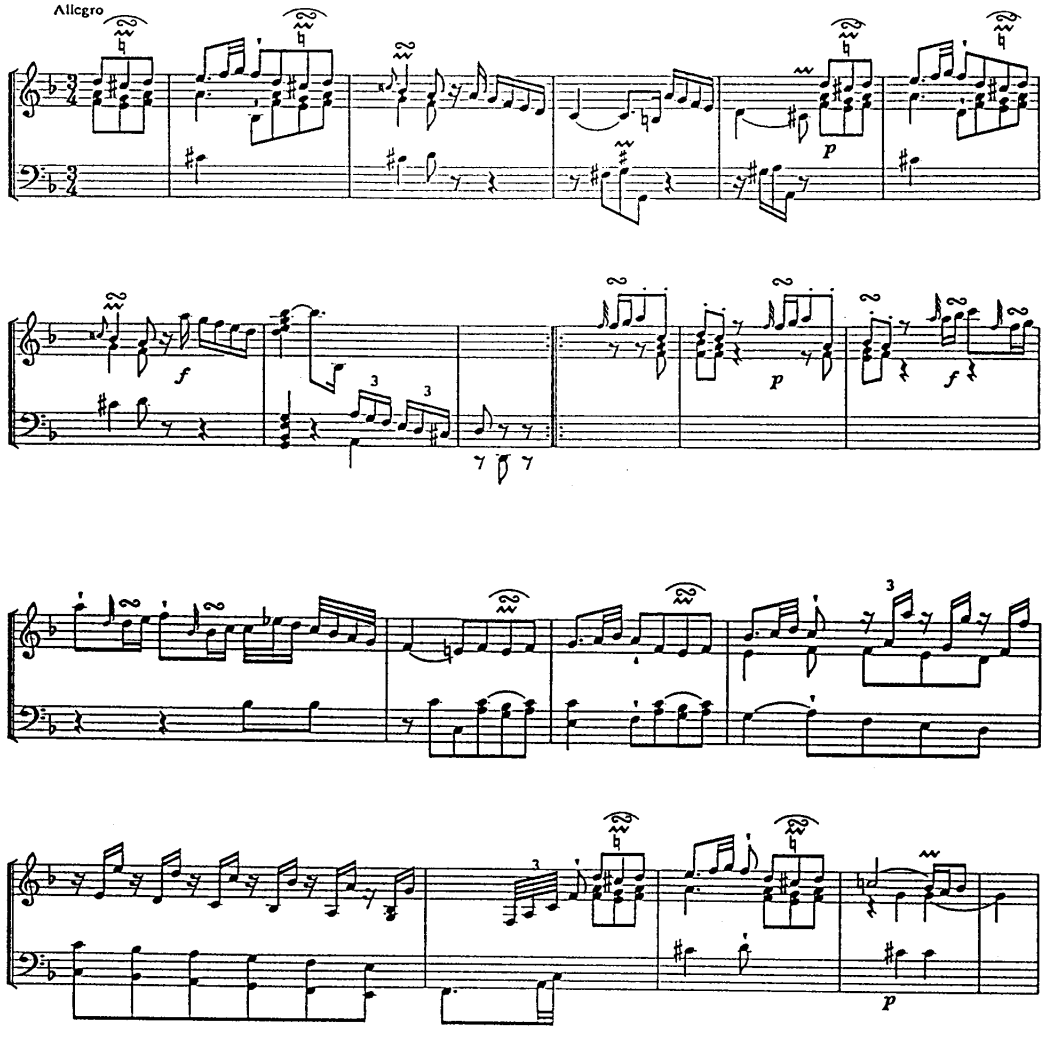


Illustration 28

Developer: Kurt Maas
Product: Amadeus Music Software
Running on: a PDP-11/73; Atari Mega ST4

Output from: Amadeus ECRM Lasersetter (1000 d.p.i.)
Size as shown: 90% of original

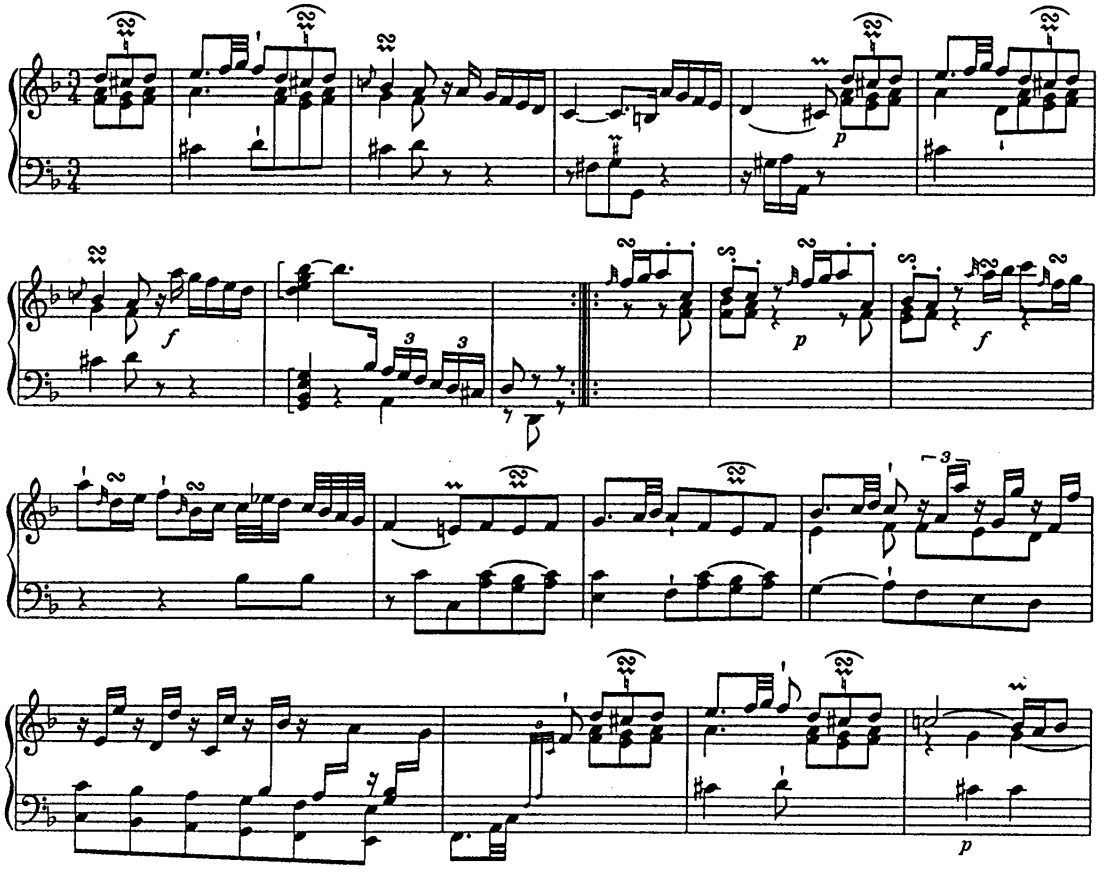


Illustration 29

Contributor: Roger McRea
Product: Temporal Acuity Products Music Printer Plus
Running on: IBM PC compatibles

Output from: Canon BJ-130 (24-pin mode)
Size as shown: 100% of original

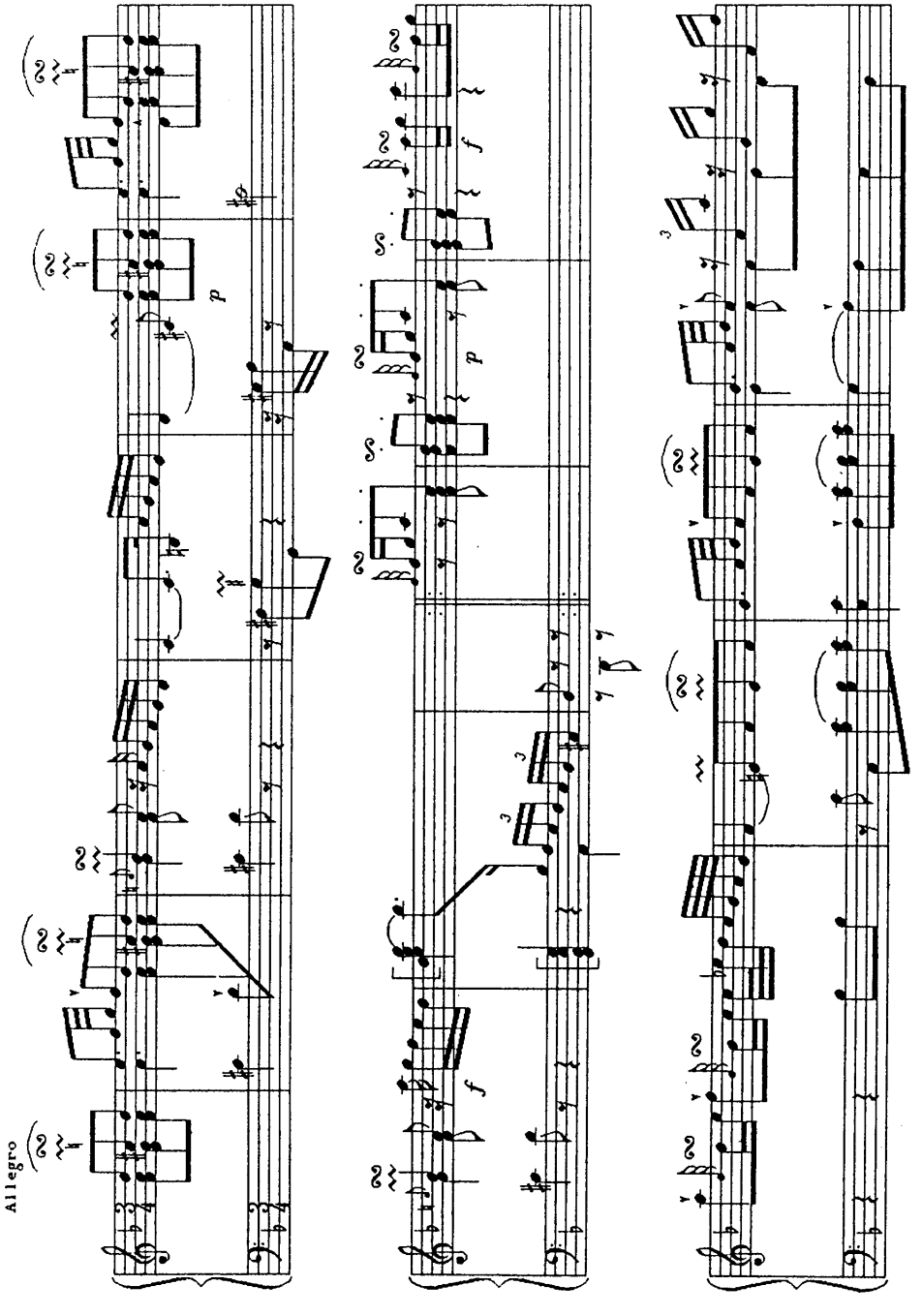


Illustration 30

Contributor: Crispin Sion
Product: The Copyist (DTP version)
from Dr. T's Music Software
Running on: Atari and Amiga microcomputers

Output from: Atari Laser Printer
Size as shown: 80% of original

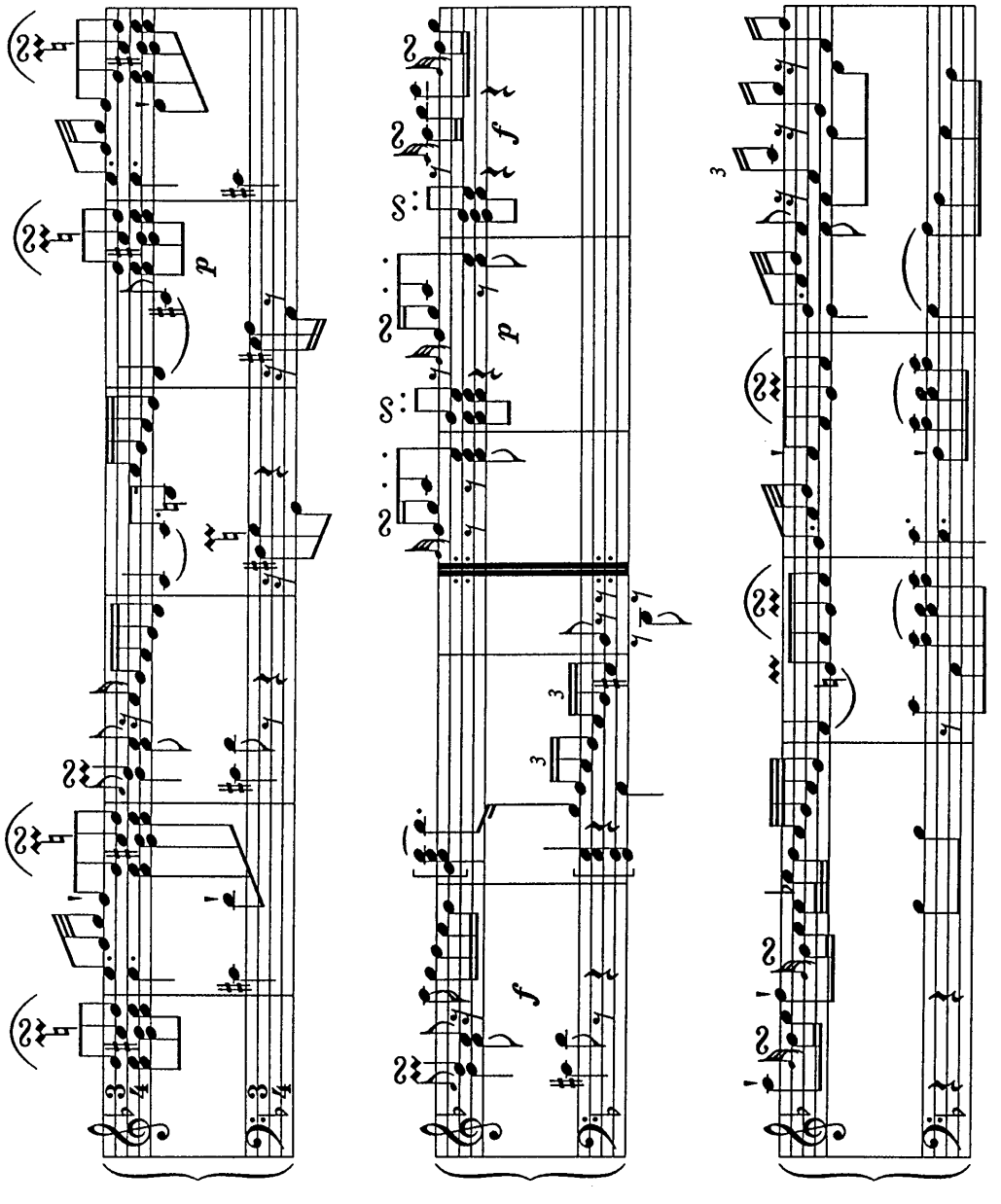


Illustration 31

Contributor: Leland Smith
Product: SCORE from Passport Designs
Running on : IBM PC compatibles

