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14 May 1983

Dear Dr. Weyer;

Let me thank you for the two papers you have already sent. After reading them and meeting with Bob Stein, I realize that your group at Atari has gone much farther toward the creation of an electronic encyclopedia than I had suggested in my paper to the Board of the EB. My paper was behind the times, though, as I explained to Bob Stein at our meeting, it was in some sense meant to be behind the times because I did not want to intimidate my audience.

My main concern is to interest humanists in the possibilities of the computer. I don't mean the way computers are now used by academics in the humanities -- for metrical studies or other kinds of quantitative analysis. I agree with a growing number of people (I presume you and Alan Kay would be in this group) that computers can serve as a new medium for all kinds of communication -- including philosophy, history, and art (both literary and graphic). Some computer specialists like you already know this, but traditional humanists and writers need to be shown how they can bring the kind of creative work they do into the electronic age. I also think that the electronic medium will benefit from the works of humanists. In fact, I am utopian enough to believe that the computer (the most "philosophical" of machines) could serve as that badly needed bridge between science and engineering on one hand and the humanities on the other. For this reason, I am quite excited about the electronic encyclopedia as a device for unifying all kinds of knowledge (scientific and humanistic) into one intellectual and technological structure. But because I was addressing academics at the EB, I made my system as conservative as possible. I was trying to whet their appetite by suggesting a system that I thought could be built and distributed today, using only well-known programming and hardware. I excluded graphics and video altogether simply because it added another dimension of complexity to the construction and particularly the marketing. Obviously pictures and illustrations are an integral

of any encyclopedia, printed or electronic. (Of course, I did all this without knowing Bob Stein and the negociations between EB and Atari that were already in progress.)

So, on the question of an electronic encyclopedia, I am probably more conservative than you, but certainly not as conservative as my report to the EB suggests. I did find both your papers exciting. "The Design for a Dynamic Book" was of course much closer to the kinds of textual manipulation that I have been envisioning. By staying with a text in natural language, you avoid the problems of knowledge representation, and so all the focus is on the questions of organization and access. The issue is then how to how allow the reader to navigate within the (strictly or loosely) hierarchical structure that you choose. The same issue is still present, of course, in the much more ambitious system of the Knoesphere. Here, I gather, the organizational principles are axes, guides, and filters. I am eager to learn how the axes serve to arrange the knowledge and how this arrangement is made known to the reader. Am I right in thinking that the Knoesphere idea combines the problem of organization with that of knowledge representation? The prose of the Britannica would be converted by human effort into a frame system, and organization and retrieval would run off these frames. What do the frames look like? I have seen a great deal of script/frame based programs here at Yale, and the feeling is, I think, that it is hard to build richly detailed frames that can fit in large numbers into an organizational scheme. Offhand, I would think that that is one area of major effort for your project. You drop a few tantalizing hints about your system -- that there are 400 different types of articles in the Macropaedia, that each paragraph needs its own frame, that there are 2000 everyday concepts to represent. I wonder if you have a document describing how it all fits together. I am also curious about the generation of natural language text (even leaving aside the visual component). My impression was that it was certainly possible to generate natural language answers from a knowledge representation, but that no one yet knows how to generate concise, fluent English.

In other words, I am trying to sound positive and cautious at the same time. These three areas -- knowledge organization and retrieval, knowledge representation, and natural language generation -- are all important and interesting. I am wondering, though, whether you have an order of priority for tackling them.

My own concern has been with with organization and retrieval (and secondarily then with

knowledge representation). I was interested to hear Bob Stein suggest that one short-term project might be the creation of an online encyclopedia that was still based on natural language text instead of an abstract representation. This project would be worthwhile in itself (I would certainly like to have an electronically organized EB online) and would provide useful experience for the long-term project you have outlined. The EB has the advantage of possessing the Propaedia, which is a good place to start for an organizational structure. I am right in thinking that Douglas Lenat intends to work on the Propaedia? I would very much like to hear how that goes. The Propaedia is in a sense already a knowledge representation scheme -- one written in natural language. That is, in an outline words are chosen fairly carefully to refer to concepts. So one could exploit the outline as it as, or translate it into some other scheme for conceptual representation. The problem is, as I said above, one of hierarchy: how to allow the reader to get into your structure with a question. Derek Price on the Board of Editors at EB suggested using the analogy of the two-dimensional map, rather than a tree. (This is probably a very primitive version of the three-dimensional axes of your Knoesphere.) Nodes in the map would be subsections of the Propaedia outline; a link between two nodes would be represent words (or concepts) shared by those nodes. The links would cross the boundaries of parts and divisions of the Propaedia. The map could be suitably displayed to the reader or be traversed automatically by a search program. The trick would be to combine the advantages of the conceptual hierarchy of the Propaedia with the capability of moving across the branches provided by the map links. As an first experiment, you could take the Propaedia as it is, generate an inverted index of all the key words that occur, and define links among nodes based on the co-occurence of these words. Then you write a small program that allows the reader to move up and down the Propaedia tree, but at any point jump to a co-occurence map to move across branches of the tree.

Also, if you are considering how to break human thought into conceptual units, you might consider looking at the Syntopicon that goes along with the Great Books. You may not want to use anything like that scheme, but it useful to see how Mortimer Adler has done this in the past. At least, you might make sure that your conceptual primitives handle everything in his list. The Syntopicon is an index into the Great Books, and, as Mortimer Adler pointed out to me when I spoke to the EB, this index has considerable potential. Combine it with the Propaedia, and you have an outline of knowledge keyed into the significant books of the Western tradition (science as

well as literature). In the future, when disk space is no longer a limiting factor, you can have these books online too. Then you can offer the reader the choice of an encyclopedic summary or several passages from Western classics. To put it in the context of the Knoesphere, some of the books in the bookcase for the reader to browse through can be these Great Books.

Actually there are any number of short term projects (either more or less text-based) that could give us experience in retrieving and displaying encyclopedic information. I can think of several reference works I would like to use interactively. Do you know the *Penguin Atlas of World History*? On each lefthand page there are maps that illustrate some aspect of a particular period in history; on the right there is an outline of the period. The English of the outline is telegraphic: nothing would be lost by converting to some knowledge representation. The subject is history, but the book includes names, events, places, and cultural movements. It is certainly rich enough to give us experience with the indexing problem. And the maps provide experience with graphics. Another possibility is that popular encyclopedia of technology called *How Things Work*, I think. It has a page or two of explanation along with diagrams on everything from computers to flush toilets. Then there are those various time-line books -- that chart history or science or evolution in graphics as well as prose. I wonder if you have considered any of this genre of book for preliminary tests and products?

