

Recent Developments in Textual Scholarship and their Application to Music

Joshua Veltman
March 15, 2001
Dr. Lois Rosow
Music 950.01

A rehearsal of the ways in which electronic technology has affected almost every aspect of modern life would be to belabor the obvious. Recently, people have begun to speak of the present times as “The Information Age,” giving the development of information technology an equal significance for human affairs to the invention of metalworking, the steam engine, and the splitting of the atom. In the realm of academia, the explosion of information and the technology to handle it has impacted not only the hard sciences as one might expect, but also the social sciences and even the humanities.

Apart from theoretical developments wrought under the influence of postmodernism (from which no humanistic discipline is immune), recent developments in textual scholarship have been largely practical. Scholars of literature have developed computerized methods that not only enhance their traditional approaches to texts (by allowing them to tackle larger corpora and with greater sophistication), but which also enable new approaches that would have been unthinkable under the constraints imposed by book technology. Some parallel developments have occurred in music scholarship. In certain activities, however, notably in the researching and preparation of critical editions, music scholars lag behind their literary cohorts (as far as use of technology is concerned). The primary purpose of this paper is to survey the recent technological developments in textual scholarship as well as the parallel developments in musical scholarship, and to

identify areas of disparity between the two, proposing along the way work that could close the gap. A secondary aim will be to consider recent developments in editorial theory that arise from or are facilitated by the use of computer technology.

Computers are in no way replacements for humans, but tools for humans. Computers shine at crunching numbers and at performing repetitive tasks that would induce slumber in humans, but it should also be kept in mind that “[c]omputers have an unbounded capacity to generate nonsense” (Huron 1999: Chapter 39). It is in the combination of the critical faculties of an intelligent mind on the one hand with the computer as an incredibly fast (albeit absolutely literal) extension of that mind on the other that the computer shows its true utility. It is this combination of mind and computer that has enabled the scholarly advances discussed here.

In order for a computer to store and process information, it must be encoded in some kind of “machine-readable” format. One way to get information into the computer domain is to optically scan it in order to produce a digital facsimile. Flatbed scanners and digital cameras can be used to produce digital facsimiles of paper-based source materials. When source materials are available on microfilm, a microfilm scanner can be used. If a relatively complex and expensive apparatus such as this is not available, a paper copy can be produced first which in turn can be optically scanned. The intermediate paper step, however, entails a loss of resolution. It should also be noted that microfilm is best for transmitting high-contrast, predominantly black-and-white material, but is notoriously poor at preserving nuances of gray and does not preserve color at all. Thus, if at all possible

(and it often is not), digital facsimiles should be made directly from the original paper. The technicalities involved in the digitization of primary sources are discussed by Robinson (1993a).

Digital facsimiles can make source materials much more widely available. The possibility for their distribution on portable magnetic or optical media or over the internet makes scholarly collaboration more likely. Moreover, source materials can be presented to the end user or “reader” as part of a critical edition. (Electronic editions and hypermedia, and the use of digital facsimiles in them, are discussed below.)

Digital facsimiles can also facilitate optical collation. Mechanical optical collation devices like the Hinman Collator, the Lindstrand Comparator, and the Randall McLeod (Shillingsburg 1996b: 135), are nothing new, and are best applied to the collation of copies from the same print edition, primarily to catch stop-press corrections. However, an alignment of the two texts sufficiently precise for comparison may be difficult to achieve with these devices, and in addition, only users with great persistence and experience can avoid “dizziness and a crick in the neck” (Shillingsburg 1996b: 135). The digital medium makes it possible to resize and reposition two images as necessary so that they can be superimposed; coloration or calculation schemes can then be employed so as to make any discrepancies between the two copies immediately apparent.

Finally, digital facsimiles can be used simply as edition identifiers. Salemans (1994) argues that the signature formulas commonly used to distinguish between editions of the same work, while very often adequate, sometimes fail to make

necessary distinctions. Superimposition of pages in a manner similar to that described above may reveal positional differences that signature formulas cannot describe.