Output from: Varityper (1250 d.p.i.)
Size as shown: 65% or original

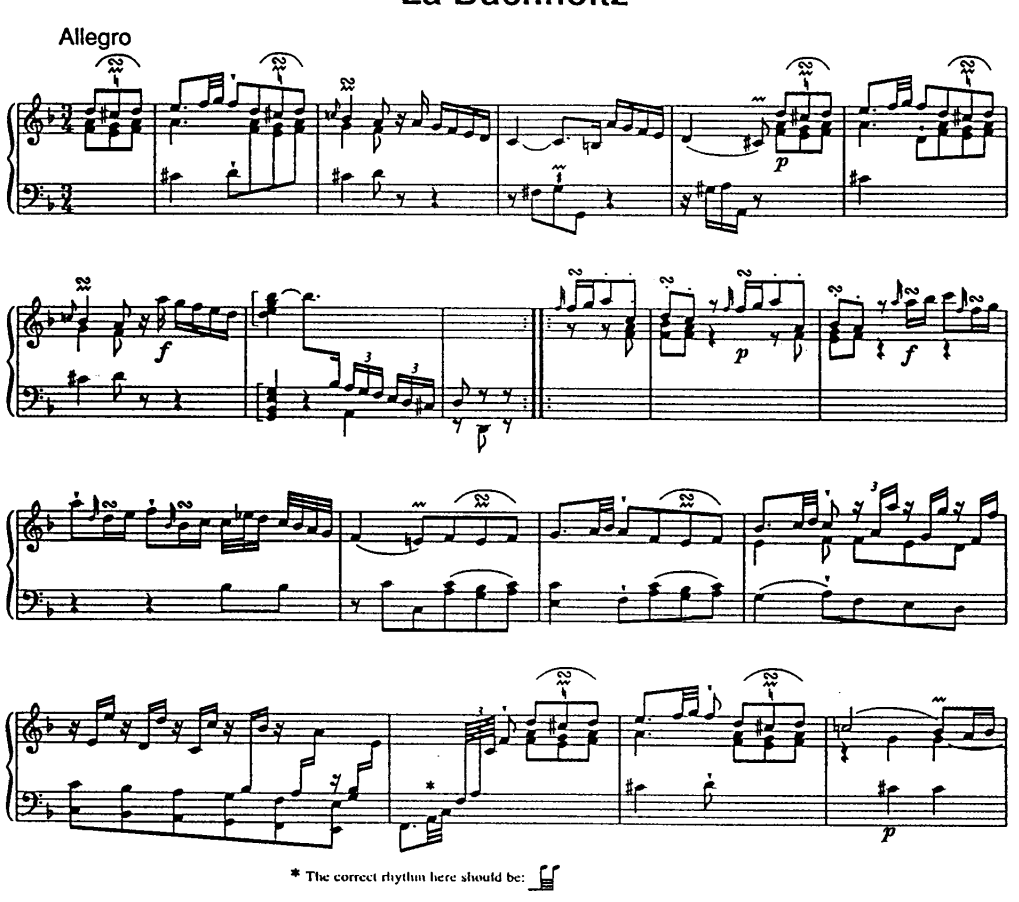


Illustration 32

Contributor: Alan Talbot
Producut: Synclavier Music Engraving System
Running on: a Synclavier Digital Audio System

Output from: Linotronic 100 Imagesetter (1270 d.p.i.)
Size as shown: 78% of original
Engraver: Gregg Sewell

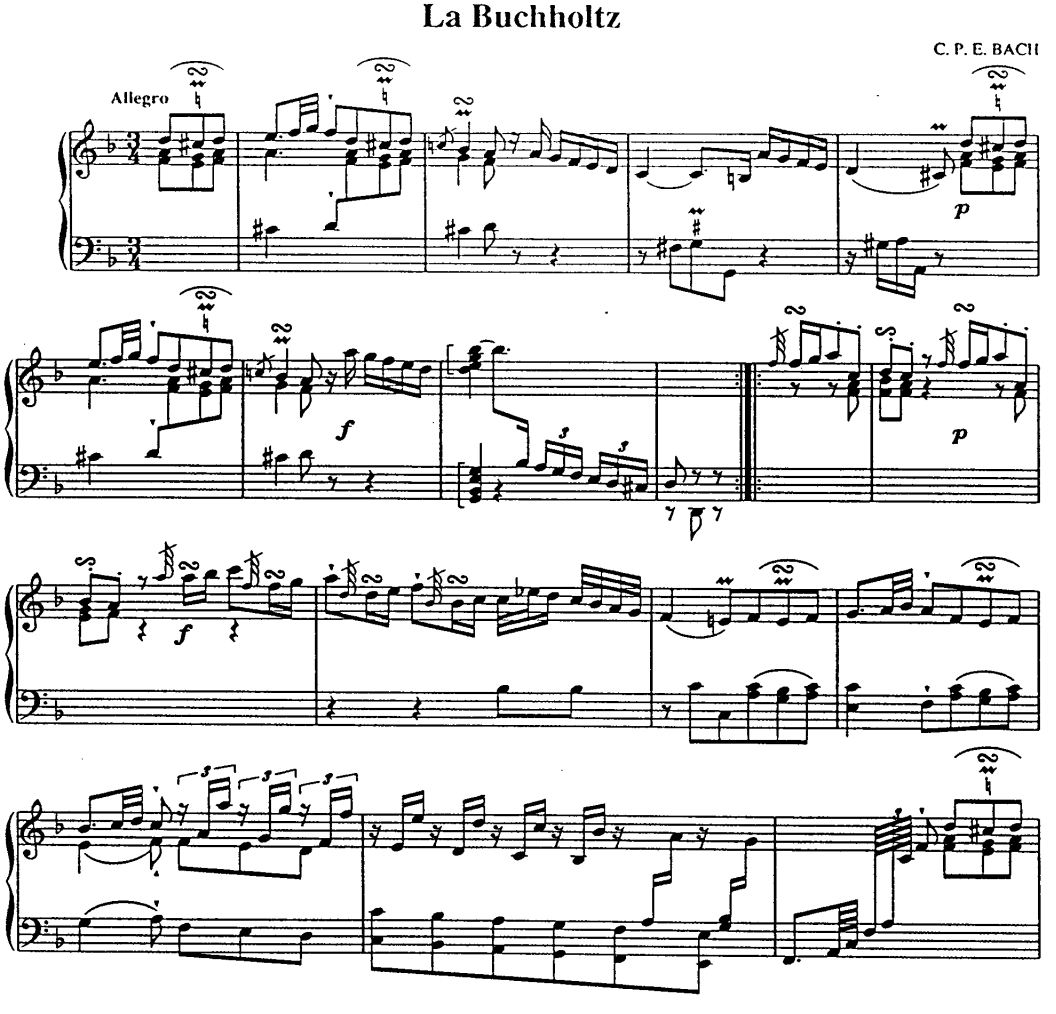


Illustration 33

Contributor; Rolf Wulfsberg
System: A-R Editions, Inc.
Running on: a Sun workstation

Output from: Linotronic L-300 typesetter
Size as shown: 83% of original

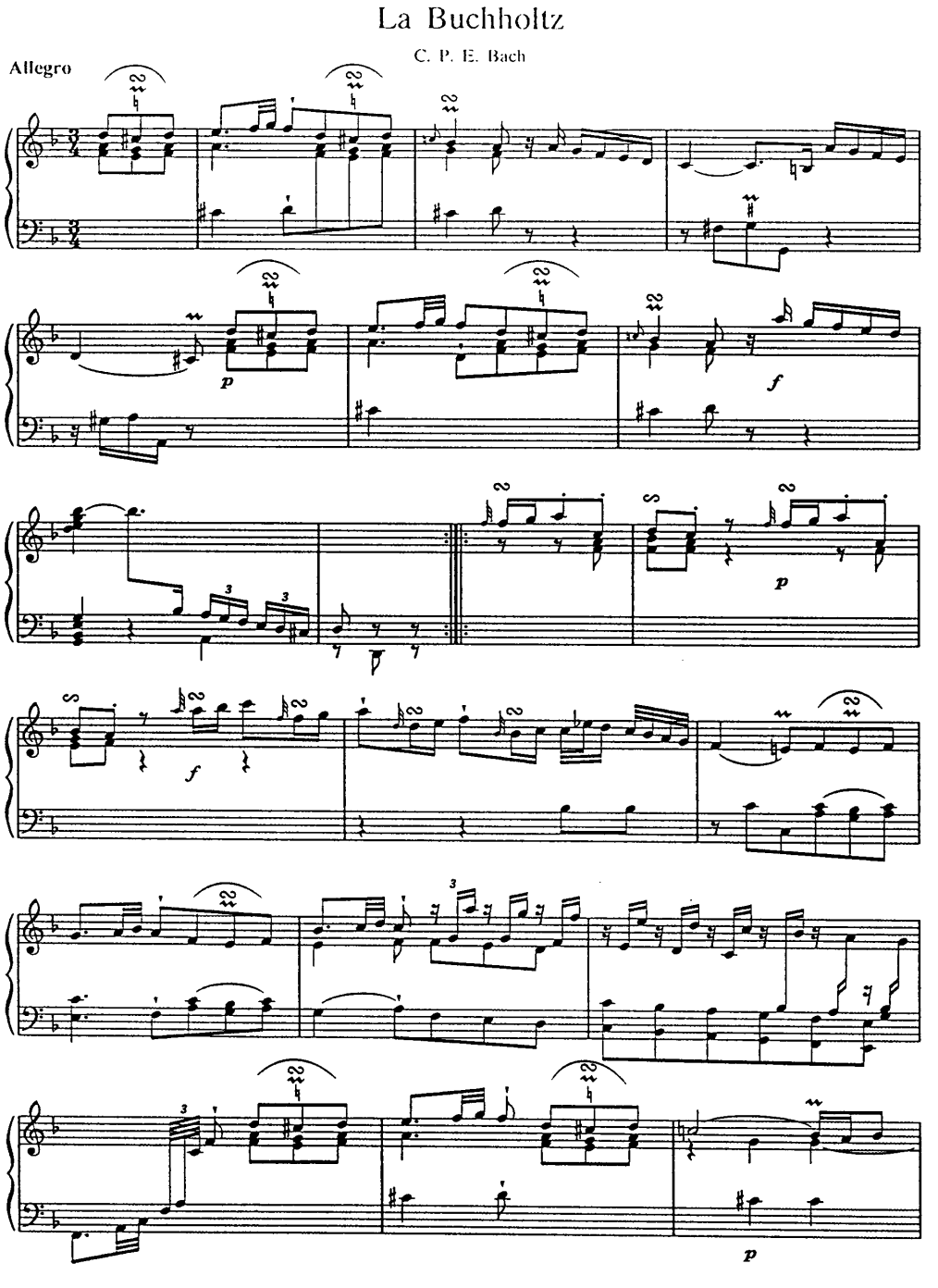


Illustration 34

Developer: Phil Ferrand
Product: Finale
Running on: Apple Macintosh

Output from: Apple LaserWriter IINT
Size as shown: 100% of original
Music font: Petrucci (from CODA)

Brahms

Liebeslied No. 7

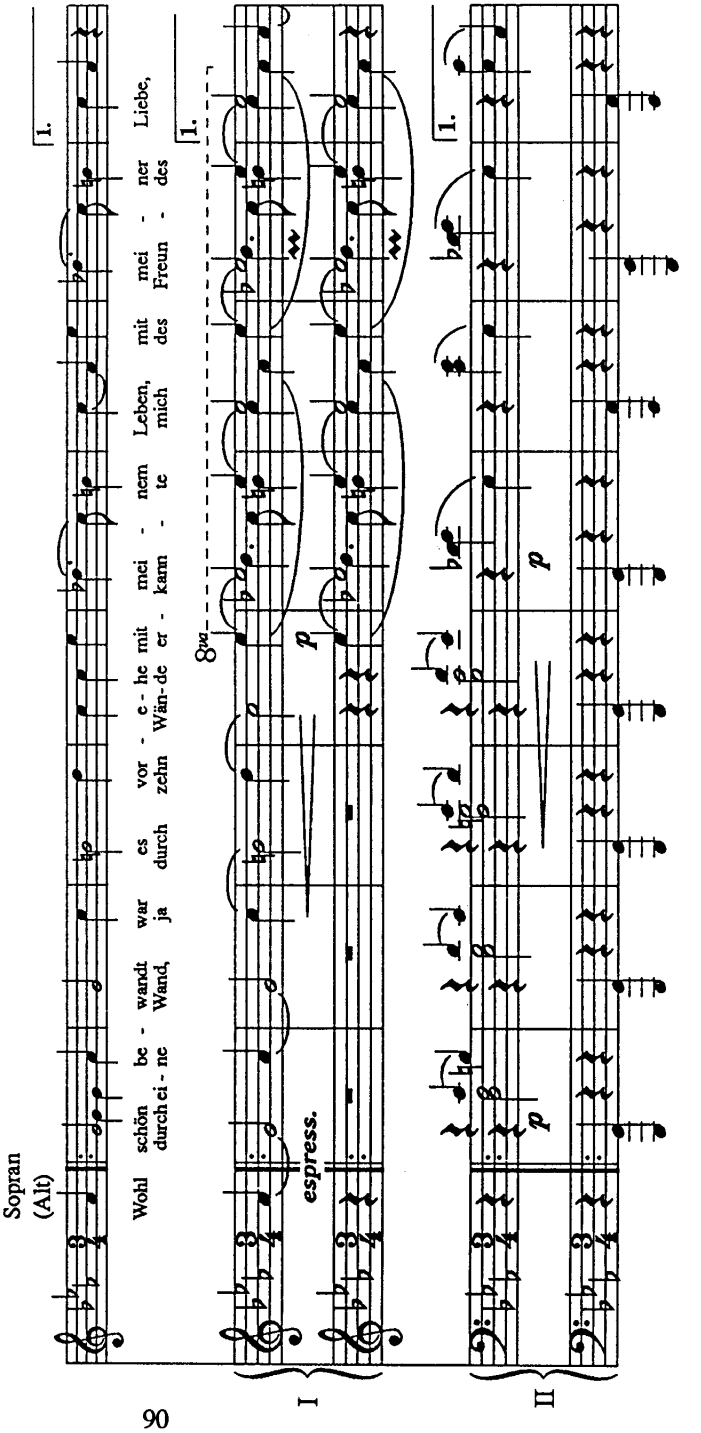


Illustration 35a

Contributor: Leland Smith
Product: SCORE from Passport Designs
Running on: IBM PC compatibles