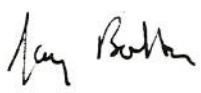
Finally, let me explain what I have enclosing. As I have said, I see my role as a kind of proselyte in the humanistic community for projects like the one you are undertaking or those I have just mentioned. The two papers I am sending are addressed to that community, so I emphasize history and literary theory. Neither of these papers are directly related to the encyclopedia, and they may not interest you; but please show them to anyone who does express an interest. The paper on "Reading and Writing in the Computer Age" is an attempt to gather evidence from many sources to show that the computer can legitimately be regarded as a new medium for ideas. I concentrate once again entirely on language, but of course similar points can be made for the visual arts and computer graphics. The other paper -- the one of electronic literature -- was written to attract writers to the possibilites of electronic literature. It sounds, I know, quite scholarly. But I realize that the computer is essentially a popular medium -- popular in a way that the printing press could never be. Interesting computer fiction will evolve one way or the other out of the adventure game, as many people are coming to realize.

I would really like to put together a summer workshop for half a dozen writers. Equip the writers with home computers and a simple episode system (as indicated in the paper), and see what experiments result. The results could then be published both as a book and as floppy disks (the advantage of using a simple program and some standard home computer). But I need to find some fairly successful writers before I can apply for such a grant, say from the National Endowment for the Arts.

Also, I must point out that there is a natural choice for the first popular electronic book: *The Hitchhiker's Guide to the Galaxy*. It is perfect for the simple episode system I describe -- because it is basically a picaresque novel in which characters wander through the author's universe. There are chains of episodes, rough orders that need to be followed, but in general the reader could participate in the order and selection of events. In addition to the picaresque plot, the book is about a computer book -- the Guide itself is a dynabook. Hence the reader should be free to suspend the plot at any point to consult the Guide. you could make effective use of graphics, especially whenever the reader consults the Guide. Also, you could give the reader the option of adding his own entries, and possibly his own episodes, as in Hypertext. The book is in fact meant to be an endless tale. I suppose I am saying nothing that you and many others have not already realized. But it strikes me that Atari would be the ideal company to approach Douglas Adams with such a scheme.

I have gone on too long, but I wanted to give you an idea of the strengths, limitations, and particular prejudices that I bring to the project of an electronic encyclopedia. I look forward to hearing from you and to the opportunity of talking in person in the near future.

Sincerely,



J. David Bolter

Reading and Writing in the Age of Computers

Jay David Bolter

You can be a poet without knowing how to write, but you cannot be a novelist, a historian, or a mathematician. All literary genres and fields of study depend upon an appropriate medium of communication. The medium is not the whole message, but it can foster a particular message, and its absence can preclude the message altogether. Novels are possible as soon as there exists a medium for capturing prose, yet the European novel only reached maturity after the invention of the printing press, when it became possible to reach a new audience of middle-class readers and to give those readers hundreds of pages of prose in a convenient form. On the other hand, transference to a new medium may distort or destroy a genre of literature: for example, Homeric epic poetry was apparently destroyed as a living art by the invention of writing.

Today the computer is becoming a medium of communication, and it is fair to ask what effect it will have upon current genres of writing. Twenty years ago, computers served principally as calculators for the scientific world and file clerks for business. It was not obvious that such machines could ever provide a medium for a wide range of verbal expression. As a medium, the computer seemed to resemble those hieroglyphic or syllabic writing systems of the ancient Near East: it only preserved data on economic and social administration for a special class of scribes and the princes they served. Of course, the computer is still a calculator and a file clerk. But the machine is also assuming functions that have traditionally belonged to handwriting and printing -- for humanists as well as scientists, engineers, and businessmen. With the coming of

electronic photocomposition, word processing, and bibliographic and academic databases, computer-controlled text can now claim to be a mature technology for storing and displaying language.

It is not the primary medium in our culture; the printed book still holds that honor. In fact, the printing press for public presentation and handwriting for private have been our principal media for so long that we are tempted to regard the computer simply as a means of performing the same functions more quickly or economically. But the computer is more than a new convenience. With its flexible (and volatile) modes of storage and display, the machine suggests a style of writing different from that of the era of print and fosters a new relationship between author and reader. In some ways electronic text resembles a manuscript more than a printed book; in others electronic text borrows and intensifies the qualities of the printed book; in still others it points in a direction not explored by any previous medium.

Although much has been written about computers and communication, analysts seldom take the approach I am suggesting -- placing the computer in its historical context among the other media for preserving and presenting language. That context in Western culture includes five hundred years of printing, more than two thousand years of handwriting, and earlier techniques of oral preservation as well. The history of these media is a vast subject, and I can only touch upon highlights in the following pages. Even a brief historical comparison makes it easier to isolate those qualities of the electronic medium that *are* truly new and to speculate intelligently about the future of writing in the age of computers.

Before the computer, ancient and modern European culture had seen four stages in the fixing

and preservation of language. The oldest was one that literate people are not inclined to think of as a medium at all -- the reliance on memory and word-of-mouth transmission of traditional wisdom. Prior to the introduction of the alphabet in the 8th century B.C., Greece was such an oral culture,[1] and memory was a true technical medium in the one arena that we know anything about -- the preservation of tales in poetic language. Greek bards like Homer developed their system of oral poetry in order to keep alive among their contemporaries the memory of the gods and heroes of their mythology. To us, this function seems extremely narrow in comparison with the range of knowledge that now needs to be preserved. Yet in telling their tales, the poets touched upon war and peace, sailing and farming, crafts and social etiquette, kings, beggars, and gods; they provided a kind of "tribal encyclopedia" for their age.[2]

The adoption of alphabetic writing by the Greeks gradually undermined the basis of oral culture. Adapting the syllabary of the Phoenicians, the Greeks completed the task of analyzing words into sound units, symbolized by letters, and through this feat of analysis and abstraction, their communications were no longer limited to the immediacy and the fragility of the spoken word.[3] While spoken words live a precarious existence "on the wind," as Homer said, words written in letters remain before our eyes for inspection and appraisal: they are fixed. From the introduction of the alphabet to the present day, the question of medium is one of how such letters will be formed and read.

For over two thousand years, European societies formed their letters by hand. Until the third or fourth century A.D., the ancients wrote their books on rolls of papyrus. Text was arranged in narrow columns, and the reader would roll the papyrus from one reel onto another, exposing a

couple of columns at a time. The rolls were cumbersome; it was particularly hard to find a passage in the middle of a text, for there were no page numbers, little punctuation, and worst of all no word divisions. Hence, the preference for spoken language remained strong; people generally read aloud, pacing their way carefully through the unseparated words of the text. Readers continued to depend upon their memories far more then we do today, and their books served as aids to memory rather than as the primary repository of knowledge. The papyrus roll was replaced in the early Christian era by the codex, the paged book as we know it. The codex was technically superior to the roll, for it allowed easier access and offered more aids to the reader. Getting to a passage in the middle of a work was now merely a matter of turning the pages. The codex could hold more text, so that a whole large work or several related works could be placed in one volume. Yet scholars still read aloud; the written text was still an aid for recreating the spoken word, which was the primary form of language.