A computer stores an image as a grid of pixels, with each pixel having a particular value for lightness or darkness, or for color. Stored in this way, symbols on the page have no significance for the computer, that is, they cannot be identified or processed as specific symbols. A recently-developed technology called Optical Character Recognition (OCR) attempts to translate from pixellated images to significant symbols, with varying degrees of success, depending on many factors including the initial quality of the image. With print sources, degraded materials or indistinct characters resulting from, for example, worn type, make OCR unreliable at best. In its current state, OCR is unuseable for manuscript sources due to the huge variety of script types and letter forms. The best way to render a primary source in machine-readable form is to transcribe it into a text-based encoding.

A useful text encoding must use some kind of markup scheme. Virtually all texts are “marked up” in some way; punctuation that segments text into clauses and sentences, indents that segment text into paragraphs, and quotation marks that identify direct speech are all examples of basic, ubiquitous markup. Word processing programs mark up texts in many additional ways, but these markups are usually invisible to the user unless a special “show codes” mode is invoked. Such programs usually employ proprietary markup schemes, creating a barrier to file exchange (even given the existence of software designed to translate among various formats, since it is not perfectly reliable).

Coombs, Renear, and DeRose (1993) make an important distinction between procedural markup and descriptive markup, and argue for the superiority of the latter. Procedural markup tells the computer *how* to display a segment of text (e.g., “italicize this word”), whereas descriptive markup tells the computer *what* a segment of text is (e.g., “this is a word from a foreign language”). Hypertext Markup Language (HTML), with which many scholars may be familiar, combines aspects of procedural markup (e.g., tags for italicization and boldening), and descriptive markup (e.g., tags for headers, list items, links, etc.). Descriptive markup is more efficient and useful on at least three major counts. First, when visual formatting is a concern, display instructions (often called a “style sheet”) can be stored in a separate file. If a decision is made to change formatting (e.g., that foreign-language words are to be boldened rather than italicized), only the style sheet needs to be changed and not every instance of a certain text element. Second, descriptive markup can be standardized to allow transparent file exchange among scholars, regardless of computer platform or favorite software package. Third, descriptive markup enables the computer to analyze text in meaningful ways.

Over the past twenty years or so, numerous text encoding schemes have been developed for individual projects (a few are described in Robinson 1994: 12-28). These idiosyncratic schemes, while perfectly consistent within themselves and adequate for the purposes of the specific project, are incompatible with one another. A growing sense among scholars of the need for a unified encoding scheme based on descriptive markup led to the establishment of the Text Encoding Initiative (TEI). The TEI was the result of a cooperative effort by three scholarly societies: the

Association for Computers and the Humanities, the Association for Computational Linguistics, and the Association for Literary and Linguistic Computing, and was funded by major public and private foundations in the United States and Europe. It began with a planning meeting in Poughkeepsie, New York, in 1987, and culminated in the *Guidelines for Electronic Text Encoding and Interchange* (Sperberg-McQueen and Burnard 1999). The first edition of the guidelines were issued in 1990, and they continue to be refined in light of new source material situations and of continuing dialog. In December 2000, a non-profit corporation called the TEI Consortium was set up to provide further development and maintenance of the TEI standard.

The TEI guidelines recommend the use of Standard Generalized Markup Language (SGML). SGML is a descriptive markup system that began its life in the 1960's, and has been adopted by certain influential business and government institutions (Robinson 1994: 29). Now many in academia are following suit: TEI-conformant projects include scores of major text encoding initiatives, including *The Piers Plowman Electronic Archive* (Duggan 1994) and *Thesaurus musicarum italicarum*, “an electronic corpus of Italian music treatises from the Renaissance and early Baroque in multimedial transcription and in digital facsimile” (Wiering 2000).

Properly marked-up texts can be searched, sorted, inventoried, tallied, and so on by computer. The ability to analyse texts in these ways has been a boon especially to linguists and literary scholars. Properly marked-up texts also enable computerized collation, a boon for those engaged in textual criticism. That is, a computer can perform a word-by-word comparison of multiple witnesses to the

same work, flagging and categorizing all variants. Several computer programs, with varying levels of sophistication, have been developed for this task (see e.g., Janus 1990, Corre 1992, Hilton 1992, Robinson 1991-95, and Johnson 1993). At least some of these programs employ an interactive approach, a perfect marriage of computer brawn and human brain. The computer does most of the tedious work, but calls on the operator for help when it loses its place due to major discrepancies such as missing pages. The most sophisticated program, and the one used in some of the highest-profile projects, is apparently Peter Robinson's *Collate*. Visit Duggan (1994) for an example of the output from *Collate*.