Output from: Varityper (1250 d.p.i.)
Size as shown: 100% of original

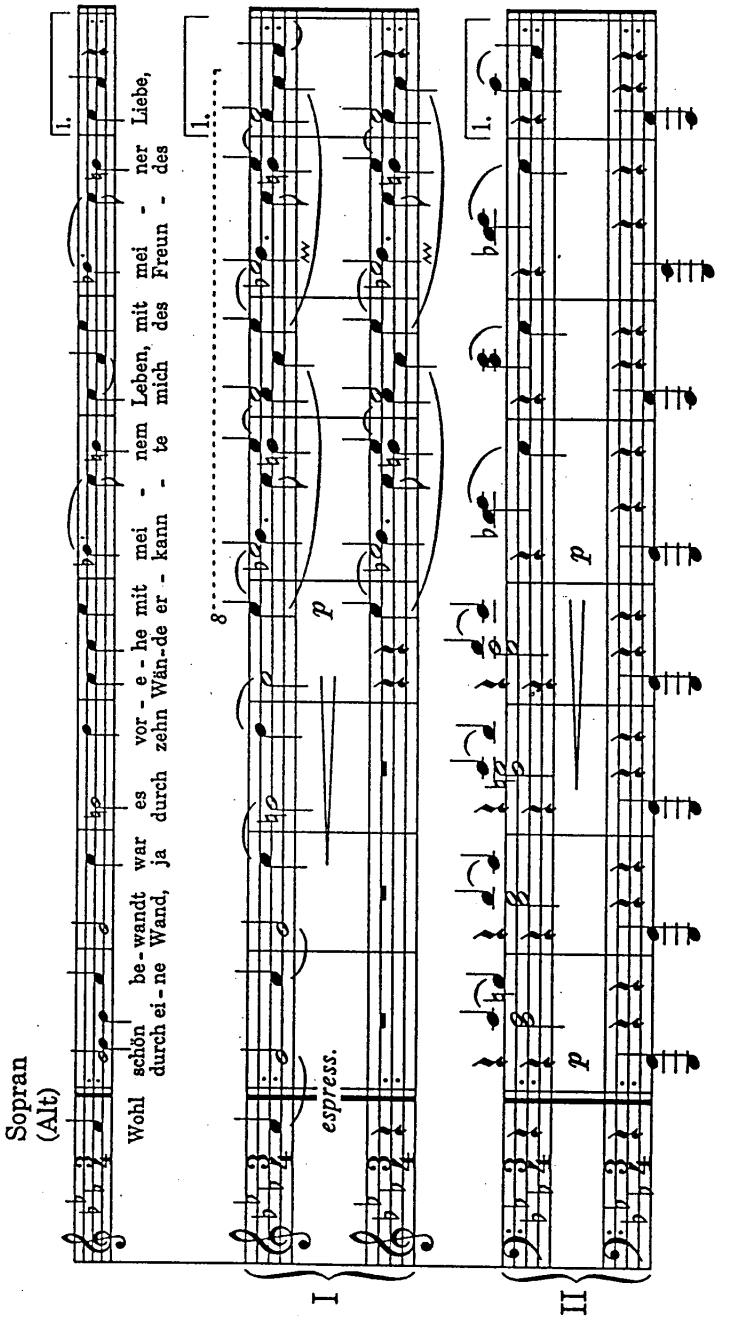


Illustration 35b

Contributor: Leland Smith
Product: SCORE from Passport Designs
Running on: IBM PC compatibles

Output from: Varityper (1250 d.p.i.)
Size as shown: 65% of original

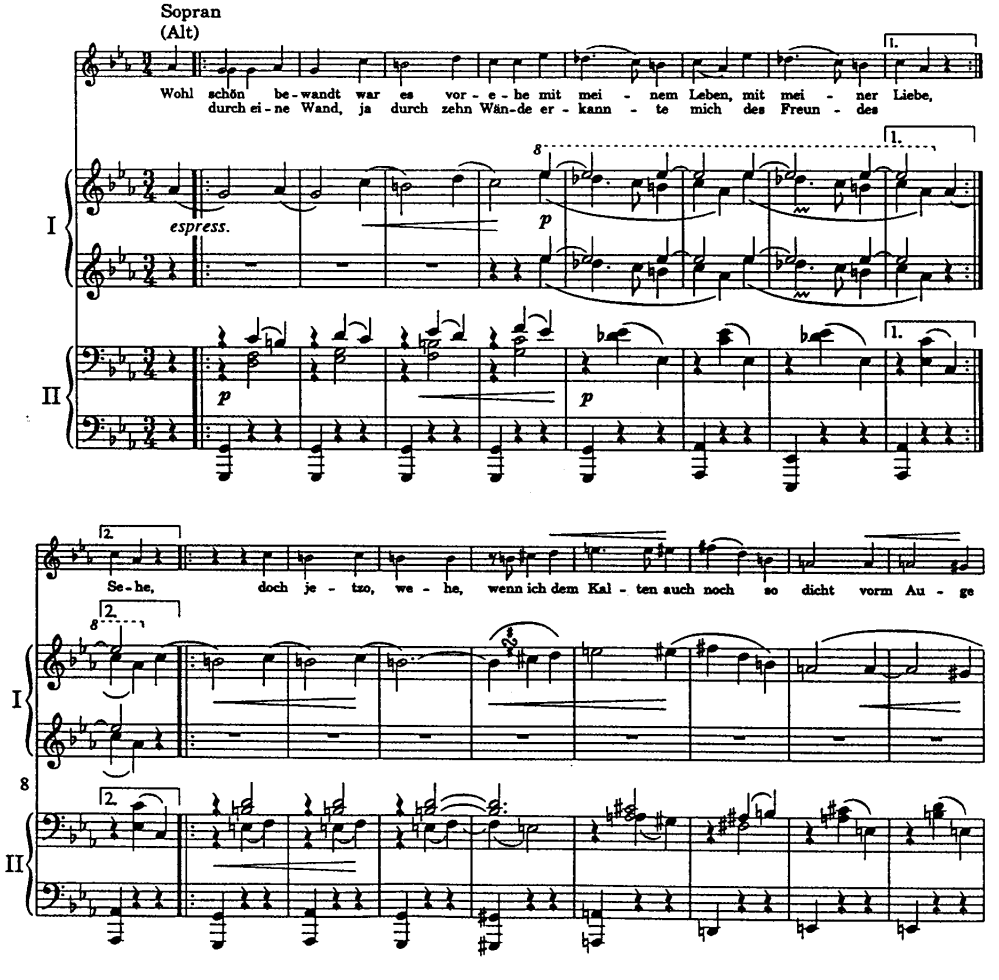


Illustration 36

Contributor: Alan Talbot **Output from:** Linotronic 100 Imagesetter (1270 d.p.i.)
Product: Synclavier Music Engraving System **Size as shown:** 78% of original
Running on: a Synclavier Digital Audio System **Engraver:** Gregg Sewell

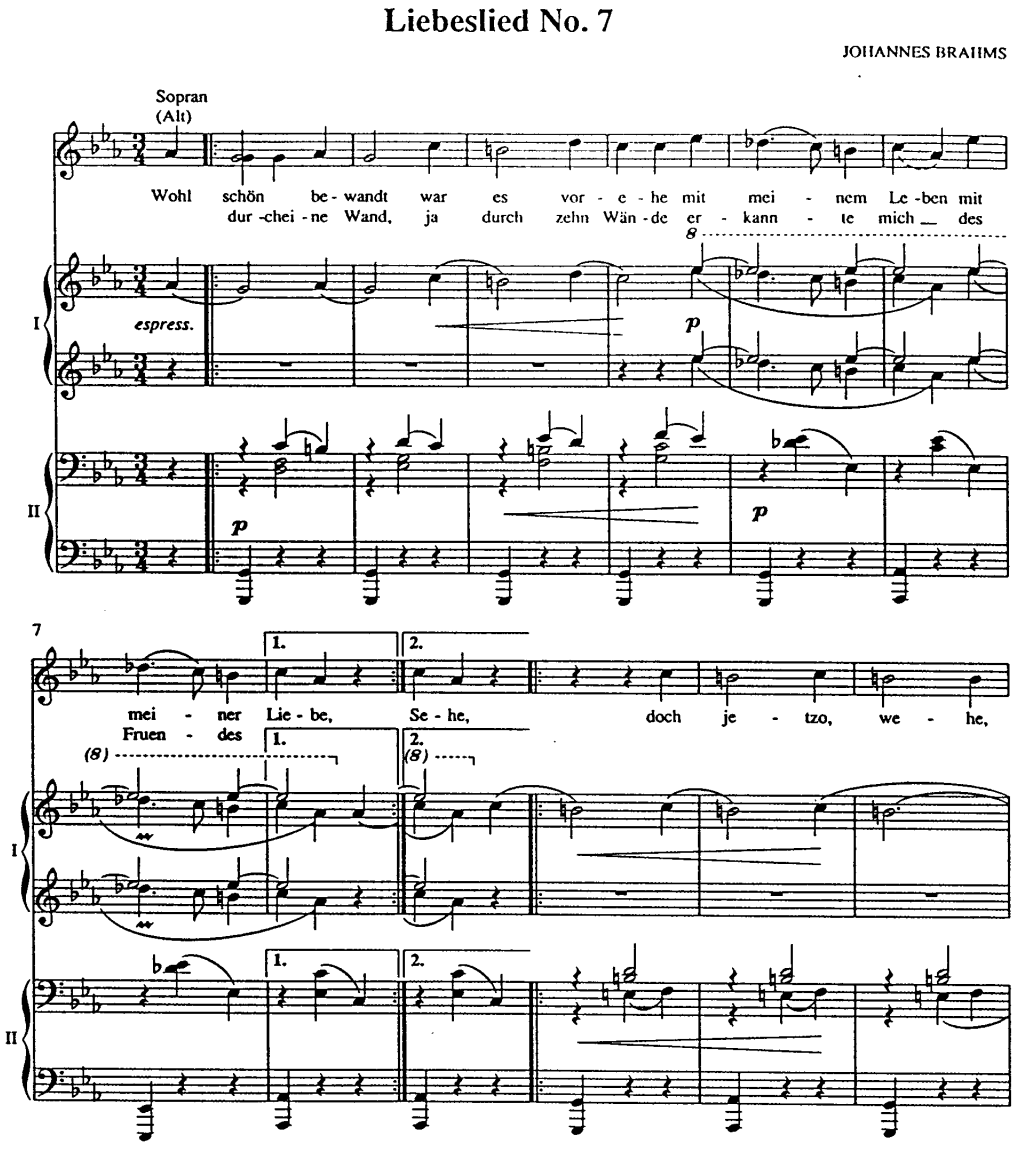


Illustration 37

Contributor: Mark Lambert
Product: THEME, The Music Editor
Running on: IBM PC compatibles

Subject: Gregorian chant
Output from: Hewlett Packard LaserJet II

Ave Maris Stella

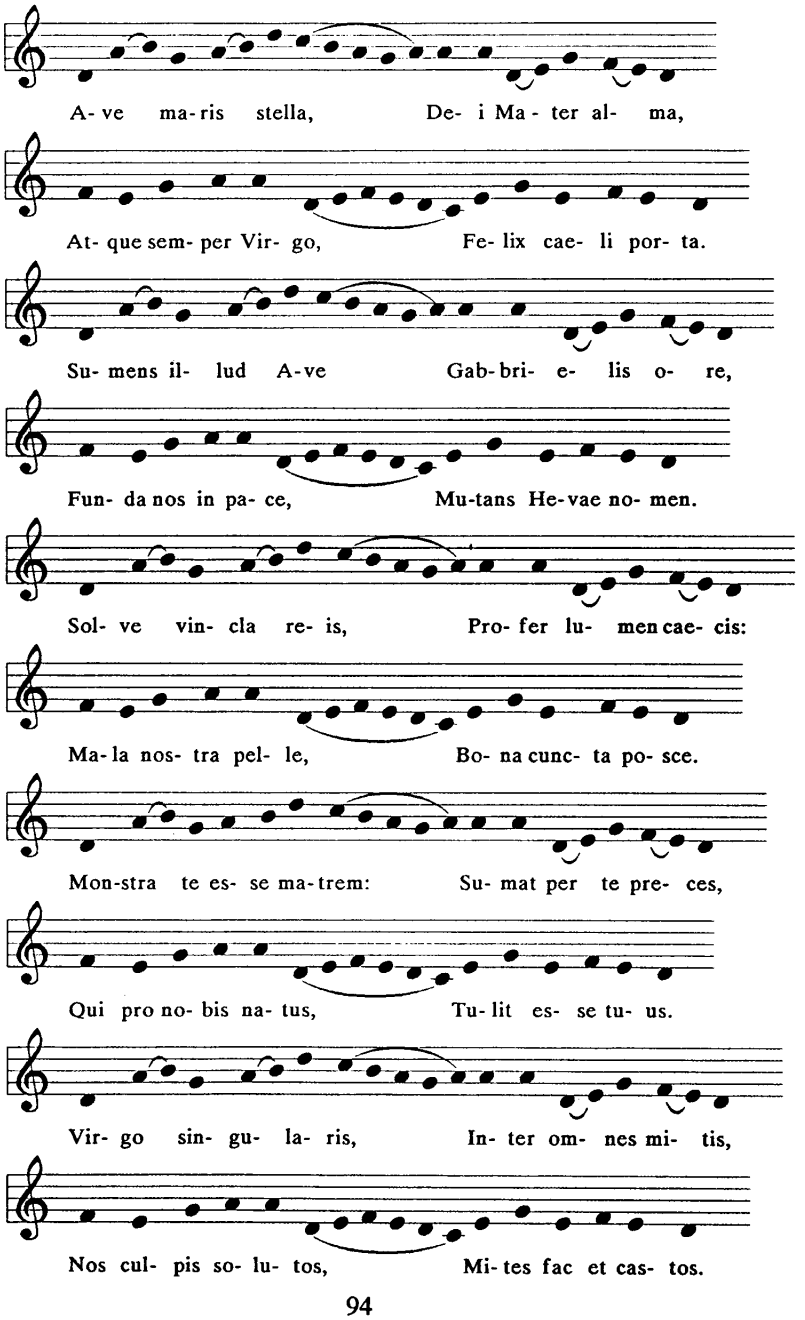


Illustration 38

Contributor: Philip Downs
Program: MusPrint (by Keith Hamel)
Running on: Apple Macintosh

Subject: Boccherini Quartet G. 159, part of larger chamber music project
Output from: Apple ImageWriter
Size as shown: 58% of original

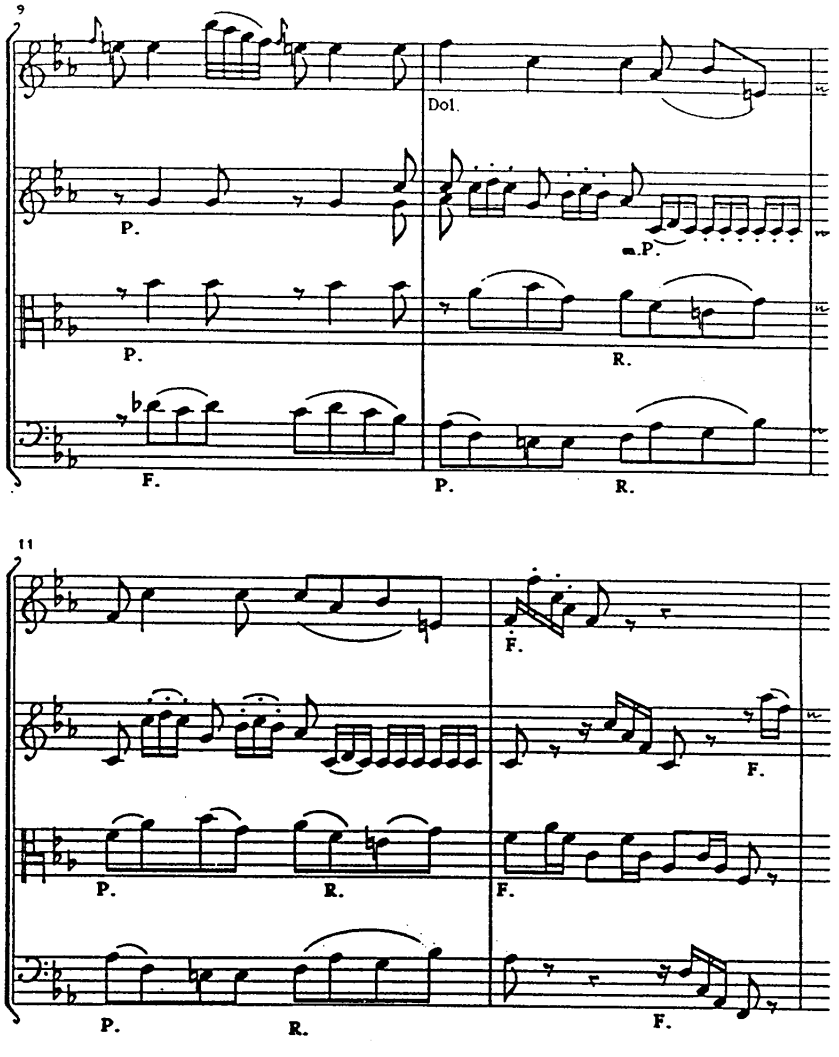


Illustration 39

Contributor: Roger McRea
Program: MusicPrinter Plus
(Temporal Acuity Products)
Running on: IBM PC compatibles