The invention of the printing press brought a new stage of literacy.[4] Because printed letters were uniform and eventually more legible than those formed by hand, it was possible to take in a printed line at a glance. Silent reading was encouraged, and soon became necessary as the number of books available to an individual reader grew. Muttering aloud, a medieval scholar could at best achieve one or two hundred words a minute, while a silent reader whose eye photographs a line of text in word groups, bypasses or makes minimal use of his "inner ear" and can manage six hundred or more words in a minute. As readers depended less upon their ears, they also relied less upon their memories. The two are closely related: even today we tend to remember passages of prose or poetry rather by sound than by sight. In any case, there were too

many books now to memorize -- perhaps 30,000 different editions before 1500 and five times that number in the sixteenth century.[5] The press made possible mass production and near perfect replication of a fixed text. It stabilized the transmission of texts that had before been subject to the cumulative errors of generations of copyists and so profoundly changed the work of humanists and scientists.

These four great media of the past (oral preservation, the papyrus roll, the codex, and the printed book) are now joined by a fifth, electronic text as it is manipulated and displayed by the computer. It has already been incorporated into the printing process in the form of computer-controlled photocomposition, in which a newspaper article or book spends part of its life in electronic form before being transferred to the older medium of print. But electronic text may also replace printing for some purposes. Videotext services seem likely to usurp functions of advertising and immediate information now belonging to the Yellow Pages, daily newpapers, and promotional mailing, while scholarly printed journals may become electronic for economic reasons, if not for reasons of convenience. Bibliographic works and such reference tools as dictionaries and encyclopedias might also migrate to the new medium.

However, the takeover may never be complete. Printing may not become obsolete in any foreseeable future, for, as is often pointed out, books are durable, convenient, and still relatively inexpensive. The printed book did not replace handwriting for all purposes: indeed, the existence of plentiful printed books fostered widespread literary and made it essential for millions in modern society to learn how to write.[6] Even if electronic text does prevail, this final battle of the books could last for generations, since it might require decades to evolve electronic

equivalents of weekly magazines or novels. In the ancient world the codex replaced the papyrus roll only gradually over a period of centuries. Christian texts led the way, partly because the primary Christian text, the Bible, was long and therefore more convenient in codex form. Pagan literature continued for some time to favor the older medium.[7] Some genres of writing may just as well resist the new medium of the electronic age. But wherever the transfer does occur, the new medium will color the style and content of the text it represents, above all by changing the fixity or permanence of the representation.

The fixity of text

A writer puts ink on paper, chisels in stone, inscribes in clay, or types at a videoterminal in order to have his words available at later time. As soon as writing in any form is developed, the issue of preservation, of collecting and passing on knowledge embodied in language, takes on new significance. Yet preservation was already important to the oral poets of Greece, who were trying to maintain the living memory of the mythological events they regarded as ancestral history. What an author seeks to preserve depends in part upon the medium he is using, and memory is an inexact medium. Instead of word-for-word preservation of a text, memory preserves its messages by building in the mind a network of associated phrases and ideas.[8] The technique of association is applied to all experience in ancient oral culture, and particularly to oral poetry. The Greek poet's repeated singing of similar heroic feats created an elaborate network of associations in the minds of audience, while repeated phrases and rhythms helped to make the associations more memorable.[9] The web of associations woven by the poet around his mythological figures and their deeds was the substance of what he sought to preserve.

The invention of writing was not an improvement over memory but rather a different kind of preservation altogether. Writing fixes language in a visual form, preserving the words of a poet or any speaker as a string of symbols on paper rather than as a network of association in the mind of the listener. The invention of the alphabet does not do away with the associative power of language, but it does introduce a new way of understanding and using words. Writing is by nature an act of analysis, by which a continuous stream of sounds is broken into a string of alphabetic symbols, and so reading and writing foster powers of abstraction and analysis that are not required in oral communication. The act of writing makes it possible to distance oneself from the one's language. An author can read and reread a sentence and strive for the exact meaning or the perfect expression; he can look at his sentence as if someone else had composed it, thereby gaining an objectivity impossible for an oral poet, who must call forth each line as the audience listens. The reader too can achieve some distance from a text. He can look ahead or look back; he can debate with the author and slowly form his own opinion. Such a procedure is much harder for a listener who must assess the speaker's words on the run.

The fixing power of handwriting brought whole new genres into existence in the ancient world: lyric poetry, history and ethnography, philosophic poetry and prose, and even drama and oratory. These forms could only develop with the aid of writing, even though they all continued to rely upon the spoken word for their impact. All of them depended upon an author's ability to fix his own thoughts at one moment and later read them back or give them to other readers for performance. All of them illustrated the new qualities made possible by writing: an (sometimes ironic) distance of author from his or her own emotions, an ability to compare one's own culture

or epoch with others, an abstract view of language and experience, and so on.

Despite these achievements, there were limits to preservation in a scribal culture. The papyrus roll and later the codex could only insure the intregrity of the author's own manuscript. Writing could fix a text for the author himself, but it could not fix it across a number of copies or over a period of centuries. Even the best scribes made frequent errors, and the laborious process of copying kept books expensive and therefore rare. In periods of decline, such as the sixth and seventh centuries in Western Europe, the few remaining copies of a work might deteriorate and the work be lost forever. Scientific works, especially tables, were most easily distorted, but any text tended to wander in time further and further from the author's original words.[10]

The printing press meant a new degree of preservation -- "cultural" rather than merely "personal" fixity. Each copy of a book printed on paper might be less hardy than a parchment manuscript, but the sheer number of copies, averaging from 1000 to 1500 even in the early sixteenth century,[11] meant that a good work would likely survive and be read until some publisher decided to prepare a new edition. The text remained stable, because of economies of scale: a printer could afford to read his proof carefully before running off 1000 copies. And each copy would be more or less identical. Authors and readers could now expect texts (though not individual copies) to remain indefinitely in their pristine form, and they came to care more about the details of that form. Our expectation that a text be utterly consistent in spelling, punctuation, and even footnote form derives from five hundred years' experience with the printing press.

However, electronic text now threatens to overturn the notion of fixity carefully cultivated

throughout the age of print. The new medium is capable of perfect preservation of text; yet it is radically unstable at the same time. Because they depend ultimately upon the electromagnetic properties of tiny particles, electronic storage media are even less durable than the poor quality paper and binding used in books today. Magnetic tapes deteriorate in a matter of years, magnetic disks as soon or sooner. Inside the machine, information rides on voltage differences or capacitance in transistors that may vanish in a fraction of a second. However, just as the printed book exploits its force of numbers to preserve texts better than parchment, so the computer preserves text through the sheer speed and ease with which new copies can be made. A tape may lose data in a few years, but it takes only minutes to duplicate the tape before it becomes defective. Within the computer, individual memory cells can be refreshed in millionths of a second or less. The electronic medium therefore preserves texts by passing them on repeatedly from one fragile copy to another, and copies proliferate in a system at a rate that is hard to control. No single copy is terribly important; none is itself a matter of style or craftsmanship. An illuminated manuscript is a work of art, and a well-made book is beautiful and valuable as a artifact, regardless of its contents. But it is difficult to envision anyone collecting old computer tapes or diskettes for esthetic reasons.