The effort required to transcribe an entire manuscript or print tradition into SGML for the purpose of collation is substantial, but so are the potential rewards. It must be emphasized that such a transcription, like any transcription, is an alternative representation of the original material and as such cannot avoid being interpretive. For example, the transcriber may need to decide the meaning of and how to represent certain non-linguistic semiotic codes in the original material, such as the hierarchy of script types and letter forms found in some manuscripts. It is possible to introduce new errors into the tradition at this encoding stage. The vast majority of errors, however, will be caught if the flagged variants are double-checked against the originals. The only case in which an error can slip through is when only one source differs from all the others for a given word, and the typist erroneously enters the word to make the one source conform with all the others (in which case a variant will not be flagged and the original will not be checked) (Shillingsburg 1996b: 137-38).

Once the sources have been collated, the results of the collation must be analysed in an attempt to determine stemmatic relationships. That is, if possible, one must try to determine which sources were copied from which, arranging sources into family groups or “traditions.” In traditional stemmatic analysis, this is done by tracing shared errors throughout the sources (Greetham 1994: 313-323). Long thought to be a task suited only to the human mind and not susceptible to statistical analysis, it now turns out that stemmatic analysis can be aided by a computer applying a statistical model developed by biologists. As Peter Robinson explains,

one could use computer methods to analyze the patterns of agreements and disagreements between and among the manuscripts and to construct from these patterns alone a reconstruction of the history of the tradition. Over the last thirty years evolutionary biologists have developed a range of methods for use in reconstruction of the descent of related species, a situation directly analogous to that of reconstruction of the descent of related manuscripts (Robinson 1992).

The methods described here have been called cladistic or phylogenetic analysis, which involves the identification of clades or “family trees” based on similarities and differences in the anatomical features of organisms. Robinson reports “astonishing success” with a corpus of Old Norse legends; cladistic analysis confirmed relationships that he had determined through circumstantial evidence, and furthermore pointed out some relationships that had escaped his notice (Robinson 1992 and 1996a). The computer program used was an early version of PAUP (*Phylogenetic Analysis Using Parsimony*); since that time the program’s author has refined it, has released public beta versions of it, and soon will release a final public version (Swofford 1989-97).

The potential rewards alluded to above for investing effort in computer

encoding, which enables the collation and analysis techniques just described, are being actualized. The *Piers Plowman* and *Canterbury Tales* projects currently underway are examples of works that have benefited from these techniques (see Duggan 1994 and Robinson and Taylor 1998, respectively). In both cases, previous editing attempts using manual methods were simply overwhelmed by the multiplicity of sources and the complexity of interrelationships among them. The new editing projects have clarified the source traditions and are proceeding with publication.

And that, of course, is usually the final goal of scholarly editing: the publication of a critical edition. As with the previous steps of encoding, collation, and analysis, computer technology presents new opportunities and challenges in the realm of publication. Some projects may still be well served by book publication, while many others will benefit from, or indeed only be feasible as, an electronic edition.

If a book format is desired, professional-grade typesetting software for desktop computers is now available to the editor. A long-standing issue in publication, and one that is hardly unique to the modern era, is the potential for errors or other alterations to be introduced into the work at the publishing house. Electronic typesetting by the editor, in allowing her complete control over the content and appearance over the final product, alleviates this problem. On the other hand, producing publication-quality print is time-consuming and technically demanding, and may distract the scholar from his true calling. It is possible to adopt a middling approach to this dilemma. The editor supplies computer files with all the content,

which the publisher then professionally formats for publication. Ideally, the entire computerized editorial process should be a continuous chain in which the output from one stage of the process is used as the input for another (Shillingsburg 1996b); i.e., encoding —> collation —> analysis ==> publication.

For many large and complex corpora, a critical edition in book format would impose undesirable limits. A manageably sized book often cannot do justice to the breadth of tradition of a particular work; it must usually present a single clear-reading text and relegate only the most important variants to a separate critical apparatus, or else would be prohibitively expensive to produce. An electronic critical edition can move beyond such limits; the massive and relatively cheap storage afforded by optical and magnetic media can easily handle the task. For the *Piers Plowman* and *Canterbury Tales* projects mentioned above, the only feasible way to publish them is as electronic critical editions, due to the vast and complex source situations.