Subject: Chopin Prelude #20
Output from; Canon BJ-130 (24-pin mode)
Size as shown: 95% of original

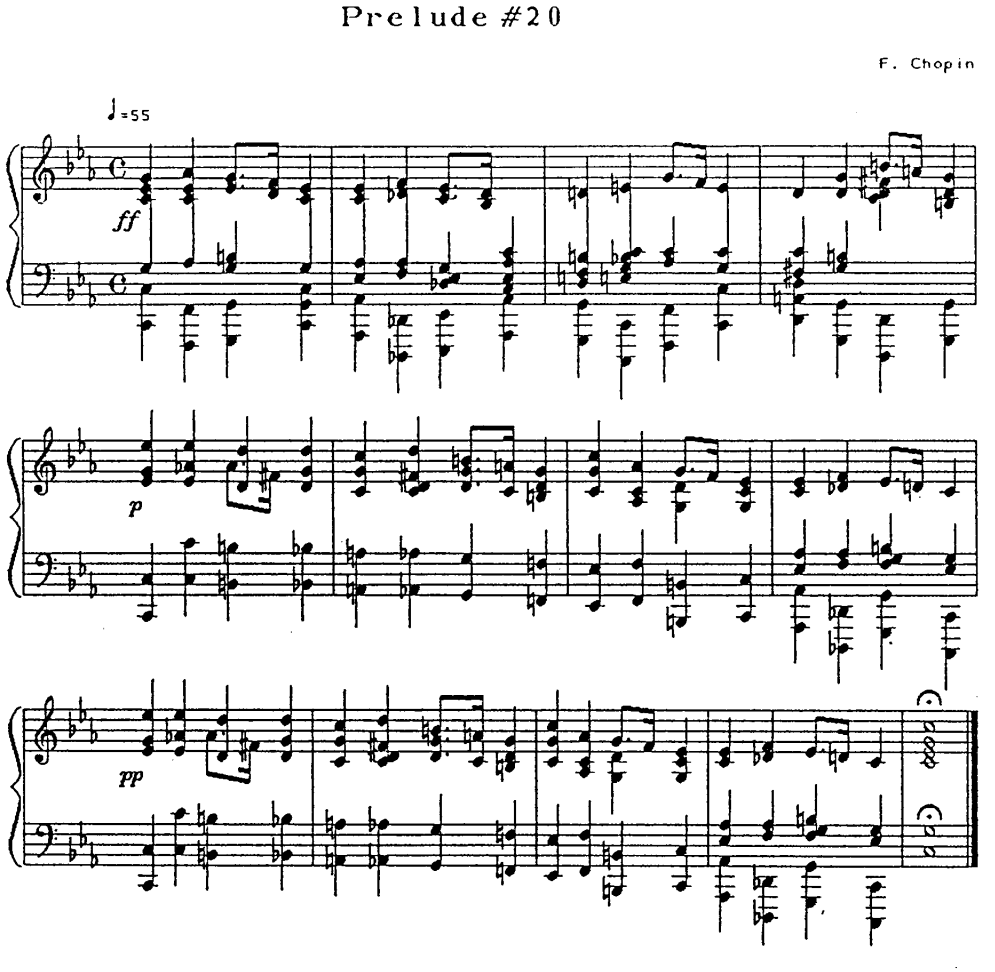


Illustration 40

Contributor: Sonus Corporation
Product: ScoreWriter
Running on: Atari microcomputers

Output device: Unspecified
Size as shown: 64% of original

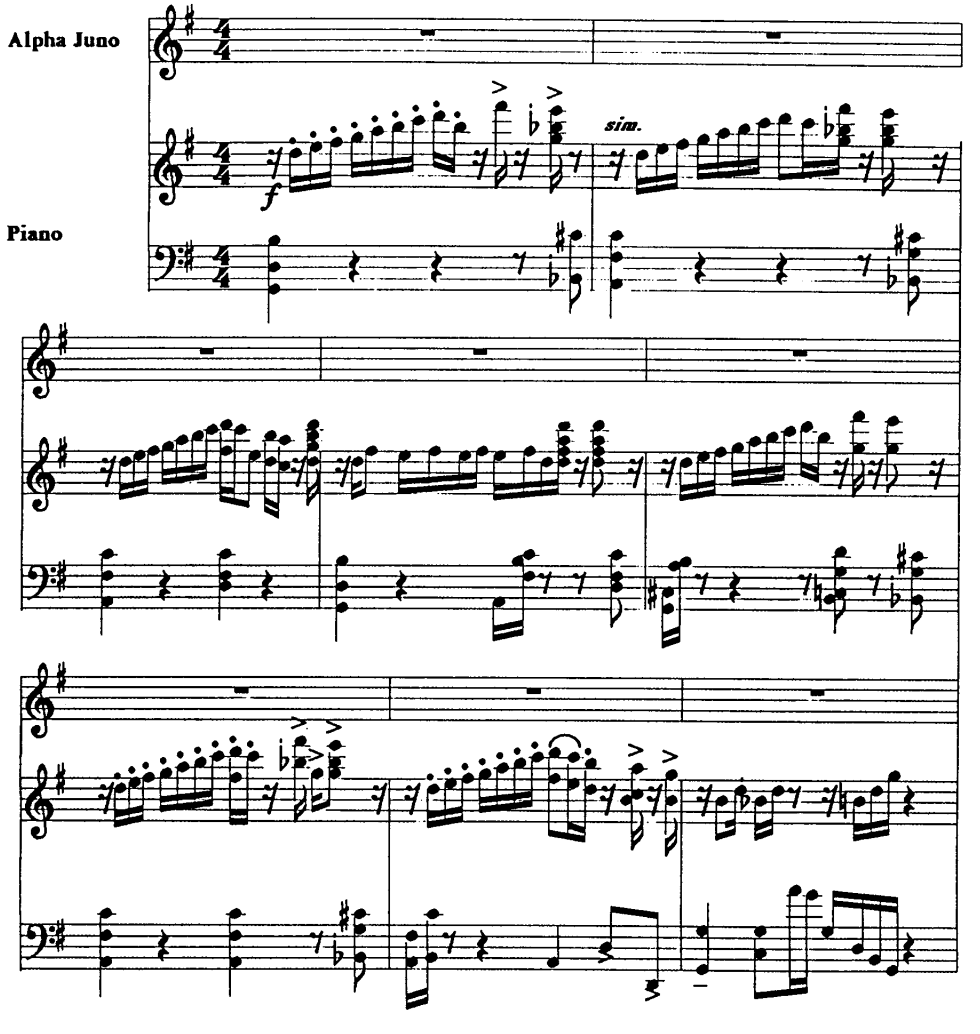


Illustration 41

Contributor: Steinberg Jones
Product: Masterscore
Running on: Atari microcomputers

Output device: Epson LQ-950
Size as shown: 70% of original

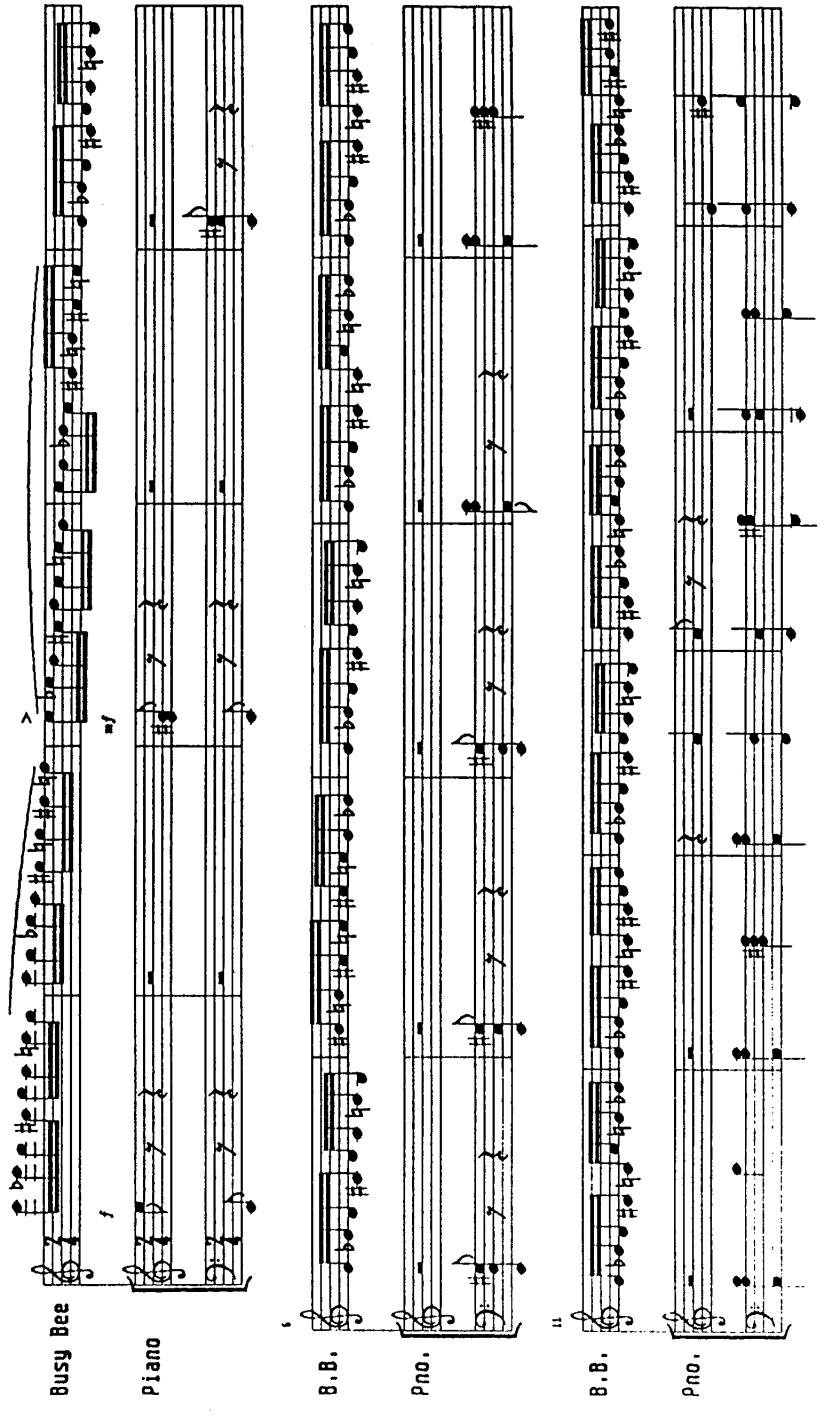
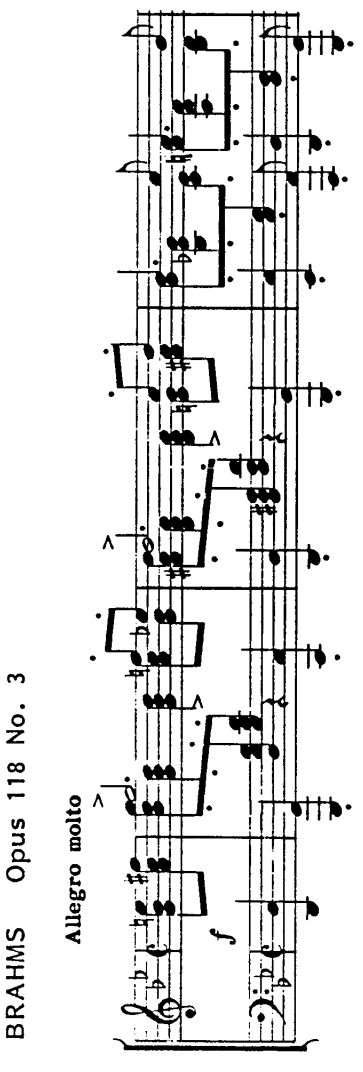


Illustration 42

Contributor: Cecil Effinger
Product: Musicwriter II
Input and output: IBM Wheelwriter

Sizes as shown:
Upper--85% of original
Lower--100% of original



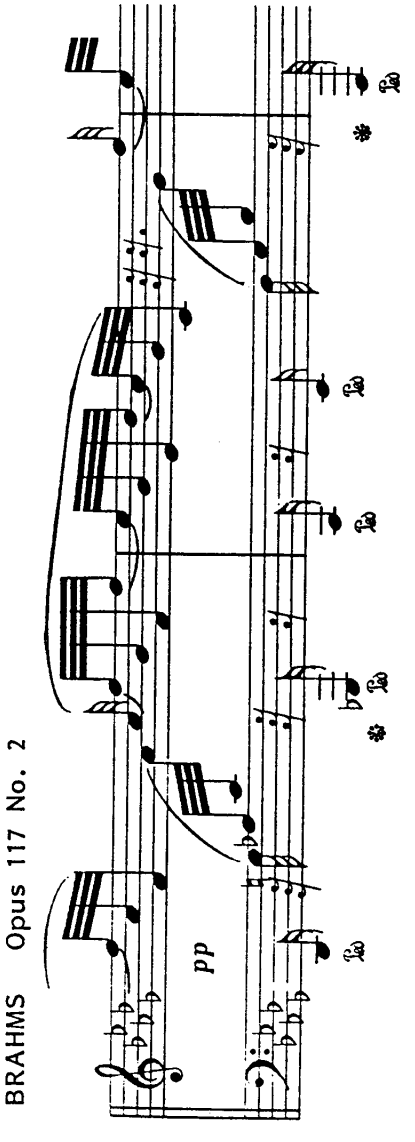
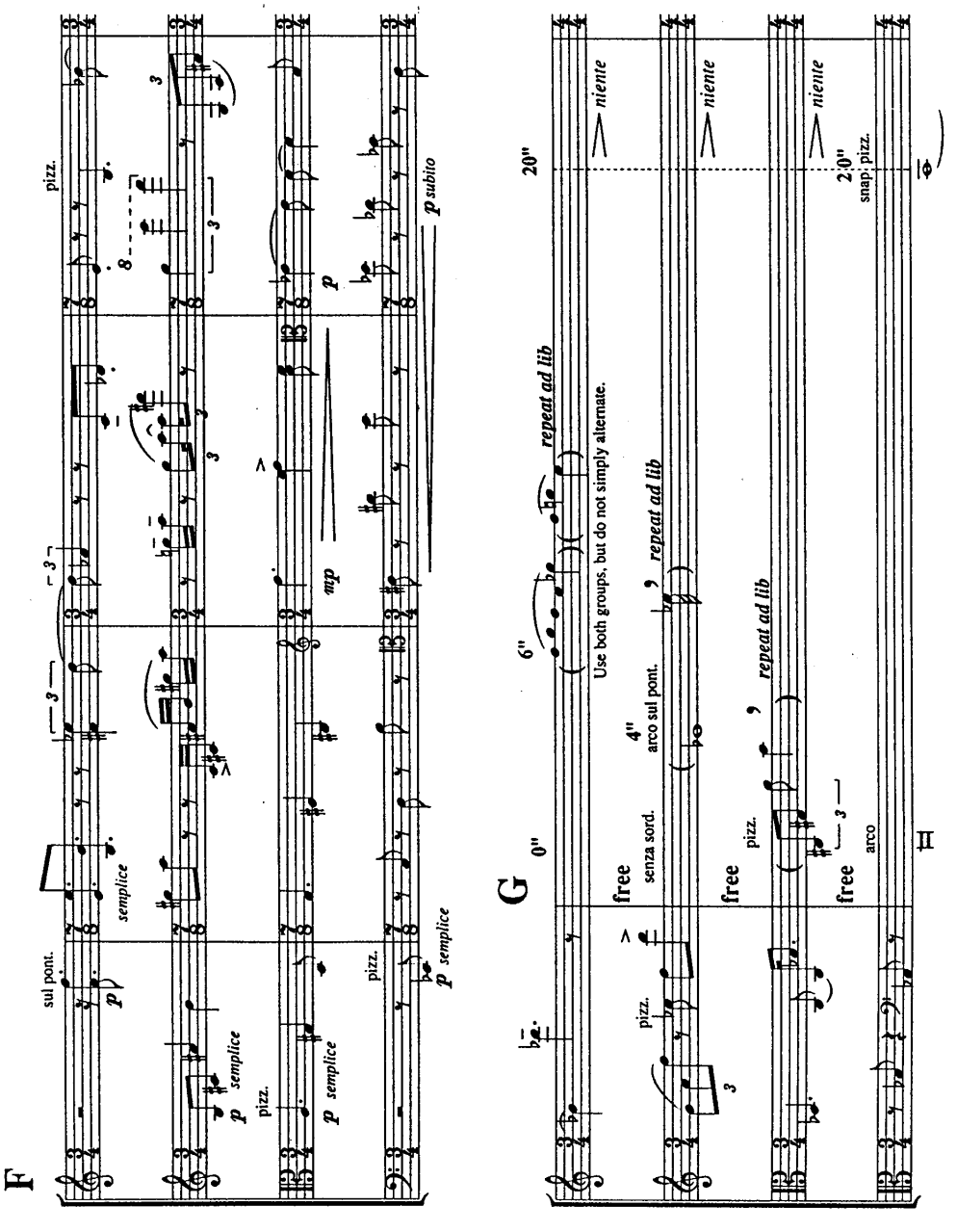