In a computer system, change is the natural state of affairs, fixity the exception. No computerized text remains fixed for long, for the temptation to alter or improve it is too great. Even unwanted change is hard to avoid: anyone who has used a text-editing program knows how easy it is to erase hours of work by pressing the wrong button. Newspapers have turned to electronic text precisely because it remains changeable until the last moment. Once a journalist

enters a story into the machine, he may continue to update as events demand. The editor may make other changes, or perhaps combine entries from several journalists, and the compositor adds commands in order to create the proper layout. The process may continue through several editions of the newspaper, where each physical printing is like a snapshot, a static picture of a set of articles and features that changes repeatedly throughout the day or night.[12] A story is really stable only when it is archived on tape or microfiche, no longer newsworthy. What is true of computerized journalism is equally true of word processing and electronic publishing for business, scholarship, or even creative writing.

In the electronic age, therefore, fixing the text may no longer be the goal; the author or group of authors may want repeated change or evolution. In this respect electronic text is more like a medieval manuscript than a printed book. Books in the age of print did certainly evolve and improve from edition to edition. In fact, Elizabeth Eisenstein has argued that the capacity of printed texts and treatises to improve from one edition to the next helped to determine the development of modern science and scholarship.[13] But revising a text and correcting errors required the hard work of setting new type: a new set of plates then produced hundreds of word-perfect copies, and even the remaining errors in the text were the same for all. A new edition involved the collective and centralized labor of many hands to write and set the copy, proofread the galleys, pull the sheets, fold the sections, distribute the books, and so on. In this mass-production industry, the personal history of a single copy was normally less interesting and important than the collective history of the edition.

For the manuscript tradition, the opposite was true: the collective history of a great text *was*

the sum of the personal histories of the copies. Each handwritten codex was unique -- carefully done in a fine hand or a hurried copy, full of errors or relatively clean. At least some errors belonged to that manuscript alone, and it was worthwhile to collate the manuscript with another of the same work to eliminate such errors. Scholars often made extensive notes in the margins, glosses that recorded their own readings and interpretations of the text. These handwritten marginalia had nearly the same status as the text itself; they were often copied along with the text by the next generation of scribes. If a work was popular, it would accumulate the wisdom and the misconceptions of scholars through the centuries. The habit of written marginal notes continued in the age of print but was much less important. The monumental status of the printed text itself tended to overwhelm notes made in the margin. Rather than correct his own copy, a scholar did a far greater service by sending a list of errata to the publisher for a second edition.

Ironically, computer text tends like the medieval manuscript to be unique.[14] Perfect copies are quickly become outdated. To give someone else a copy of a text is to invite him to change it for his own purposes, and, as with the manuscript, changes have the same status as the original text. In fact, glosses are not limited to the margins but can be inserted right into the text using an editing program. In the case of electronic mail, the reader can attach his comments and send both texts on to third parties. In most cases there is no final product, and the result at any moment is the effort of many hands. Like a medieval codex during its centuries of active use, an electronic text is organic, continually being adapted to new needs. Of course the time scale is different, for the vigorous lifespan of an electronic text is measured in years, months, or merely

days. But longlived or not, electronic text is radically different from a printed text, which leaves the press in near perfect condition and cannot change except to deteriorate.

The electronic medium results in a curious reversal of the age-old problem of preservation. An author fixes a text in any written medium in order not to lose it, yet in the electronic medium he is threatened with loss from a new and unexpected quarter. In the age of manuscripts, the danger was scarcity of copies. Printing assured that no important works needed to be lost, since some copies could be expected to last until a new edition was prepared. Through the agency of the press, the Renaissance of the fourteenth and fifteenth centuries became a permanent rebirth of learning.[15] The electronic medium unfortunately outdoes the press in this respect: it assures that not even the most trivial text need be lost. The reader is confronted with an embarrassment of riches: his problem is to find what is valuable amid a wealth of available texts or to decide what to preserve among his own files. If I sign into the USENET after a few months' absence, I discover dozens of messages competing for my attention. Each message is provided with a title called a "header," but even to work through the headers is annoying. The same problem arises in word-processing or programming in general. Looking over files I created a year ago, I may find five with similar names and contents: which is the most recent or most complete version?

Because preservation in the new medium is far less laborious than in print or manuscript, authors and readers must work commensurately harder at organization. In computer science, techniques of searching, indexing, and retrieving form the subject of doctoral dissertations. Organization requires such mathematical and logical sophistication because the medium is itself abstract and sophisticated. Pages of electronic text cannot be set out on a desk and numbered

by hand. The simple methods of physically arranging and tagging rolls, manuscripts, or books on a library shelf must now be replaced with programs to manipulate files in electronic storage. On the other hand, once the programs have been written, they allow for a flexibility of organization that no written or printed technique can match.

Organizing and using the preserved text

In the past the capacity to fix language has improved with each shift of medium: oral culture could fix ideas in formulaic terms, scribal culture allowed exact language to be preserved but only for the life of the author's manuscript, and the printing press extended the fixity from the personal to the cultural level. At the same time, flexibility of organization has decreased as fixity has increased. In an oral culture, organization was entirely a matter of memory, and memory was not limited by any of the physical restrictions of representing symbols on papyrus, on paper, or in a computer's transistors. Since memory organized experience simply by associating one phrase, event or idea with others, the organization was immediately accessible. What a listener had once heard and fixed in his mind could be instantly recalled and used. However, except for short texts, word-perfect recall was not possible or desirable.

The advent of writing, which did allow for word-perfect preservation, also meant that more material would have to be retrieved. A new set of techniques gradually developed -- in the ancient world the techniques of storing and tagging texts on rolls of papyrus. Memory and therefore association remained important because papyrus rolls served best either for the reading of whole works or as an aid to memory.[16] As knowledge or at least books continued to

accumulate in the Hellenistic Age, more technical written aids were devised. Libraries were organized and catalogued: the first great library was the one at Alexandria, catalogued by the scholar-poet Callimachus. Along with the library, which was (and still is) a great collective book, scholars began to compile secondary books -- encyclopedias and handbooks on special subjects. Their purpose was to collect and explain the knowledge found in other books, to save the reader from hunting up rare or difficult individual works for himself.