Another limitation of the book format which an electronic edition can transcend is its fixed, sequential presentation. With a book, the reader is constrained to the format chosen by the editor, but more importantly, the reader must accept the formal theoretical orientation of the editor. If an editor has chosen an eclectic approach, for instance, a reader more interested in a “best text” can reconstruct that best text from the critical apparatus only with difficulty. Shillingsburg (1996b) proposes an ecumenical approach to the problem; an editor need not abandon a formal theoretical orientation altogether, but should put the edition together in such a way that accommodates other orientations. Electronic editions make this

possible. Transcriptions of *all* sources can be presented, if necessary, to allow the reader to pursue whatever facet of the source tradition seems most interesting. The most sophisticated electronic editions also provide search and analysis tools to facilitate study of the work by the reader. After all, the ultimate goals of critical editions include not only making works available to a wider scholarly and general audience, but also the appreciation of works and an understanding of their place in cultural history.

An interesting demonstration of some of the possibilities just discussed is an online electronic edition of a 19th-century novel segment called “Smoke, Flame, and Ashes” from Ik Marvel’s (Donald Grant Mitchell) *Reveries of a Bachelor* (1850) (Spiro 1999). It makes available transcriptions of five separate editions of the work, a tradition spanning 35 years. It also provides a view called “All Variants Visible Simultaneously and in Context”—in essence, a full collation of all five editions. All of the views are generated “on-the-fly” from a single SGML-tagged text. In addition, above each transcribed page is provided a digital facsimile of the source page.

The natural medium for this type of electronic edition is hypertext (or hypermedia, when anything in addition to text is involved). The prefix “hyper” means “beyond” or “outside of,” and hypertext has come to mean text providing active links to other texts and so on, from which a web of interlinked texts is created. Hypertext theorists like to point out that the etymological origins of the word “text” are related to weaving; the word “textile” makes this etymology clear. In addition to the presentational possibilities afforded by hypertext, it has the benefit of the widest potential distribution over the internet. (“Internet” refers to the physical

infrastructure of cables and computers; “World Wide Web” refers to the web of texts themselves.)

Given the possibilities of hypertext, why stop with the primary sources? Why not include secondary material such as letters and diaries, for example, and other relevant research material? Some editors have moved precisely in this direction, moving beyond critical edition and into the realm of critical archive. A pioneer in this regard is Jerome McGann, who has been preparing *The Complete Writings and Pictures of Dante Gabriel Rossetti: A Hypermedia Research Archive* (McGann c2000). Rossetti not only wrote many texts but also produced works of visual art, and often the two media interrelate in significant ways. Hypermedia is the natural environment and perhaps the only real choice for such a corpus.

Hypertext/hypermedia comports well with some recent developments in literary criticism and editorial theory. To highlight only one of the most prominent voices in this regard, Jerome McGann has elaborated the idea of the “socialized text” (McGann 1991: 86; also see McGann 1983). With this term he wishes to shift emphasis away from (potentially chimerical) authorial intention toward the role of societies and institutions as the most salient shapers of art works. Hypermedia editions and archives can effectively present the entire life of a work in all its social-historical facets in a way that is difficult to do with books. In response to the charge that hypermedia archives are therefore “decentered,” McGann contends that they are indeed decentered, but that does not mean that they are necessarily destabilized or unstructured (McGann 1997: 40-45). He likens the critical archive to a library, which certainly has stability and structure but which never dictates which books or

in what order the user takes them down from the shelf. Hypertext also resonates with recent discussions of intertextuality. Perhaps it is no coincidence that McGann's title "The Rationale of Hypertext" (1997), published both as hypertext and on paper, forms an intertextual mini-web with W. W. Greg's "The Rationale of Copy-Text" (1950-51) and G. Thomas Tanselle's "The Rationale of Textual Criticism" (1989).

The foregoing discussion is oriented primarily toward literary works. To what extent have similar tools and techniques been applied in musical scholarship, and how might they be applied if they currently are not? The following discussion offers some answers to these questions. It will be seen that some promising inroads into computerized critical editing have been established, but that significant work remains to be done in this field. Each of the activities discussed above (digital imaging, text-based encoding, collation, analysis, and publication) will be considered in turn.

The digital imaging of music does not differ in any significant way from the digital imaging of text. All the considerations and techniques discussed above, whether for manuscripts or prints, apply to music as well.