Illustration 43

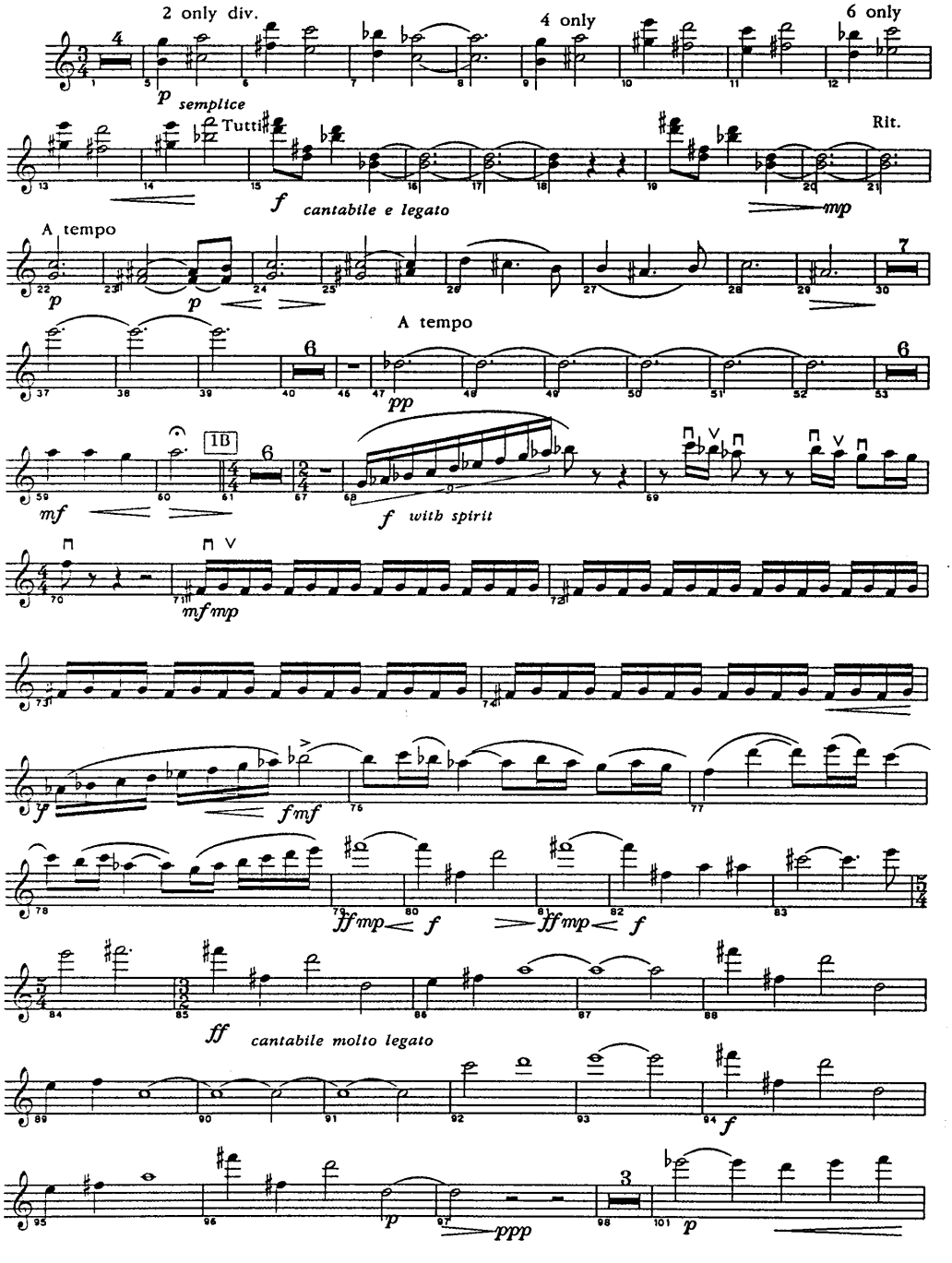
Contributor: Don Byrd
Product: Nightingale
Running on: Apple Macintoshes

Output device: Linotronic L-300 typesetter
Size as shown: 70%



Contributor: John Hawkins
Program: Music Manuscriptor
from Erato Software Corporation
Running on: Erato workstation

Output from: Hewlett Packard LaserJet II
Size as shown: 64% of original

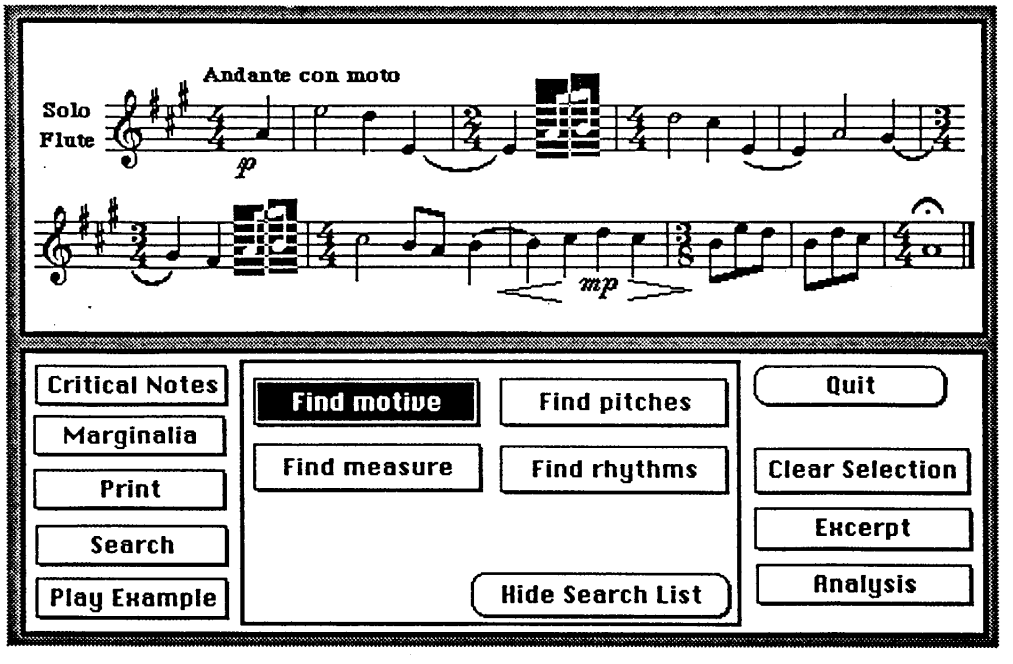


Contributor: Robert Fruehwald
Product: Music Manager
Running on: Apple Macintoshes

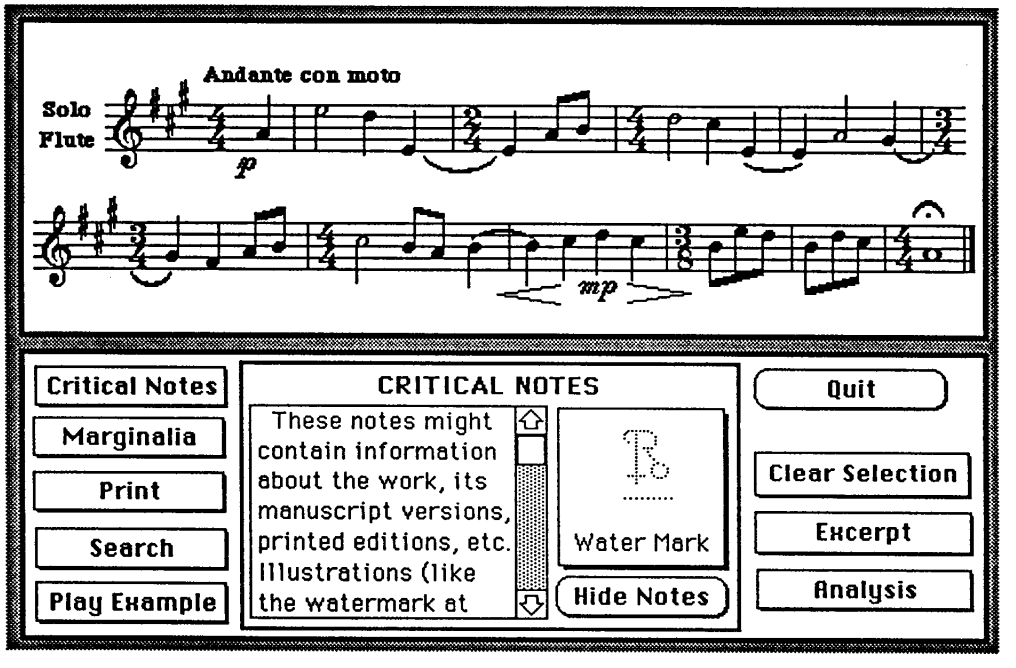
Output device: Apple ImageWriter

Music Manager is a hypertext program that is designed to support the management of files containing diverse kinds of information about musical works and/or sources. Incipits may be assembled using a companion program, *Melody-Maker.* Notes about sources and analytical information can be stored in linked files (the program does not currently perform analytical tasks). Screen information is shown below.

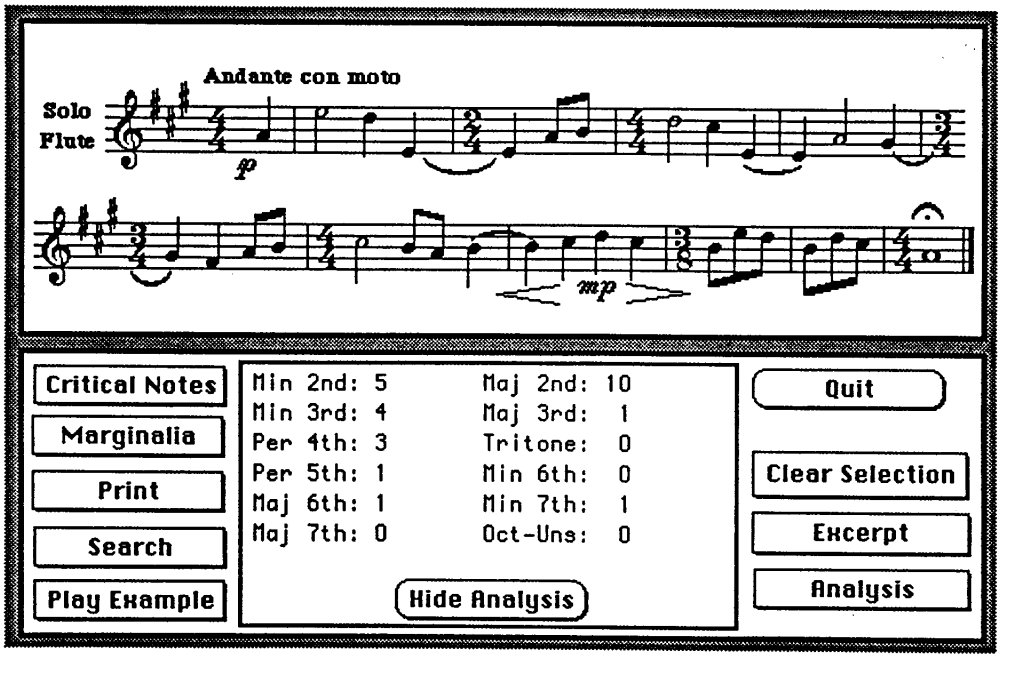
Display of a search:



Display of critical notes:



Display of analytical information:

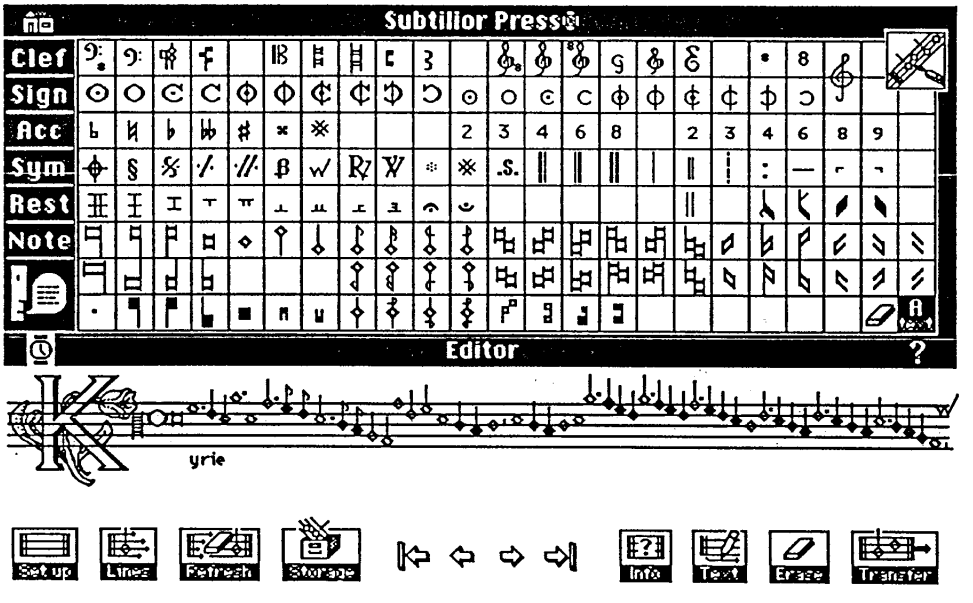


Contributor: David Palmer
Program: Subtilior Press
Running on: Apple Macintosh

Output device: Apple LaserWriter

Subtilior Press provides a menu of symbols from which users can assemble facsimiles of any of several systems of notation in use in the Renaissance. Users may design their own symbols, may alter the number of lines in the staff, and may control the placement of staves.