The Middle Ages developed an even wider range of mnemonic and scribal techniques for organizing a growing body of written knowledge. Writers of encyclopedias and handbooks flourished -- from Martianus Capella and Isidore of Seville to the prolix Vincent of Beauvais in the thirteenth century. The medieval mind loved to systematize, borrowing and extending such ancient systems as the trivium and quadrivium. Medieval writers could appeal to principles for organizing secular and religious knowledge that all educated medieval men and women knew and accepted, and such an appeal made arrangement of their materials much easier. In a manuscript, no comprehensive index was possible, though there could be a table of contents without page numbers. Yet the reader could navigate through an encyclopedia by remembering where a topic was likely to appear within, say, the seven liberal arts. In the later Middle Ages, the systems became more complex in response to changing human experience, especially in the technical arts, but editors continued to rely on familiar themes such as the trivium and quadrivium.[17]

In the age of printing, the explosion of knowledge in both the sciences and the humanities called into question the simpler organizing principles used by medieval and ancient men. More "objective" techniques of display and retrieval were called for, including the systematic use of

title pages and page numbers. Readers could now find passages in texts more easily, and they relied less upon their memories. Encyclopedias were more popular than ever, for there was more knowledge than ever to summarize and assimilate. Yet printed encyclopedias and the new dictionaries came gradually to favor alphabetical rather than topical arrangement. There was no longer general agreement over the place of new scientific and technical discoveries in the general scheme of human knowledge, whereas alphabetical order ensured that all readers could find entries they needed. Today an encyclopedia may present its alphabetized contents using a subtle system of font sizes, indices, footnotes, headnotes, sidenotes, cross-references, and abbreviations -- all in the interest of providing an method of access to readers of varied backgrounds and points of view.

Each change of medium, then, has diminished the importance of the associative powers of human memory. Organization in an oral culture was entirely a matter of associations of ideas. Scribal culture still depended upon the reader's powers of association, when it organized material by topics. The liberal arts were categories that the reader knew by heart, and each spawned a network of associations to which he could refer when he wanted to remember some bit of knowledge or consult his manuscript. Printing tended to replace association with mechanical methods of references in the printed text itself. Instead of expecting the reader to possess a set of categories for associating one idea with another, a printed encyclopedia refers him from one page and column to another. Indeed, the goal of reference techniques in the age of print seems to be to eliminate the need for memory altogether.

In this sense electronic text is the heir to printing, for it intensifies the mechanical qualities of

organization and retrieval. The programmer can manipulate the symbols of the text with even less concern for the associative weight they might carry in memory. Indices can be generated automatically, and there can be many indices for the same text. The reader can search the text automatically for the co-occurrence of letters, words, or phrases, he can search for the occurrence of two words in the same passage, or he can retrieve all passages that contain one phrase and omit another. The electronic medium easily embodies any system of organization that depends upon the manipulation of strings of letters. Databases for newspaper articles, law journals, or bibliographies operate in this fashion.

On the other hand, the mechanisms of computerized text are more sophisticated than those of print. The reader is freed from some of the limitations of print, since he confronts a flexible medium that embodies more convincingly the associative powers of memory. In printed works, cross-references and indices require flipping pages and shuffling volumes; even a printed encyclopedia cannot afford to burden its reader with too many references. But an electronic text can be shot through with pointers from one passage to others and from one file to several, pointers that remain invisible until the reader asks for them. In principle electronic text can be as highly associative as human memory, with each passage relating to a dozen others for a dozen different reasons. Because branching is nearly effortless, the reader is free to explore any one association as far as he likes, before turning back to explore another.

An electronic text may include many tables of contents and give the reader several distinct organizations, different orders for approaching the text. The reader may even write programs to define his own order. Hence encyclopedic databases can once again be arranged by topic, as they

were in the age of manuscripts -- but now with the reader dictating the topical arrangement he prefers. If he does not find any arrangement congenial, he can rely upon the more objective techniques of organization also available in electronic text, such as alphabetization of entries and sequential word search. It took a few generations for printers to realize the qualities of organization inherent in the press and provide consistent pagination, tables of contents, and the like. It will likewise take some time for author/publishers to develop the potential for associative as well as mechanical organization in electronic text.[18]

Linear and multidimensional text

A computer text is like a printed text that can be cut up and repasted to suit each reader: it is dozens or hundreds of printed books in one. Printed books present ideas in one order, determined by the author and realized by the printer who set the type. Except for reference works, printed books are meant to be read in that one order -- from first page to last, top to bottom, left to right. Electronic text is not so rigid. The reader may begin in the middle, or he may divide his text into a hundred fragments, which he then reassembles in a new order. Reading news articles from a large database or pieces of electronic mail may involve just this sort of selection.

Printing is ideal for any texts that describe events or ideas in a single sequence unfolding in time. Narrative fiction has therefore thrived in the medium of print, where the author can manipulate the reader's experience of event in time. Of course, the author may not choose not to tell his story in chronological order. But when he uses flashbacks to juxtapose incidents that have taken place years apart, the author can be sure that his reader will experience the

flashbacks in just the desired order. In the same way, nonfiction, complex arguments in mathematics or philosophy, can be presented to the reader in one orderly fashion. This is not to say that authors in the printed medium have never sought to break up the linear order of presentation. The encyclopedia is the most obvious example of a work not meant to be read from beginning to end, but its cross-references and indices are cumbersome in print. By far the easiest and most natural way to use a book is to read it in linear fashion.

The codex and the papyrus roll also demanded linear presentation. Cross-references were even more difficult to manage. In fact, scribal techniques made referencing so difficult that the reader often preferred to trust his memory. By reading aloud and building up associations in memory, the reader of a manuscript was less committed to fixed and linear organization of ideas. For memory is emphatically not linear. Associations from one idea may lead us in many directions. For example, if we are reminded of a movie we have seen, we may first think of a scene in the middle. This memory may lead us to another, later or earlier scene for some associative reason: the same actor, the same emotion, the logical outcome of the conflict in the first scene, and so on. We can and do "walk through" our memory of a movie in a variety of orders, none of which may correspond to the original order of the scenes.

In an oral culture, networks of association are the only repositories of language and ideas. In a scribal culture associative memory still plays a large role. Printing further diminishes the importance of memory and therefore of association, though it cannot wholly ignore the human capacity to associate. Primacy is given to the orderly, linear development of texts and ideas. The electronic medium now emerges with the capacity to reinstate the importance of association.

Multiple systems of reference can be built into texts, and readers can pursue their own associative paths though it. A computer text is, like our memories, multidimensional.

Its multidimensional character suggests that new kinds of texts and a new view of language may evolve in the electronic age. Today the computer is still used to manipulate and manage texts that are destined to be converted into printed results. For all its flexibility, computer journalism still aims at producing printed newspapers, while the prime appeal of word processors is that they create perfect typed copies of business correspondence and reports. Writers are still aiming for a product that is printed and therefore fixed and linear. But we can easily envision texts, both fiction and nonfiction, written solely for display by computer and therefore composed to exploit the associative, multidimensional, and interactive qualities of the new medium.