The situation is less straightforward for text-based encoding. Perhaps MIDI (Musical Instrument Digital Interface) springs to mind as a suitable machine-readable (if not actually text-based) format. However, MIDI is oriented toward performance; as such it is performance-rich but information-poor. Essentially, a MIDI file is a set of instructions for a digital instrument, telling it when to start and stop notes and how loudly to play them, what timbre to use, and so on. It does not

identify rhythmic values nor does it disambiguate enharmonic equivalents, among other shortcomings. Clearly MIDI cannot be used for editorial purposes. Beyond MIDI, various notation programs, like various word processors, employ proprietary formats that are potential barriers to file exchange. Furthermore, these formats are oriented towards visual presentation (i.e., procedural markup) and are poor candidates for computerized analysis.

Is there some kind of descriptive markup for music? SGML will not work; it is designed for texts and is not suitable for encoding music. As was the case with text, a variety of text-based encoding schemes for music have been developed, schemes that are consistent within themselves and are (more or less) adequate for the tasks for which they have been developed. But once again some kind of standard would be desirable.

It would appear that such a standard is emerging in the form of David Huron's *Humdrum* format (Huron 1993-96, 1995, and 1999). This format along with the software tools developed to analyze it have proven to be powerful and flexible. A significant indicator of its increasingly wide acceptance can be seen in the fact that the Center for Computer-Assisted Research in the Humanities (CCRAH), which has developed its own encoding system called MuseData, recently decided that henceforth it would publish electronic musical materials in *Humdrum* format.

The performative nature of music along with the graphical peculiarities of musical notation make text-based transcription of it an all the more interpretive task. The *Humdrum* format does not constrain the user to a limited vocabulary of codes. Several pre-defined representations have been developed, but the user is free

to develop his or her own representations in order to encode whatever information is of interest.

Is the *Humdrum* format a type of descriptive markup? The answer is, properly speaking, no, since tags or markups are not employed, but the *Humdrum* format affords many of the same benefits as descriptive markup. Each vertical column of data (or “spine,” representing a horizontal line of music) must be headed by an “exclusive interpretation.” Within each exclusive interpretation, each element in the character set employed has an unambiguous meaning as to the nature (e.g. rhythmic value or pitch) and value (e.g. eighth-note, G#) of the element being encoded (at least in the pre-defined representations developed by Huron). As with descriptive markup, these features, along with the ability to create customized representations, permit the analyses of considerable power and flexibility mentioned above.

Humdrum was designed for musical analysis and not collation as such. But the system can be adapted to perform collations without much difficulty. Examples 1 and 2 below present a very brief “proof-of-concept” collation and the beginnings of a critical apparatus generated by *Humdrum* from electronic source materials of a Vivaldi violin concerto (fuller discussion below).

What about stemmatic analysis? There seems to be no reason why collation results could not be generated in the format required by PAUP. To my knowledge no one has applied cladistic analysis to musical sources, and it is an exciting possibility that must soon be explored.

Moving into publication, the same options present themselves to the editor

of a musical work as to the editor of a literary work. With paper publication, the same ideal for the uninterrupted chain of the output of one stage of the editorial process becoming the input for the next stage obtains, but the final stage (electronic typesetting) presents a great challenge. As complicated as the graphical technicalities of text publication are, the graphical technicalities of music publication are even more complicated. Apparently some publishers find it easier to start from scratch than to accept files from editors that must be formatted.

It seems at least theoretically possible that a system could be devised whereby content files are used to generate an instructional script for music typesetting programs such as *Score*, a professional-grade program used by many music publishers. Perhaps it could be refined to the degree that publishers would not hesitate to deal with material generated in this way. As proof of the validity of this concept, and also as a demonstration of its still embryonic status, consider a chain of output and input that has already been (tentatively) established between *Humdrum*, *Mup*, and *Postscript*. A non-standard, thoroughly un-debugged command in *Humdrum* exists that takes *Humdrum* input and renders it as a script for *Mup*, a quirky text-based music notation program. *Mup* in turn generates a *Postscript* file, i.e., a set of instructions to a laser printer for the drawing of a sheet of music. The *Humdrum* to *Mup* command often “chokes” on music approaching moderate complexity, but this is a technical and not a conceptual barrier.