Menu of symbols:



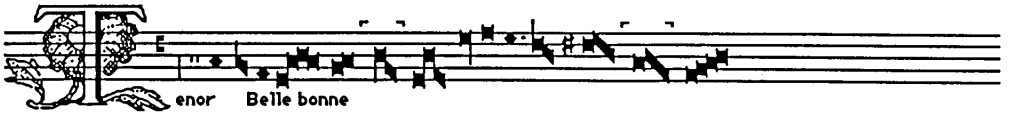
Above is the on-screen editor for Subtilior Press© (reduced to 85%). It allows the user to point and click on the symbol desired and position it precisely on the staff. The placement and appearance of all symbols are completely under the control of the user; new symbols can be added or old ones changed in minutes. The user also has complete control of the number of lines per staff, the number of staves, and the placement of staves, limited only by screen size. There is also a directory for the storage and retrieval of multiple documents.

Facsimile transcriptions:

MS Chantilly
1047,
page 11

Belle bonne

M. Baude Cordier



Venice,
1503

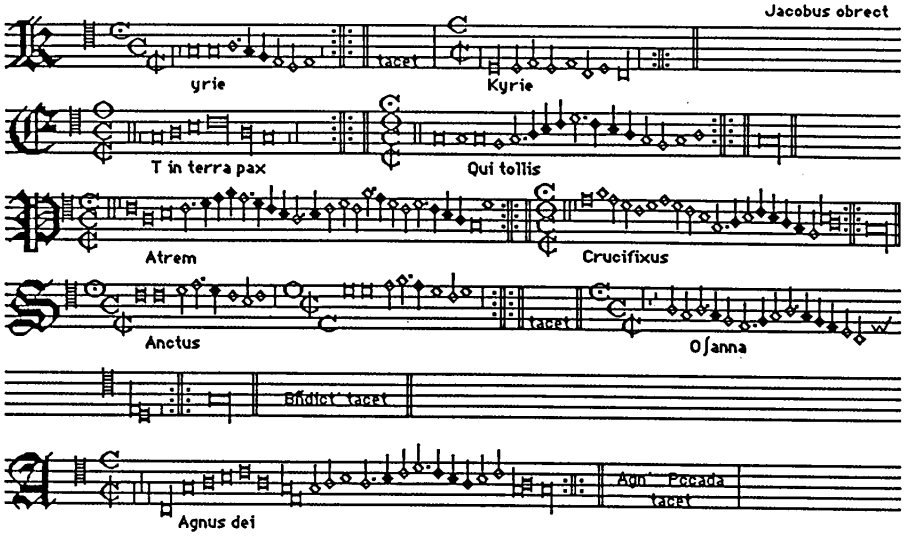
L'ome arme

Pe. de. la rue

Venice,
1508

Si dedero

Jacobus obrect



Log of Current Applications

I. Text Applications

A. Composer Studies

Bruckner/Lovallo
Title: *Anton Bruckner Discography*
Scope: an indexed catalogue of all recordings of Bruckner's music
Investigator: Lee Lovallo
Place: Sacramento, CA
Duration of project: 1984-1989

Krenek/Bowles
Title: *Ernst Krenek--A Bio-Bibliography*
Scope: an annotated bibliography and catalogue of writings by and about Krenek
Investigator: Garrett Bowles
Duration of project: 1988
Hardware, OS: IBM-AT
Database software: custom

Vivaldi Arias/Hill
Title: *Vivaldi's Opera Aria Texts*
Purpose: to discover text paraphrasing as a clue to musical borrowing [Illustration--1988: p. 127]
Investigator: John Walter Hill
Duration of project: 1986--
Place: Urbana, IL
Hardware, OS: IBM PC/AT, DOS
Database software: Savvy PC
Associated literature: "Two Relational Databases for Finding Text Paraphrases in Musicological Research" [with Tom Ward] in *Computers and the Humanities*, XXIII/2 (1989)

B. Authorship Studies

The Authorship of *Psyché*/Noe

Title: "Psyché--un exercise de style classique" in *Literary and Linguistic Computing* 3 (1988), 244-9

Purpose: to differentiate the literary styles of *Psyché*'s four authors--Corneille, Lully, Moliére, and Quinault--on a stylometric basis; the uniform assimilation of classical traits predominates over recognizably individual ones

Investigator: Alfred Noe

Place: Institut für Romanistik, University of Vienna

C. Repertory Studies

CANTUS/Steiner

Title: *CANTUS: A Database for Gregorian Chant*

Scope: creation of a database of indices to the Gregorian chants from the Divine Office, emphasizing manuscript sources; searchable and sortable by third parties via diskette

Investigator: Ruth Steiner

Place: Catholic University of America, Washington, DC

Hardware: IBM PC

CAO-ECE/Falvy *et al.*

Title: *Corpus Antiphonalium Oficii-Ecclesiarum Centralis Europae*

Scope: a collection of four related databases concerned with Hungarian plainchant and associated repertories; searches for text incipits, source, liturgical function are supported

Investigator: Zoltán Falvy (Budapest), László Dobszay, David Hiley (Regensburg), and many others

Database software: dBase III

Country Dance/Keller

Title: *British-American Country Dance to 1810*

Scope: a database of country-dance and cotillion choreographies from printed and manuscript sources; queries for specific figures and sequences are supported

Investigator: Robert Keller

Associates: Kate Keller, Jacquelyn Schwab

Place: Darnestown, MD

Duration of project: 1988-90

Hardware, OS: MS/DOS on IBM compact

Database software: dBase IV

Early Italian Monody/Hill

Title: *Index of Early Italian Monody Sources*

Purpose: to locate source concordances and to identify contrafacta through comparative study of meter, scansion, and rhyme

Investigator: John Walter Hill

Duration of project: 1987--

Place: Urbana, IL

Hardware, OS: IBM PC/AT, DOS

Database software: Savvy PC

Associated literature: *see* "Vivaldi Arias/Hill", *above*

Fourteenth-century Music/Stinson and Griffiths

Title: *The Fourteenth-century Music Project*

Scope: comprehensive inventory of the music of the 14th century, with related databases of scholarly literature, archival documents, manuscript descriptions, and relevant iconography. Data encoded for the Liturgical Repertoires project can be integrated into this repertory database

Directors of project: John Stinson, John Griffiths
Associates: Giovanni Carsaniga, Robyn Smith
Place: La Trobe University, Melbourne
Duration of project: 1984-92
Hardware: Compaq 386S, VAX, Macintosh
Software: dBase III+, SCRIBE

Lute Manuscripts/Meyer et al.
Title: *Descriptive Catalogue of Manuscript Sources in Tablature: Music for Plucked Stringed Instruments*
Goal: to catalogue the entire corpus of manuscript sources in tablature by title, location, and thematic incipit
Phase I: to create a catalogue of manuscripts in tablature for lute and theorbo
Phase II: to create a catalogue of manuscripts in tablature for the guitar and other plucked instruments
Duration: longterm
Investigators: international collaboration headed by Christian Meyer with national centers for data collection
Associates: Victor Coelho (Calgary), Dinko Fabris (Ferrara), François Lesure (Paris), Monique Rollin (CNRS, Paris), Jean-Michel Vaccaro (Tours)
Hardware: IBM PC compatibles

Motet/Erviti
Title: *Profiles of the Motet, 1500-1535*
Purpose: to index complete texts, text sources, and various musical features of motets, facilitating identification of similarities and possible shared musical characteristics of the texts
Investigator: Manuel Erviti
Place: University of Illinois, Urbana-Champaign
Duration: 1987--
Hardware: IBM PC/AT
Database software: Savvy PC

Nineteenth-century Operas/Clinkscale

Title: *Nineteenth-century Operas*
Scope: composer, title, first-performance database of 19th-century operas
Investigator: Edward Clinkscale
Place: UC Riverside
Database software: R:BASE for DOS

RELICS/Crawford

Title: *Renaissance Liturgical Imprints: A Census*
Scope: creation of a database of liturgical books printed between 1450 and 1600 [3500 records to date]
Investigators: David Crawford, James Corders
Software: SPIRES

Vocal Music in Italian Lute MSS/Fabris

Title: *Systematic catalogue of vocal music in 100 manuscript sources of Italian lute tablature from the 15th to the 17th century*
Goal: to catalogue this category of vocal music as a complement to the broader census of the vocal repertory explained under "Italian *poesia per musica*" [below]; the repertory consists of roughly 1000 pieces
Investigator: Dinko Fabris
Time frame: 1989-90
Place: Ferrara
Hardware: IBM PC compatible
Database software: dBase III+, IV
Music printing software: Note Processor
Associated Literature: "Un progetto internazionale di catalogazione della musica per liuto (secolo XV-XVIII)" forthcoming in *Schifanoia*, n. 5.

D. Subject Bibliographies

Austrian Music/Antonicek

Title: *Datenbank zur österreichischen Musik*
Scope: a register of all data that relate to music in Austria (at present mainly bibliography)
Investigator: Theophil Antonicek
Associate: Elisabeth Hilscher
Place: Kommission für Musikforschung, Institut für Musikwissenschaft der Universität Wien
Hardware: IBM PC-AT, IBM 3090
Database Software: Euroscript, Asksam

Bibliography of Venetian Music/Passadore

Title: *Bibliografia Musicale Veneta*
Scope: bibliography of all works regarding music of the Venetian Republic, including writings in periodicals, catalogues, theses, and books
Coordinator: Francesco Passadore
Place: Fondazione Levi, Venice
Associated Literature: *Acta Musicologica* **LIX** (1987), 328

Italian *poesia per music*/Vassalli

Title: *Census of Italian* poesia per music *(1500--1700)*
Goals: to identify the authors and sources of Italian poetry in musical settings of the 16th and 17th centuries; the results provide an analytical and annotated index to the *Bibliografia della musica italiana vocale profana pubblicata dal 1500 al 1700* by Emil Vogel, Alfred Einstein, François Lesure, and Claudio Sartori
Phase I: examination of all printed sources of Italian lyric poetry to 1650; to date 3000 collections of poetry have been identified and roughly half have been analyzed
Phase II: creation of a database of this material that may be expanded and queried
Investigator: Antonio Vassalli

Associates: Angelo Pompilio, Silva De Marchi (with data entry by Cecilia Luzzi and Gianmario Merizzi)
Places: Ferrara (direction), Bologna and Florence (programming, data entry)
History: begun in 1977 by Lorenzo Bianconi and Antonio Vassalli under the title *Indagine sulla poesia per musica intorno al 1600* with funding from the Swiss National Research Council
Time span: provisional report planned for 1990
Hardware: IBM PC compatibles
Software: custom, in C
Associated Literature: Thomas Walker, "L'Archivio del Madrigale a Ferrara" in *Le fonti musicali in Italia: studi e ricerche*, I (1987), 55-61

Musical Citation Index/London
Title: *SMT Musical Example Database*
Scope: off-line database of musical examples cited in current books and periodicals
Investigator: Justin M. London
Associates: James Ruhler, John Schaffer
Place: University of Pennsylvania, Syracuse, Madison, WI
Duration: 1989--
Hardware: IBM XT, Apple Mac

E. Source Bibliographies

EDISON/Giuriati
Title: *Computerized Catalogue of Italian Folksong*
Scope: index of 20,000 documents belonging to the Laboratorio Didattica Etnomusicologia
Investigator: Giovanni Giuriati
Place: University of Rome

French Music Engraving/Bowles

Title: *French Music Engraving--A Bibliography, 1660-1720*

Scope: a descriptive catalogue of all engraved music published in France from 1660 to 1720

Investigator: Garrett Bowles

Duration: to 1991

Hardware: IBM-AT

Database software: custom

Other software: troff--Apple Laserwriter

Italian Music Prints/Pompilio

Title: *Bibliografia della musica a stampa pubblicata in Italia tra il 1570 e il 1630*

Scope: to create a computerized catalogue of Italian music prints (sacred, secular, instrumental, and theoretical), both surviving and indirectly documented, for the specified period; the material recorded is designed to facilitate research on editorial and printing practices; 5000 titles to date

Investigator: Angelo Pompilio

Associate: Cecilia Luzzi

Place: Ferrara, Istituto di Studi Rinascimentali; Bologna

Duration: to 1990

Database software: dBase III

Music Catalogue of the Netherlands

Title: *Muziek Catalogus Nederland (MCN)*

Scope: joint catalogue of 170,000 titles in five libraries; 40,000 titles added each year; 15 searchable fields

Director: G. C. M. van Dijck

Central location: Utrecht

RIPM/Cohen

Title: *Répertoire International de la Presse Musicale*

Scope: series of indices to musical periodicals from the late 18th to the early 20th century; each journal is indexed in a separate volume [UMI, in progress]

Investigators: H. Robert Cohen, director; Marcello Conati, Christoph-Hellmut Mahling *et al.*

Place: University of Maryland
Associated Literature: *Acta Musicologica* **LIX** (1987), 308ff.

Schatz Libretto Collection/McClymonds
Title: *Albert Schatz Libretto Collection*
Scope: to catalogue the 9000 libretti of this Library of Congress collection in conjunction with US-RISM
Chief investigator: Marita McClymonds
Place: University of Virginia
Method of distribution: bibliographical records will be deposited in the Research Libraries Information Network (RLIN)

Stephen Foster Collection/Root
Title: *A Catalogue of Scores and Recordings in the Stephen Foster Memorial Collection*
Purpose: to create a complete catalogue of musical materials in the collection
Chief investigator: Deane L. Root
Place: University of Pittsburgh
Method of distribution: bibliographical records will be deposited in the Online Computer Library Center (OCLC) database

F. Fulltext Databases

Central European Theory Treatises/Ward
Title: *Central European Medieval Treatises*
Scope: creation of a fulltext database of music theory treatises concerning chant and measured polyphonic music written in central Europe during the 15th century; study of concordances and interrelationships
Investigator: Tom Ward
Place: University of Illinois
Hardware: IBM PC compatible
Software: Savvy PC
Associated Literature: "Two Relational Databases for Finding Text Paraphrases in Musicological Research" [with John Hill] in *Computers and the Humanities* **23** (1989), 105-11

THEMA/Pinegar

Title: *THEMA (Archive of Musical Theoretical Documents of the Middle Ages)*

Scope: direct transcription (including abbreviations) of over Latin treatises on music of the 13th century [30 to date]

Method: abbreviations are encoded, so that paleographical information as well as text content can be studied

Investigator: Sandra Pinegar

Place: Columbia University

Duration: ongoing

Hardware, OS: IBM AT and PC DOS

Analysis software: Oxford Concordance Program

Database software: dBase III+

G. Graphic Lexicons

Analytical Notation/Kwiatkowska

Title: *Universal Analytical Music Notation*

Goal: to establish a set of 325 systematically organized graphic symbols expressing music elements in their qualitative and quantitative modes.