Encyclopedic material would fit neatly into this new form, but other kinds of nonfiction could also use the computer to advantage. For example, the author may have six interrelated topics in his "essay" and allow his reader to peruse those topics in a variety of orders. The effect will be somewhat different in each case. A clever author can exploit those differences, so that, in any given session, the reader will realize one order from many possible. Further, the computer permits a text to be composed and displayed in layers. Consider the transfer of a text read in a college English course, a play or poem, to the electronic medium. The text of the poem itself makes one layer; it may be accompanied by linguistic, historical, and literary commentaries, each forming a separate layer and each keyed to lines of the original poetic text. The reader can began with the poem and then jump from one commentary to another as his needs or interests dictate. Such a procedure is much easier than referring back and forth among several printed

books.[19]

The procedure is not limited to journalism or scholarly essays; Electronic fiction would work in the same way. Indeed, the most interesting experiments are possible in fiction.[20] The author could, for example, create a series of episodes and define links among them. The reader would begin with one episode and proceed through the story choosing paths by answering questions or making choices specified by the author. We can imagine a murder mystery, in which the reader takes the part of the detective. His reading and understanding of the clues enables him to choose the right path through the episodes; eventually he reaches the final episode where the mystery is solved. The detective example need not be frivilous: *Oedipus Rex* and *Hamlet* are both detective stories. I choose this example because adventure games available for home computers already embody all the programming needed: in these games the hero/reader works his way through a maze of chambers or scenes solving puzzles, killing monsters, and gaining treasure. The prose of these games is now trivial, but it need not be. The emphasis needs to be changed from traversing the maze to reading the prose, and the trappings of pseudo-medieval quest literature must give way to more sophisticated literary values. The potential for real literature is there: after all, good popular cinema developed from the nickelodeon.

Author and reader

In electronic fiction, and indeed in all forms of electronic text, there is a new relationship between author and reader. The reader takes a more active role in constructing or creating the text, as he chooses passages to read and the order in which to read them. In the case of a

database of news articles, the reader is simply performing the same role as a discriminating reader of a printed paper. (A printed newspaper employs headlines, special layout, and tables of contents precisely in order to overcome the linear nature of the medium.) With electronic fiction the reader has a new role to play. What the author creates is a potential fiction, a series of episodes that could have many orders, each of which would make for a different story. The reader then realizes one particular order as he reads; he performs much the same function as a musical performer who realizes the work of a composer. Like interpreter and composer, the reader and author form a kind of partnership to bring a fiction to life.

This interactive partnership redefines the very nature of authorship. We need not wait for electronic fiction: even in its current guise the new medium brings about a confusion of the roles of author and reader. Consider multiple authorship in electronic journalism. One story may be an amalgam of the prose of several reporters and one or more editors: who is the author? Except for articles with bylines, the result is meant to be homogeneous, and the reader cannot distinguish the various contributors.

Collective authorship has a long tradition. In the age of manuscripts, notes were added and altered by generations of anonymous scholars, and words and phrases originally meant as glosses were sometimes copied directly into the text. In ancient oral culture, the whole poetic system -- the diction, the meter, the phrases, even the episodes and themes -- was the product of generations of bards. We know only the final work, the *Iliad* and *Odyssey* that we ascribe to Homer, and it is impossible now to determine the originality of this final poet in the tradition. In general the transmission of customs and stories by human memory alone tends to homogenize the

product. Folktales presumably evolve over ages, but we do not know the names of the authors who change them.

A very different view of authorship grew up in the age of printing. A printed book was by nature monumental. Although each copy might be inexpensive, putting out an edition required expertise and an investment of capital, so that publishing was an exclusive and centralized activity. Even today, publication through a reputable press carries some status, for it means that hundred or thousands of copies of one's words will be distributed throughout the reading world. The advent of the printing press drew a sharper distinction between author and reader. In the ancient world, by contrast, becoming an author simply meant ordering a few slaves to make copies and distributing these among friends; at times it seemed that every Roman aristocrat had "published" an epic poem. There was also no counterpart in the classical or medieval world for the system of royalties that has been developed in the last three centuries. Nor was there any parallel for the notions of copyright and plagiarism. Only when it became possible to freeze his words in type, could an author conceive that that particular order of words belonged to him. Plagiarism was almost taken as a compliment in the ancient world. Eisenstein has suggested that the press fostered a new concept of individualism and a new genre to express it, the essay. The distinction between public and private man took on real significance only after the press made possible mass "publicity." Authors now became concerned with their inner lives and expressed this concern in essays, diaries, and autobiographies.[21]

The electronic medium now threatens to reverse the attitudes fostered by the press by breaking down the barrier between author and reader. When the reader becomes the author's

collaborator, authorship loses its privileged status. Anyone can become an author and send his merest thoughts over one of the networks to hundreds of unwilling readers. His act of "publication" is neither an economic nor a social event. And he can hardly claim to own the copyright to words that he sends so casually over phone lines and cables and satellite links to destinations he cannot even name.

Mail networks such as ARPANET or USENET illustrate the attitudes that the electronic medium has already encouraged within the scientific community. In addition to personal communications, there are numerous mail groups that discuss issues of common interest by means of "open letters" to hundreds of network members. The prose of these letters is not what we might expect from scientists; it is often rambling, unfocused, and ungrammatical. Contributors may send out the most tentative conjectures or the simplest questions. They often neglect to cite sources or verify their facts and write simply "I read somewhere" or "I haven't time to check this in the library." Mail in the networks is more like conversation than printed prose, far less sophisticated than good handwritten letters used to be. The ease with which messages can be corrected by subsequent messages gives the sender little incentive to make his text right or stylish. An author whose work is destined for print shows some concern to be exact and well written. An electronic letter writer does not, and yet with the touch of a button he can "publish" his text on a larger scale than many printed books.

The subject matter of the networks is extremely varied, but there is more casual chat than scientific inquiry. The USENET currently has special groups for discussing jobs, poems, jokes, and even suicide. Within a group, contributors are usually free to stray as far as they like for the

specified subject, and discussions tend to have an organic existence over days or months. One contributor may begin with an offhand query: say on the possibility of surviving in space without a gas-pressurized suit. The query may touch off a flurry of remarks from others. If the subject catches the interest of enough readers, there begin to appear claims and counter claims of varying lengths. Many contributors will know little about the physics or biology of gas pressure, while a few will offer thoughtful, well-organized responses. Someone may well provide a definitive answer in several dozen lines of text, but this text will not put an end to the debate, for it will be buried among dozens of other wrong and right replies. There are time delays in passing a message through the network, and many will not have the chance to read a good reply before providing their own misinformation. The subject spreads like a fever through the network, until the whole system is throbbing with claims and denials, accurate reports and fallacies. Gradually the crisis passes: contributors lose interest, run out of things to say, or recognize that the point has been effectively made. The number of replies dwindles, and another subject begins to grow in its place.