Beyond paper publication, no hypermedia editions or archives of specifically musical works have come to my attention. The community of music scholars and aficionados could benefit greatly from these. It seems that some technical

challenges must be tackled first in order to allow them to be truly interactive. A promising recent development in this regard is that the notation programs *Sibelius*, *Score*, and *Finale* have all developed web-browser plug-ins to view and play music. None of these plug-ins, however, are scriptable, which would be necessary for generating variant musical readings “on-the-fly.”

An electronic critical edition of Vivaldi’s Opus 8 (violin concerti) has been published, not as hypermedia, but simply in *Humdrum* format, by Eleanor Selfridge-Field (1998). Although quite a large body of music has been encoded in *Humdrum* format, Selfridge-Field’s publication is, to my knowledge, the first (but hopefully not also the last) electronic *critical* edition of music. She has written a command that can extract (from amalgamated source files) transcriptions not only of her critical edition, but also of the various sources for each concerto movement. One can extract and examine sources identified as the Amsterdam print, the Manchester partbooks, the Turin manuscripts, and the Dresden manuscripts. As an exploratory exercise, I used Selfridge-Field’s “edition” command and various *Humdrum* and *Unix* commands to create a collation and the beginnings of a critical apparatus for the *violino principale* part of Op. 8 No. 10, mvmt. 3. Partial results are shown in Tables 1 and 2 below. (The Selfridge-Field critical edition and the Amsterdam, Turin, and Dresden sources are indicated by ****s**, ****a**, ****t**, and ****d**, respectively). This exercise was performed quickly and for the purpose of demonstrating the possibilities of computerized collation of musical materials.

**Example 1. Vivaldi, Op. 8 No. 10 mvmt. 3, solo violin part:
electronically-generated collation (sample).**

**s	**a	**t	**d
=1-	.	.	.
(16b-LL	.	.	.
16ddJ	.	.	.
8ff)	.	.	.
8bb-J	.	.	.
=2	.	.	.
.			
.			
.			
=35	.	.	.
(16gLL	.	.	.
16b-	.	.	.
16gg	.	.	.
=36	.	.	.
(16fLL	.	.	.
16a	.	.	16b-
16ff	.	.	.
=37	.	.	.
(16fLL	.	.	.
16a	.	.	16b-
16ff	.	.	.
=38	.	.	.
etc...			

**Example 2. (Toward) an electronically-generated critical
apparatus.**

**s	**a	**t	**d
=36	.	.	.
(16fLL	.	.	.
16a	.	.	16b-
16ff	.	.	.
=37	.	.	.
(16fLL	.	.	.
16a	.	.	16b-
16ff	.	.	.
=61	.	.	.
4a/	4f/	.	4f/
8r	.	.	.
*_	*_	*_	*_

In many ways it is a brave new word for those interested in critical editions of literary and musical works. It is to be hoped that music scholars in particular will lay claim to the possibilities presented here and will not shy away from the challenges they entail.

Selected Bibliography

Center for Computer-Assisted Research in the Humanities. <http://www.ccarh.org>

Coombs, James H., Renear, Allen H., and DeRose, Steven J. 1993. "Markup Systems and the Future of Scholarly Text Processing," in *The Digital Word: Text-based Computing in the Humanities*, Delany, Paul and Landow, George P., eds. Cambridge, Mass.: MIT Press: 85-135. Republished by Boulder, Colo.: Netlibrary, Inc., 1999 [computer file].

Corre, A. D. 1992. "Concorder—Concordance Software for the Macintosh," *Computers and the Humanities* 26/5-6: 463-464.

Delany, Paul and Landow, George P. 1993. "Managing the Digital Word: The Text in an Age of Electronic Reproduction," in *The Digital Word: Text-based Computing in the Humanities*, Delany, Paul and Landow, George P., eds. Cambridge, Mass.: MIT Press: 3-28. Republished by Boulder, Colo.: Netlibrary, Inc., 1999 [computer file].

Doss, Phillip E. 1996. "Traditional Theory and Innovative Practice: The Electronic Editor as Poststructuralist Reader" in *The Literary Text in the Digital Age*, ed. Richard J. Finneran. Ann Arbor: University of Michigan Press: 213-224.