Investigator: Barbara J. Kwiatkowska

Place: Los Angeles

Hardware: Macintosh

Baroque Notation/Pont

Title: *The Notation of Baroque Music*

Scope: to describe and index the elements of musical notation and the figures formed by combining elements; to compile an index of technical vocabulary derived from scores and theoretical writings. Images are captured from optical scanning of printed and manuscript sources [see p. XX]

Investigator: Graham Pont

Associates: Nigel Nettheim, Linda Rosendahl

Place: University of N.S.W., Sydney, Australia

Duration of project: 1989-91

Hardware: IBM-AT, Image Scanner

Software: custom, by Nigel Nettheim

II. Integrated Text and Music Applications

Thematic Indices

Burns/Ashmead and Davison

Title: *Relation of Words and Music in the Songs of Robert Burns*
Purpose: to develop computer analysis programs in C for the analysis of folk tunes and words
Investigators: John Ashmead, John Davison
Duration of project: three years
Place: Haverford College
Hardware: IBM PC, Macintosh, VAX
Database software: will adapt database for folk tunes studied by Bertrand Bronson
Other software: Grammatik, Songwright 4.0
Associated literature: *The Songs of Robert Burns* (NY: Garland, 1988)

Hymn Tune Index/Temperley

Title: *Hymn Tune Index*
Purpose: to index and sort all tunes associated with English-language hymns found in sources printed before 1821
Investigator: Nicholas Temperley
Associates: Charles G. Mann, Joseph Herl, Margo Chaney
Place: University of Illinois
Duration: 1982-90
Operating system: UNIX
Database software: INGRES

Marais/Bowles

Title: *Thematic Catalogue of Marin Marais's Instrumental Music*
Goal: to produce a published book including musical incipits
Investigator: Garrett Bowles
Duration of project: to be finished by 1990
Hardware: IBM-AT
Encoding and printing software: SCORE

Associated literature: "The Computer-Produced Thematic Catalogue: An Index to the *Pièces de violes* of Marin Marais", Ph.D. thesis, Stanford University, 1978 [resume in *Fontes Artes Musicae* **26**/2 (1979), 102-7]

Motet/Lincoln

Title: *The Latin Motet, 1500-1550: Indexes to Printed Collections*

Scope: thematic index of all Latin motets found in collections printed between 1500 and 1550, as indexed by RISM; modelled after *The Italian Madrigal* [1988: 113]

Investigator: Harry B. Lincoln

Duration of project: 1988-1991

Place: SUNY Binghamton

Database hardware (OS): IBM 3090, VM/CMS

Encoding software: DARMS

Database, analysis software: local programs

Music-printing hardware, software: Zeta plotter, custom programs

Associated literature: *The Italian Madrigal and Related Repertories: Indexes to Printed Collections, 1500-1600* (Yale University Press, 1988)

RISM A II Concordances/Schlichte

Title: *Incipit Comparisons and Concordances from the RISM A/II Database*

Scope: recent searches on 80,000 encoded incipits of musical manuscripts from the seventeenth and eighteenth centuries [1988: 11-24] have yielded surprising results--concordances between Haydn and Mozart manuscripts and anonymous sources (1%), new attributions for Haydn and Mozart *incerta* (22%), attributions for previously unattributed works (2%), and multiple attributions of the same work in diff erent sources (6%). Concordances between individual movements of diverse works have also been identified [see XX].

Investigators: Joachim Schlichte, Klaus Keil
Place: RISM Zentralredaktion, Frankfurt, FRG
Software: custom, with complete pitch and rhythm information and filters for ornamentation

Thematic Catalogue Index/Tortiglione
Title: *A General Index of Thematic Catalogues*
Scope: to provide an index to the contents of widely used thematic catalogues
Investigator: Paolo Tortiglione
Place: Milan Conservatory
Time span: 1988-90
Hardware: IBM PS2
Software: dBase III+, Xywrite
Music-printing software: Personal Composer, SCORE

Thematic Catalogue Search Tool/Midolo
Title: *Electronic Thematic Catalogue*
Goal: to set up thematic catalogues that can be accessed using melodic and rhythmic search-keys
Investigator: Sebastiano Midolo
Duration of project: 1989-1990
Place: Turin, Italy
Hardware: AMIGA, MIDI keyboard
Software: custom, in C

Venetian Ospedali/Whittemore
Title: *Music of the Venetian Ospedali: A Thematic Catalogue* [Pendragon Press, forthcoming]
Scope: catalogue of 1300 music manuscripts associated with the Venetian *ospedali*; 700 are previously uncatalogued items from the archives of San Marco
Investigator: Joan Whittemore

Source Transcription and Analysis

Byzantine Music/Zannos

Title: Transcription and Analysis of Byzantine Music

Purpose and scope: to provide a means of transcribing the historical Greek Orthodox repertory and to facilitate comparison with Turkish music; at present the program searches for all patterns of sign combinations, notes, degrees, intervals, and rhythms occurring more than once. [See pp. XX]. The lexicon of formulae is self-developing. This is part of a dissertation project concerned with improvisation and ornamentation in Greek Orthodox and Turkish music

Investigator: Ioannis Zannos

Place: Musikwissenschaftliches Institut, University of Hamburg

Hardware: Atari ST 1024

Software: custom, in APL and LISP

Associated Literature: Dana Angluin, "Finding Patterns Common to a Set of Strings" in *Journal of Computer and System Sciences* **21** (1986), 46-62.

Fourteenth-Century Liturgical Repertories/Stinson

Title: *Comparative Study of Fourteenth-Century Liturgical Repertories*

Scope: comparison of musical repertories and scriptorium practices in France and Italy

Investigator: John Stinson

Associates: Margaret Manion, Cecilia O'Brien, Vera Vines Brian Parish

Duration of project: 1989-1992

Place: La Trobe University

Hardware: Compaq 386S

Encoding and analysis software: SCRIBE [see p. 53]

Database software: dBase III+

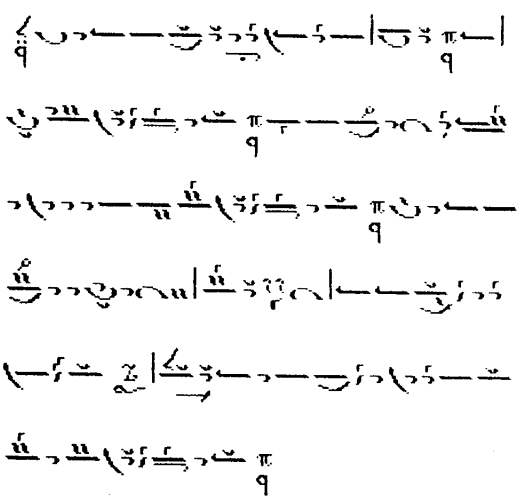
Automatic transcription:

Byzantine Music

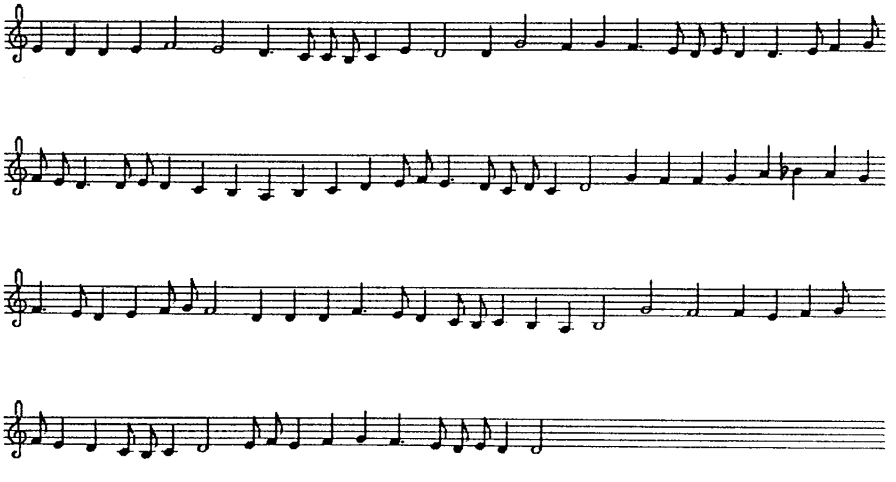
Contributor: Ioannis Zannos
Input: Atari ST 1024
Place: Hamburg, Musikwissenschaftliches Institut

1. NEO-BYZANTINE NOTATION

Κεκραγάριον, ἦχος α΄



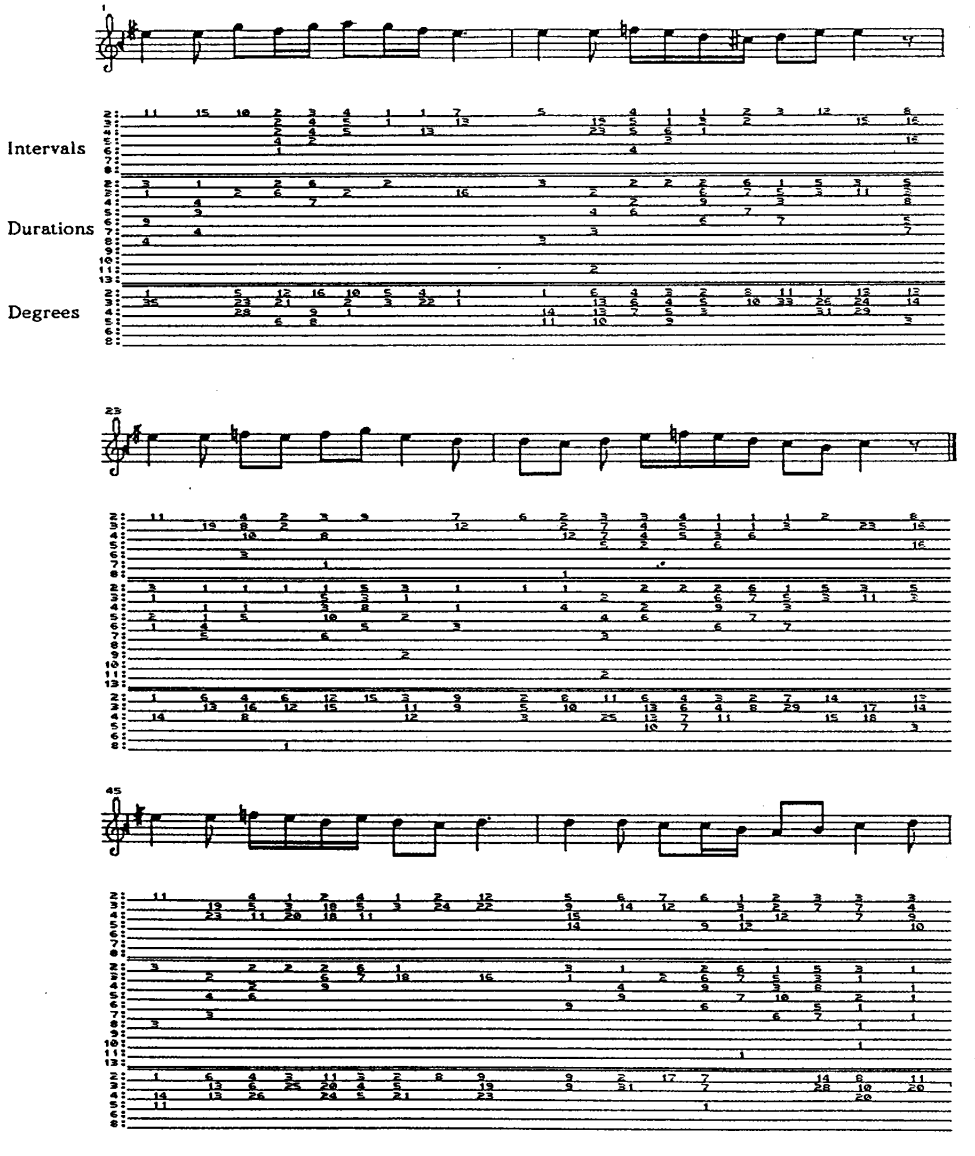
2. TRANSCRIPTION OF THE ABOVE EXCERPT



This research project, using APL and LISP, is designed to facilitate comparison of Greek and Turkish music in diverse notations. First, all patterns of sign combinations, notes, degrees, intervals, and rhythms are identified and catalogued. A self-developing concordance is created. Then a table of formulae is assembled. Finally, relationships between musical formulae and text elements are examined.

3. ANALYSIS

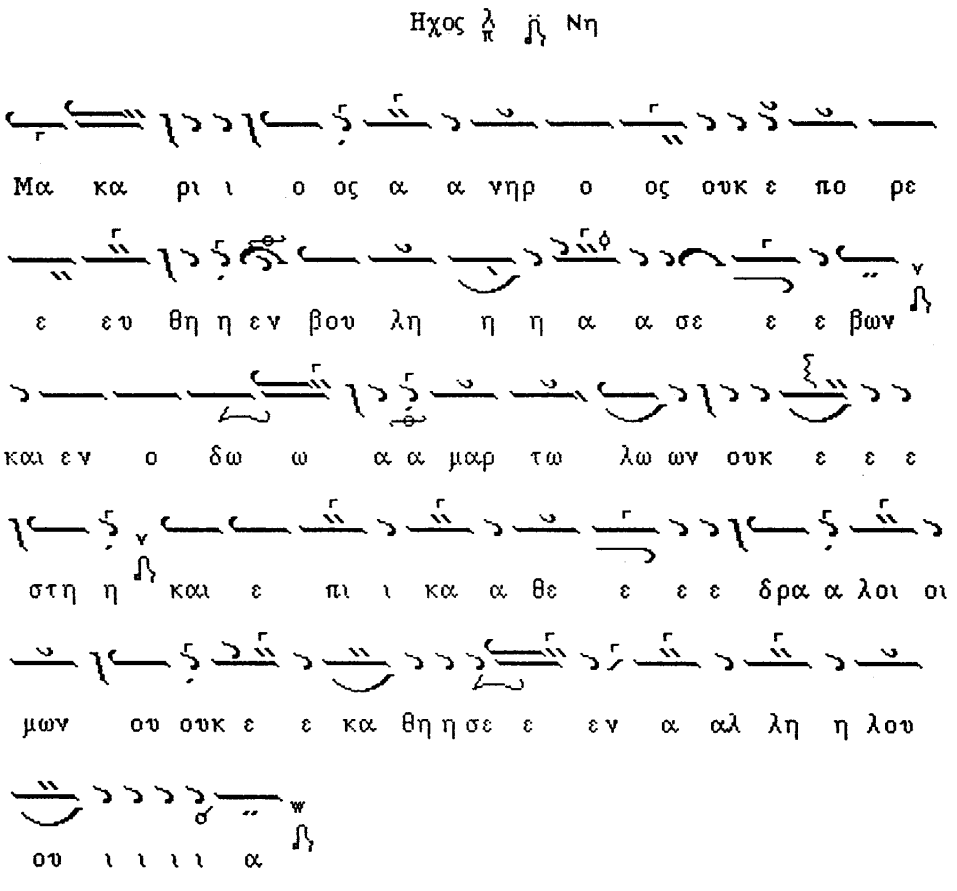
Zacharias (the Hanende) (- 1740): Hüseini Ağır Semai (Bars 1-6)
Aspects: Intervals, Durations, Degrees. Positions of the formulae found.