The closest printed equivalent to these mail groups are debates in scholarly journals or those that sometimes rage on the letters page of better newspapers. But the electronic version is much more flexible, casual, and even confused. In a journal or paper, the author takes more time to consider and compose his reply: printing slows the exchange and perhaps reduces the heat of the discussion. Far fewer people can take part, and the whole contest is supervised by the editor, who selects the most cogent or important replies for publication. Because printing is an expensive medium, someone must decide what is worth preserving in print.

Conclusion

Not all the qualities of the electronic medium are ones that we might welcome. The casual style and ease of publication in mail groups may make us long for the exclusivity and formality of print. The consolation is that, like writing or printing, electronic text only serves to convey ideas in language -- it does not fully determine them. As electronic text becomes more important in our culture, a whole library of earlier texts will need to be carried into this new medium. Just as ancient and medieval manuscripts were transferred into printed books, so books will now be transferred into machine-readable form. In fact, that transferrence has already begun. Reading Plato or Dickens as electronic text will be a new experience; nevertheless, the qualities that the original medium lent to each text will also remain. Even appearing in translation on a videoterminal, Plato's dialogues will continue to reflect the combination of oral and scribal cultures that characterized Greece in the fourth century B.C. A Dickens novel will remain a complex narrative structure whose primary effect is achieved by a linear reading from the first sentence to the last.

The presence of older texts may provide a counterbalance to the excesses of the electronic medium. But the new qualities of the medium cannot be entirely circumvented, and it does not make sense to try. There is no reason why good fiction and nonfiction cannot be written exploiting the defining qualities of electronic text. The lack of fixity, associative organization, and multidimensionality of electronic text can establish a new genre of fiction and a new form of essay. The breakdown of the barrier between author and reader could turn passive readers into

active writers and so improve literacy. What is needed most is a willingness on the part of good writers in the printed medium to begin to experiment with the computer.

[1]The Mycenaean civilization, which flourished on the Greek mainland in the second millennium B.C., had a syllabic writing system now called "Linear B," apparently used solely for administration. This system was lost with the downfall of the culture around 1100 B.C., and the Greeks had to learn the art of writing once again from the Phoenicians.

[2]On oral poetry and the work of Milman Parry, see A. B. Lord, *The Singer of Tales* (Cambridge, 1960). Eric Havelock has explored the impact of writing upon archaic and classical Greek society in his *Preface to Plato* (Cambridge, 1963) and *Prologue to Greek literacy* (Cincinnati, 1971).

[3]See Havelock, *Prologue to Greek Literacy*, pp. 6ff

[4]See Elizabeth Eisenstein, *The Printing Press as an Agent of Change* 2 vols. (Cambridge, 1979).

[5]Lucien Febvre and Henri-Jean Martin, *The Coming of the Book: The Impact of Printing 1450-1800*, trans. by David Gerard, ed. by Geoffry Nowell-Smith and David Wooton (London, 1976), p. 262. Most of course would have been Bibles, prayer books, missals, and other religious materials.

[6]Walter Ong argues in general that one medium need not fully replace its predecessors in *The Presence of the Word* (New Haven, 1967), pp. 88-89.

[7]See L. D. Reynolds and N. G. Wilson, *Scribes and Scholars: A Guide to the Transmission of Greek and Latin Literature* (London, 1974), pp. 30-32 and F. G. Kenyon, *Books and Readers in*

Ancient Greece and Rome (Oxford, 1932), pp. 111ff

[8]Oral poets seem to believe that their technique assures perfect recall of what they have composed. A. B. Lord has worked extensively with oral poets in modern Yugoslavia, in some ways similar to the bards of ancient Greece. These poets claim that they can always sing the same story in the same way -- in other words, that they can preserve the tales perfectly in their heads. But tape recordings show variations of vocabulary and detail from one performance to the next. By our standards of exactness, the poet is straying from his previous version, but to an illiterate singer and his audience, repetition does not carry the same meaning. See *Singer of Tales.*

[9]In both *Preface to Plato* and *Prologue to Greek Literacy*, Havelock rightly stresses the affect in an oral culture of memory techniques upon the message preserved. However, I think he goes too far when he claims that all transmission in an oral culture -- of laws and customs as well as tales -- must be poetic.

[10]See Eisenstein, *The Printing Press as an Agent of Change*, p 114.

[11]Febvre and Martin, *The Coming of the Book*, p. 218.

[12]See Anthony Lewis Smith, *Goodbye Gutenberg: The Newspaper Revolution of the 1980's* (Oxford/New York, 1980).

[13]*The Printing Press as an Agent of Change*, p. 108. This major theme in Eisenstein's analysis returns throughout the book.

[14]I. de Solo Pool makes this point in "The Culture of Electronic Print," *Daedalus* 111:4 (Fall, 1982), 27

[15]Eisenstein, *The Printing Press as an Agent of Change*, pp. 175ff.

[16]Rather than relieving memory of its burden, the ancient writing system demanded more accurate memorization. In particular, orators evolved an elaborate "art of memory," using visual imagery to organize and recall the points of their speeches. See Frances Yates, *The Art of Memory* (Chicago, 1966).

[17]For a description of medieval encyclopedic systems, see the *Journal of World History* 9:3 (1966) 483-616; indeed, the whole issue is devoted to the history of encyclopedias.

[18]Software specialists at Atari are already doing a preliminary design for a full-fledged electronic encyclopedia for the home.

[19]James Catano has used a computerized text system for teaching English poetry to college students. See "Poetry and Computers," *Computers and the Humanities* 13 (1979) 269-275.

[20]Paul Starr points out just this possibility in "The Electronic Reader," *Daedalus* (Winter, 1983), 154. The idea is not at all far-fetched, as it might seem to humanists not acquainted with computers.

[21]Eisenstein *The Printing Press as an Agent of Change*, 230ff.

The following paper was written with an audience of humanists and creative writers in mind; it proposes the simplest form of electronic literature. Computer specialists will recognize that the programming techology (such as hypertext and the dynabook) already exists to do much more with the manipulation and display of written texts. But it seems to me that the theory and the technological prototypes are far ahead of actual practice with electronic text. Everyone talks of the possibilities of fiction in the computer medium, but so far adventure games are the only widely available examples of this genre. While adventure games do show how the medium can be used, they tend to concentrate on graphic effects at the expense of prose style and the literary structure. In this paper I am trying to work from another direction by encouraging writers who have already mastered the medium of print to bring their skills to the electronic medium.

My strategy in appealing to humanists is first to provide a historical basis and a literary theory of the electronic medium, and then to describe a simple system that writers could immediately use for experiment. I am suggesting a system that could easily be programmed on a home computer and could illustrate the flexibility and multi-dimensionality of computer-controlled text: a system of fixed episodes joined by multiple links. I would like to interest currently successful writers in this sytem, perhaps by holding a summer workshop. Then we could see what fiction was possible with this limited system and what other features writers would prefer.