Duggan, Hoyt N. 1994. "Creating an Electronic Archive of *Piers Plowman*." <http://jefferson.village.virginia.edu/piers/report94.html>

Greetham, D. C. 1994. *Textual Scholarship: An Introduction*. New York: Garland Publishing, Inc.

Greg, W. W. 1950-51. "The Rationale of Copy-Text." *Studies in Bibliography* 3: 19-36. Reprinted in *Sir Walter Wilson Greg: A Collection of his Writings*, Joseph Rosenblum, ed. Lanham, Md.: Scarecrow Press, 1998.

Hilton, M. L. 1992. "The Urica! II Interactive Collation System," *Computers and the Humanities* 26/2: 139-144.

Huron, David. 1988. "Error Categories, Detection, and Reduction in a Musical Database," *Computers and the Humanities* 22/4: 253-264.

Huron, David. 1993-1996. *The Humdrum Toolkit: Software for Music Research*. Computer Program, version 1.1. <http://dactyl.som.ohio-state.edu/Humdrum/index.html>

Huron, David. 1995. *The Humdrum Toolkit: Reference Manual*. Stanford, California: Center for Computer Assisted Research in the Humanities.

- Huron, David. 1999. *Music Research Using Humdrum: A User's Guide*.
<http://dactyl.som.ohio-state.edu/Humdrum/guide.toc.html>
- Janus, L. 1990. "Hum—A Concordance and Text Analysis Package for Unix,"
Computers and the Humanities 24/5-6: 510-512.
- Johnson, Eric. 1993. "Collate—Interactive Collation of Large Textual Traditions."
Computers and the Humanities 27/5-6: 401-403. Review of Robinson 1991-1995, Release 1.1.
- Landow, George P. 1989. "Hypertext in Literary Education, Criticism, and Scholarship," *Computers and the Humanities* 23/3: 173-198.
- Landow, George P., ed. 1994. *Hyper/Text/Theory*. Baltimore: Johns Hopkins University Press, 1994.
- Luong, N. X. 1989. "Using a Tree Model in Textual Analysis," *Computers and the Humanities* 23/4-5: 397-402.
- McGann, Jerome. 1983. *A Critique of Modern Textual Criticism*. Chicago: University of Chicago Press.
- McGann, Jerome. 1991. *The Textual Condition*. Princeton: Princeton University Press.
- McGann, Jerome. 1996. "The Rosetti Archive and Image-based Electronic Editing" in *The Literary Text in the Digital Age*, ed. Richard J. Finneran. Ann Arbor: University of Michigan Press: 145-84.
- McGann, Jerome. 1997. "The Rationale of Hypertext" in *Electronic Text: Investigations in Method and Theory*, Kathryn Sutherland, ed. Oxford: Clarendon Press: 19-46. Available online at
<http://jefferson.village.virginia.edu/public/jjm2f/rationale.html>
- McGann, Jerome. 2000, copyright. *The Complete Writings and Pictures of Dante Gabriel Rossetti: A Hypermedia Research Archive*.
<http://jefferson.village.virginia.edu:2020>
- McGee, W., and Merkley, P. 1991. "The Optical Scanning of Medieval Music," *Computers and the Humanities* 25/1: 47-53.
- Nettheim, N. 1993. "On the Accuracy of Musical Data, with Examples from Gregorian Chant and German Folksong," *Computers and the Humanities* 27/2: 111-120.