Automatic Transcription:

Neo-Byzantine Notation

Contributor: Dimitris Giannelos
Input: Macintosh Plus, IBM PC
Output: Apple ImageWriter
Place: ERATTO, Paris



Music-printing hardware: Roland DXY 990 plotter
Associated literature: "Decoration, Text, and Music in Fourteenth-Century Italian Choirbooks", *Miniatura* 1 (1988), 183

Gershwin Piano Rolls/Wodehouse
Title: *George Gershwin's Piano Rolls*
Purpose: conversion of Gershwin piano rolls to MIDI data and printed scores; the stored data will be used to study the evolution of Gershwin's style as a performer; based on the collection of Mike Montgomery
Investigator: Artis Wodehouse
Place: Palo Alto, CA
Hardware: Micro-W video roll reader; Yamaha Disklavier
Music-printing software: *Finale* (with adaptations by by George Letterst)
Associated Literature: forthcoming in the newsletter of the Institute for Studies in American Music

Greek Religious Music/Giannelos
Title: *Research into the Automatic Transcription and Analysis of Traditional Greek Religious Music*
Goal: fully automatic transcription of Neo-Byzantine notation into European notation; creation of software for analysis of this and other traditional religious music as well as Greek folk music [see pp. XX]
Period of repertory: 1800-present
Investigator: Dimitris Giannelos
Duration of project: from 1987
Place: CNRS-ERATTO
Hardware: Macintosh Plus, IBM PC
Encoding software: custom, in MS BASIC
Music-printing hardware: ImageWriter
Music-printing software: conventional output from Michel Wallet's *Euterpe*

ISIS/Philip

Title: *Interactive Signal Inspection System (ISIS)*
Description: ISIS allows the display of digitized music in the form of an oscillogram; segments displayed on the screen can be detached and measured in pitch frequency and duration (in milliseconds)
Investigator: Margot Philip
Software developer: Johannes Philip
Intended application: ethnomusicological study of repertories without fixed pitch and/or rhythmic elements

LIAO Database/Schaff rath and Zhang

Title: *Songs of the Chinese Han Population*
Scope: input, analysis, and cataloguing of Chinese folk melodies
Investigators: Helmuth Schaff rath, Bo Yu Zhang
Places: Essen University; Beijing Conservatory
Duration: 1985--
Hardware: IBM 4381 and PC; Great Wall 0520
Music code: ESAC (converted from MIDI)
Database software: STAIRS and Asksam (Essen)
Analysis software: in BASIC, PROLOG (Beijing)
Music-printing software: Personal Composer
Associated literature: Zhang's "The Use of Computers in the Field of Music" in the *Journal of the Central Conservatory of Music* 1988/4

Karelian Lament/Vaughn

Title: *Karelian Lament*
Purpose: to study interrelationships of vocal tremor and emotional state
Investigator: Kathryn Vaughn
Place: UCLA
Hardware: Fairlight voice tracker
Software: Music Mapper (custom)

String Quartet Incunabula/Downs

Title: *The Incunabula of the String Quartet*

Scope: diplomatic scoring of string chamber music from part books of 1760-90 [Illustration, p. 95]

Investigator: Philip G. Downs

Associates: David Hill, David Palmer, Dillon Parmer, Andrea Sherlock

Place: University of Western Ontario, London, Ontario

Duration: 1986-89

Hardware: Macintosh IIx

Software: *MusPrint*, *Finale*

Trouvère Lyrics/Tischler

Title: *Trouvère Lyrics with Melodies and Lais: Complete Comparative Edition*

Scope: a) preparation of camera-ready copy; b) creation of database for comparing melodies and other musical features

Investigator: Hans Tischler

Associate: Alice Tischler

Duration of project: 1990-1992

Place: Indiana University

Hardware: Macintosh PC

Ugaritic Notation/Halperin

Title: *Ugaritic Notation*

Goal: decipherment of cuneiform notation from Ras Shamra (Ugarit) *c.* 1600 B.C. using quasi-cryptographical methods based on permutations and distance metrics

Investigator: David Halperin

Place: Tel Aviv University

Completion: 1989

Hardware: IBM PC XT

Software: custom

Analytical Software and Applications

AGO Toolset/Laine

Title: *AGO--a Toolset for Music Analysis and Generation*
Developer: Pauli Laine
Place: University of Helsinki
Musical entry code: RELAM [Relatively Timed MIDI]
Music-printing software: Personal Composer

Analytical Layers/Popovic

Title: *Analytical Layers: An Object-Oriented Approach to the Processing of Musical Structure*
Goal: to design and implement an interactive environment for analytical and compositional processing of musical structure
Investigator: Igor Popovic
Place: Yale University
Hardware: IBM PS/2; Macintosh
Musical encosing: DARMS and custom

Byrd/Morehen

Title: *The Unpublished Latin Sacred Music of William Byrd (1543-1623): A Case Study in Musical Authorship*
Scope: to determine the likely authenticity of a group of unpublished Latin motets attributed to Byrd in manuscripts of the late 16th and early 17th centuries
Investigator: John Morehen
Duration of project: 1988-1990
Place: University of Nottingham
Hardware: ICL VME 3900 series
Data-entry software: custom
Music-analysis software: FORTRAN77
Associated literature: *Byrd Studies* [Cambridge University Press, 1992]

Classical Harmony/Ferková

Title: *MUSIC--Analysis of Classical Harmony*

Scope: automatic search for known harmonical structures--chords, scales, harmonic functions--and evaluation of their harmonic-dynamic potentials

Investigator: Eva Ferková

Associates: Marian Dudek, Andrej Ferko

Duration of project: 1986-1989

Place: Slovak Academy of Science, Bratislava

Hardware: IBM PC

Software: custom

Encoding: modified ALMA

Associated literature: E. Ferková, *Some Possibilities in Computer Assisted Analysis of Melody and Tonal Harmony*, Ph.D. thesis, Bratislava 1986 [*n.b.*: the Fourier index sorting technique mentioned in 1988: 114 in connection with Ferková's work was by Lyuba Ballová]

Classification of Children's Singing Games/Osborn

Title: "A Computer-Aided Methodology for the Analysis and Classification of British-Canadian Children's Traditional Singing Games" in *Computers and the Humanities* **22** (1988), 173-82

Goal: analysis of phrase structure following Bartók's "grammatical principle" to improve music education

Investigator: F. E. Ann Osborn

Place: Lakehead University, Thunder Bay, Ontario

Chorale Harmonization/Ebcioglu

Title: "An Expert System for Harmonizing Four-part Chorales"

Goal: to develop a rule-based expert system (CHORAL) for harmonization and Schenkerian analysis of chorales in the style of J. S. Bach

Investigator: Kemal Ebcioglu

Place: Thomas J. Watson Research Center, NY
Hardware: IBM 3081-3090
Software: in Backtracking Specification Language (BSL)
Associated Literature: in *Computer Music Journal* 12/3 (1988)

Computational Theories/Camilleri
Title: *Computational Theories of Music: Theoretical and Applicative Issues*
Scope: review article concerned with relationship of computer modelling to traditional music theory
Investigator: Lelio Camilleri
Place: Florence Conservatory/CNUCE

Counterpoint Generation/Di Scipio
Title: *Contribution to the Design of an Expert System for the Automatic Generation of Tonal Multiple-Counterpoint*
Purpose: to review previous approaches to automatic counterpoint
Investigator: Agostino Di Scipio
Associated Literature: proceedings of the European Workshop on Artificial Intelligence and Music held in Genoa in June 1988

Counterpoint Generation/Frigon
Title: *Counterpoint Generation*
Goal: to create a contrapuntal generator based on musical theory from the 16th through the 18th centuries
Investigator: Chris D. Frigon
Place: Marshfield, MA
Hardware: Dell 200

Declarative Analysis/Roeder
Title: *Declarative Analysis of Non-tonal Music*
Goal: to develop non-procedural models of analytical thinking about non-tonal music
Investigator: John Roeder

Duration of project: 1985-present
Place: University of British Columbia
Hardware, operating system: Macintosh, UNIX
Encoding and analysis software: custom, in PROLOG
Associated literature: "A Declarative Model of Atonal Analysis", *Music Perception* 6/1 (1988), 21-34

Error Detection/Huron
Title: "Error Categories, Detection, and Reduction in a Musical Database" in *Computers and the Humanities* **22** (1988)
Purpose: to study the relationship between kinds of analytical processing and the effect of errors in musical encoding
Investigator: David Huron
Place: University of Nottingham, University of Waterloo
Hardware: IBM PC
Software: Humdrum Toolkit

Graphics-based Analysis/Roeder
Title: *A Graphics-based Music Analysis System*
Goal: to implement a general-purpose, interactive music analysis graphics system with search routines for identifying pitch repetitions, intervallic patterns, etc.
Investigator: John Roeder
Associate: Keith Hamel
Duration of project: 1988-1991
Place: University of British Columbia
Hardware: Macintosh
Software: custom, written in LISP and C
Associated literature: "Issues of Representation in the Analysis of Atonal Music", *Proceedings of the First Workshop on Artificial Intelligence and Music, AAAI-88*, Menlo Park: AAAI, 1988, 138-147

Hierarchical Modelling/Conklin and Witten

Title: *Hierarchical Modelling of Music*

Purpose: to consider possibilities for implementation of theory; Schenkerian analysis cannot be automated because of lack of specificity in coordination of rhythmic, melodic, and harmonic abstractions

Investigators: Darrell Conklin and Ian H. Witten

Place: University of Calgary

Meaning of Indicants/Cohen and Katz

Title: *The Meaning of Indicants not included in Standard Music Notation*

Goal: the further development of methods for assessing timbre, intonation, and intensity

Investigators: Dalia Cohen and Ruth Katz

Place: Hebrew University of Jerusalem

Hardware: Jerusalem Melograph et al.

Analysis software: ILS (signal processing software) et al.

Associated Literature: "The Performance Practice of the Rig-Veda: A Musical Expression of Excited Speech" in *Yuval* IV (1986), 292-317

Mozart Sonata Simulation/Cope

Title: *The Step by Step Computer Simulation of a Mozart Sonata*

Procedure: after MIDI entry of data, the features of two works are compared by superimposing harmonic and melodic images; form is obtained externally; a new work is created with object-tree syntax for ordering

Investigator: David Cope

Place: University of California at Santa Cruz

Music Description Interpreter/Spiegel

Title: *Music Description Interpreter*

Goal: development of a representation, model, and vocabulary for parametric, structural, relational, and procedural aspects of musical material and process, for the storage, analaysis,

transmission, and generation of music
Investigator: Laurie Spiegel
Place: New York, NY
Hardware: Macintosh (with Aztec C), Amiga 1000

Music Information Retrieval System/Pearce
Title: *A Computer Program for Music Information Retrieval*
Goal: to produce a prototype retrieval system allowing location of segments and their variants
Investigator: Alastair Pearce
Place: Birmingham Polytechnic
Completion: October 1989
Hardware: IBM PC compatibles

Music Understanding Research/Dannenberg
Title: *Music Understanding Research*
Goal: to create a computer accompaniment system that listens to live performers and provides an accompaniment in synchrony, whether the performance strictly follows a notated score or is improvised; systems for monophonic and polyphonic input are both under development
Investigator: Roger Dannenberg
Associates: Paul Allen, Joshua Bloch, Bernard Mont-Reynaud, Hal Mukaino
Place: Computer Science Dept., Carnegie Mellon University
Associated Literature: "Following an Improvisation in Real Time" in *Proceedings of the 1987 International Computer Music Conference (ICMC)* and "New Techniques for Enhanced Quality of Computer Accompaniment" in the *1988 ICMC*

MusicFile/Wilkins
Title: *MusicFile: Music Cataloguing Software*
Capabilities: searches and sorts exact performing resources for instrumental works (11 parameters)
Developer: Grover Wilkins
Place: Paris
Hardware: Macintosh

Personal Orchestra/Hawley

Title: *The Personal Orchestra*

Goal: construction of an audio research system in which a workstation controls 64 synthesizers and a computerized Bösendorfer grand piano; the piano's computer-driven performance can be accompanied by an orchestra of synthesizers; this technology involves a family of analytical programs that identify key, melodies, and other features of the music [debut performance of Liszt's *Totentanz* in October 1989]

Investigator: Michael Hawley

Place: MIT Media Lab

Hardware: Sun-3/260; IBM PC; NeXT; Apple; numerous synthesizers of various kinds

Pitch-Class Set Segmentation/Isaacson

Title: *A Localized Connectionist System for Pitch-Class Set Segmentation of Atonal Music*

Goal: to build an system that learns from one piece and applies generalizations to others

Investigator: Eric Isaacson

Place: Indiana University

Hardware: VAX 8650

Pitch-Class Sets and Relations/Forte

Title: *Pitch-Class Sets and Relations*

Goal: to provide tools for the exploration of the pitch class set paradigm in analysis of atonal music

Investigator: Allen Forte

Place: Yale University

Duration: 1986--

Hardware: IBM PC compatibles, Canon Bubble Jet

Analysis software: custom

Music-printing software: The Note Processor

Associated Literature: "New Approaches to the Linear Analysis of Music" in *Journal of the American Musicological Society* **XLI/2** (1988)

Pitch-Class Software/Dembski

Title: *Pitch-Class Software*

Goals: a) to develop a generalized step-class oriented system of pitch-classes for compositional and theoretical tasks; b) to create software for generating and analyzing arrays of sets of pitch-classes by user-defined criteria. The tonal and twelve-tone systems are regarded as eccentric special cases.

Investigator: Stephen Dembski

Associates: David Becker, Tim Keith

Duration of projects: 1) 1984-92; 2) 1986-90

Place: University of Wisconsin--Madison

Software: 1) a custom menu-driven package ("Circles") in Waltz LISP (a Franz dialect); 2) high-level languages "MDG" for data generation and "MQP" for query

Associated literature: "LISP Software for the Generation and Analysis of Pitch-Class Arrays" (Lancaster, 1988); "Steps and Skips from Content and Order: Aspects of a Generalized Step-Class" (Baltimore, 1988)

Plainsong/Harbor

Title: *Plainsong*

Scope: development of software to facilitate data entry, printing, and analysis (variants in multiple sources, re-use of melodies and melodic fragments) in plainsong

Investigator: Catherine Harbor

Associates: Steve Eaton, Andy Reid, Peter Wilton

Polymetric Perfrormance Measurement/Grieshaber

Title: *Polymetric Performance of Percussionists and Pianists*

Goal: descriptive statistics and graphics of accuracy of rhythmic performance

Investigator: Kate Grieshaber

Place: University of Washington, Seattle

Hardware: IBM PC

Representation of Scores/O'Maidin

Title: *Representation of Scores for Analysis*

Purpose: to provide a software environment for representation and analysis of musical scores

Investigator: Donncha O'Maidin

Place: Waterford Technical College

Completion: 1989

Row SuperClasses/Laprade

Title: *A Study of Row SuperClasses and their Partially Ordered Properties*

Goal: a) to create row superclasses defined by twelve-tone operators, retrogradation, and rotation; b) to identify types of rows used in certain repertories

Investigator: Paul Laprade

Duration of project: April-Oct. 1989

Place: Eastman School of Music

Hardware: Compaq

Encoding and analysis software: custom, in Turbo C

Segmentation/Camilleri

Title: *An Expert System Prototype for the Study of Musical Segmentation*

Goal: to create an analysis environment for testing the content of particular theories; rules for phrasing and phrase hierarchies based on the theories of Lerdahl and Jackendoff were tested using Schubert *Leider*

Investigator: Lelio Camilleri

Place: Florence Conservatory/CNUCE

Semantic Space Analysis/Chesnut

Title: *Semantic Space Analysis*

Goal: to trace time-lines through semantic space in representative works of classic-romantic music

Scope: a four-dimensioned system, derived from Charles Osgood's semantic differential, to categorize the affective meaning of a work

Investigator: John Chesnut
Place: Spartanburg, SC
Duration of project: 10 years
Hardware (OS): Amstrad PCW8256 (CP/M)
Associated literature: "Affective Design in Schubert's *Moment musical*, Op. 94, No. 6" in *Explorations in Music, the Arts, and Ideas*, ed. Narmour and Solie [NY: Pendragon Press, 1989]

Tonal Melody/Williams
Title: *The Computer-Aided Analysis of Tonal Melody*
Goal: development of a set of programs to perform reductive analysis on phrases of tonal melody; programs are especially useful for work with jazz
Investigator: J. Kent Williams
Place: University of North Carolina, Greensboro
Hardware: VAX/VMS
Encoding: MUSTRAN

* * *

The preceding listing is limited to projects not previously reported or significantly changed since last reported. For information on more than 200 projects reported in previous issues, please see the indices.

The address lists given in the following pages are likewise limited to persons, agencies, and businesses mentioned in this or a recent issue.

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Cumulative Indices, 1985-89

Compiled by Steven Rasmussen

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A. Researchers and Institutions

B. Computer Software and Hardware

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