- Olsen, M. 1993. "Critical Theory and Textual Computing—Comments and Suggestions," *Computers and the Humanities* 27/5-6: 395-400.
- Robinson, Peter M. W. 1991-95. *Collate*. Computer Program. Release 1.0 April 1991, 1.1 (revised and augmented) April 1992. Release 2.0 (substantially rewritten) June 1994; 2.1 February 1995 (revised). Oxford: Computers and Manuscripts Project; Leicester: Centre for Technology and the Arts.
- Robinson, Peter M. W. 1992. "Report on the Textual Criticism Challenge 1991." <http://www.ibiblio.org/bgreek/archives/greek-1/msg00015.html>
- Robinson, Peter M. W. 1993a. *The Digitization of Primary Textual Sources*. Oxford: Office for Humanities Communication Publications.
- Robinson, Peter M.W. 1993b. "Redefining Critical Editions," in *The Digital Word: Text-based Computing in the Humanities*, Delany, Paul and Landow, George P., eds. Cambridge, Mass.: MIT Press: 271-291. Republished by Boulder, Colo.: Netlibrary, Inc., 1999 [computer file].
- Robinson, Peter M. W. 1994. *The Transcription of Primary Textual Sources using SGML*. Oxford: Office for Humanities Communication.
- Robinson, Peter M. W. 1996a. "Computer-Assisted Stemmatic Analysis and 'Best-Text' Historical Editing" in *Studies in Stemmatology*, P. Van Reenen and M. Van Mulken, eds. Amsterdam: John Benjamins: 71-103.
- Robinson, Peter M. W. 1996b. "Is There a Text in these Variants?" in *The Literary Text in the Digital Age*, ed. Richard J. Finneran. Ann Arbor: University of Michigan Press: 99-116.
- Robinson, Peter M. W. 1997. "New Directions in Critical Editing" in *Electronic Text: Investigations in Method and Theory*, Kathryn Sutherland, ed. Oxford: Clarendon Press: 145-172.
- Robinson, Peter M. W. and Taylor, Kevin. 1998. "Publishing an Electronic Textual Edition: The Case of *The Wife of Bath's Prologue on CD-ROM*." *Computers and the Humanities* 32: 271-284.
- Ross, Charles L. 1996. "The Electronic Text and the Death of the Critical Edition" in *The Literary Text in the Digital Age*, ed. Richard J. Finneran. Ann Arbor: University of Michigan Press: 225-232.
- Salemans, Ben J. P. 1994. "Comparing Text Editions with the Aid of the Computer," *Computers and the Humanities* 28 (3):1 33-139.

- Selfridge-Field, Eleanor, ed. 1998. *Vivaldi's Op.8 Concertos (including the Four Seasons)*. CCARH Publications.
<http://www.ccarh.org/publications/data/humdrum/vivaldi-op8>
- Selfridge-Field, Eleanor, ed. 1995. *"The Four Seasons" and other Violin Concertos: In Full Score, opus 8, complete, by Antonio Vivaldi*. New York: Dover Publications.
- Shillingsburg, Peter. 1996a. "Principles for Electronic Archives, Scholarly Editions, and Tutorials" in *The Literary Text in the Digital Age*, ed. Richard J. Finneran. Ann Arbor: University of Michigan Press: 23-34.
- Shillingsburg, Peter L. 1996b. *Scholarly Editing in the Computer Age: Theory and Practice*, 3rd ed. Ann Arbor: University of Michigan Press.
- Smith, M. 1995. "Hypertexts—Critical Theories and Current Realities," *Computers and the Humanities* 28/4-5: 311-317.
- Spiro, Lisa, ed. 1999. "Smoke, Flame, and Ashes"—A "Reverie" from Ik Marvel's (Donald Grant Mitchell) *Reveries of a Bachelor* (1850). A Critical Edition with Facsimile. <http://etext.lib.virginia.edu/users/spiro/Contents2.html>
- Sperberg-McQueen, C. M. 1996. "Textual Criticism and the Text Encoding Initiative" in *The Literary Text in the Digital Age*, ed. Richard J. Finneran. Ann Arbor: University of Michigan Press: 37-62.
- Sperberg-McQueen, C. M. and Burnard, L., eds. 1999. *Guidelines for Electronic Text Encoding and Interchange*. Chicago: TEI P3 Text Encoding Initiative. Revised edition. Available online: <http://www.tei-c.org/Guidelines2/index.html>
- Swofford, David L. 1989-97. *PAUP: Phylogenetic Analysis Using Parsimony (and other methods)*. Computer Program. <http://www.sinauer.com/Titles/frswofford.htm>
- Tanselle, G. Thomas. 1989. *A Rationale of Textual Criticism*. Philadelphia: University of Pennsylvania Press.
- Unsworth, John. 1996. "Electronic Scholarship, or, Scholarly Publishing and the Public" in *The Literary Text in the Digital Age*, ed. Richard J. Finneran. Ann Arbor: University of Michigan Press: 233-244.
- Various authors. 1995. *Computers and the Humanities* 29/1-5. All five issues in this volume are devoted to discussion and application of the Text Encoding Initiative Guidelines.

Wiering, Frans. 2000. *Thesaurus musicarum italicarum*.
<http://www.euromusicology.org/tmiweb/tmiweb.htm>