It may turn out that the constraints of fixed episodes are too rigorous. On the other hand, new poetic forms may evolve even within these limitations. People often say that the possibilities of the new electronic medium are infinite, but they really mean that we have not yet learned what the limitations are. We can draw analogy to music at the turn of the century, when Schonberg and his colleagues were experimenting with atonality. The breakdown of all rules of tonal harmony meant that the possibilities of composition became infinite. But with no limitations there was no form. Schonberg had to fashion new musical forms by imposing new constraints: the result was serial music. What we now need are intelligent tools that define both possibilities and limitations in the electronic medium, and such tools may well emerge through experiments with creative writers.

Some Thoughts on Literature in an Electronic Medium

by J. David Bolter

I

In what sense is the computer a new medium of communication? Since the material now being communicated by computer is limited to business records or mathematical data, it is hard to see the importance of the machine for the kinds of communication that matter to creative writers and humanists: poems, historical monographs, short stories, essays on politics, novels, satire, letters, philosophical papers, plays, journals -- serious fiction and nonfiction. Of course, all these forms (and any other written communication) can be entered into a word-processor, checked for spelling, arranged in paragraphs with right justification, and printed out. But in that case the machine is simply preparing the text for its intended medium, the printed page. The computer becomes its own medium only if the text is written to be read at a terminal, only if the printed document is regarded as a secondary copy, for security or convenience -- or is dispensed with altogether.

The computer does in fact promise true innovation in the whole range of creative, as well as pedestrian, uses of language, and this innovation will flow from the very nature of the machine. We think of computers primarily as calculators, which solve mathematical problems for scientists. In a deeper sense, the computer is designed to manipulate and transform any kind of discrete symbol -- words as easily as numbers. There is nothing mysterious about these manipulations; in fact the computer has a very limited repertoire of tricks. In addition to arithmetic operations, the machine can sort words (or arbitrary character strings) into alphabetical order, search lists of words for matches, delete unwanted characters or whole passages, copy passages verbatim, rearrange passages, and so on. All these operations, it turns out, can be prescribed by the rules of symbolic logic and embodied in electronic circuits.

The computer does not in any deeper sense understand the symbols (words, phrases, sentences) it manipulates, but that does not matter. If the machine is to function as a medium for human communication, it is the author and his reader who are responsible for the understanding. They decide how to program the machine to make the words do what they want: they are, in Humpty Dumpty's sense, the masters. What the computer contributes is the capacity to set words and

texts in motion. "Manipulation" simply means that the words need not stay put, as they must on a printed page. The computer medium is alive with potential change; it is literally an electric medium which strains at every moment to let its electrons fly into some new configuration. A clever author can exploit this liveliness -- by setting his words, images, and ideas into a moving design he has created. (Marshall McLuhan, incidentally, was wrong to suggest that television is the defining medium of our age, for the computer in the largest sense includes that and all other digital electronic devices. Broadcast television itself is simply a means of displaying digital signals in a manner the eye can appreciate. In its traditional form television is a lifeless medium -- who needs to be convinced of that? It can only display images, not act upon them.)

Each medium in the history of communication has had its own peculiar character. The handwritten papyrus roll, the codex, and the printed book (as well as clay, stone, wax, or wooden tablets) each imposed limitations and suggested possibilities to their users. Spoken language, which antedates all of these, too has limitations and possibilities. Genres of literature (and indeed a culture's whole outlook) are profoundly affected by the media of the age. A nineteenth century novel is obviously unthinkable for a culture that carves its inscriptions on stone or wood; the Homeric epics are in the same way impossible in an age of printed books. We can expect that the electronic medium will also demand new genres and a new language -- and make other genres impossible. In fact, in some ways the new medium will bring us closer to modes of fiction that existed in oral or manuscript cultures.

Most notably we will be able to break free of the limitations of the last dominant medium, the printed book: the computer will put an end to the dominance of "linear" text. Printed books present ideas in one fixed order, determined by the author and realized by the printer who sets the text. Generally books (excluding works of reference) are meant to be read in only that order -- from left to right, top to bottom, first page to last. But in computer systems texts need not exist in one immutable form; instead, they can be copied, altered, fragmented, recombined, and recopied -- all with an ease that bears no comparison to the printed book. The computer allows a new freedom of "access" to the text, permitting the reader a variety of approaches. He can look into the middle of a text without worrying about the beginning or the end, or even read backwards from that point. His text can be broken into a hundred or hundred thousand parts, and he may use electronic pointers to gain access to exactly those parts that interest him. In

short, a computerized text is multi-dimensional, its structure defined by the needs of its creator and user.

Fragmentation and reordering are characteristic of the electronic medium, and fiction and creative nonfiction can exploit this characteristic as well as, indeed better than, business inventories and scholarly bibliographies. To type into the machine an essay that is to be read line by line, page by page, is to equate the computer with the book. For preserving such linear prose, the computer will never replace the book, which is cheaper and more easily portable. Works that are written specifically for the new medium should take advantage of its multi-dimensional structure. They should have no single, canonical order; they should instead be in some sense episodic -- with the order of episodes defined loosely by the author and realized explicitly by each reader at the time of reading.

I realize that the idea of multidimensional fiction is not entirely new. Some authors in the past have tried to free themselves from the constraint of linear prose. We can view the narrative and graphic tricks played by Stern in *Tristram Shandy* in such a light. Certainly the twentieth century is full of interesting experiments. There is Dada and concrete poetry. There are novels that consist of loose pages, to be shuffled and read at random. There are circular novels. The complex, later works of Joyce impose a variety of orders of image and theme on top of the linear order of events. In fact at least one novelist has consciously used the technique of programmed learning: the reader is directed to turn to different sections of the book based upon his response to various questions. This is very like my idea of electronic fiction, as presented in section III below. The difference is that all these earlier experiments were doomed, because they were working in the wrong medium. The printed book is too rigid to facilitate the kind of reading I have in mind; the reader will soon get tired of flipping pages in his programmed novel. To use a book in this way is to work against one's medium, and this in the long run must fail. We are reminded of Charles Babbage, the nineteenth century mathematician who sought to make a programmable computer out of gears instead of electronic components (which did not then exist). In principle, the task was possible, but in fact the medium of gears proved intractable for the evanescent transfer of signals that is computation.

II

In ancient and Western European culture, there have been three great changes of literary media: from oral to written literature (in Greece in the eighth century B.C.), from written to printed literature, (in the time of Gutenberg), and now from print to electronics.

The first Greek "literature" was oral, composed more or less spontaneously before a listening audience, and in fact the *Iliad* and the *Odyssey* were products of oral composition (though, fortunately for us, they were frozen by some scribe into the medium of written language). Homeric poetry was formulaic, composed from predetermined patterns, which the poet could call forth and personalize to fit the immediate situation. These formulae extended from the level of words and phrases to scenes, episodes, and in some sense whole plot structures. The oral poet inherited or invented a system of conventions to help him in the act of composition, for he had to compose, as he went, under the pressure of an attending audience. So Homer repeated himself endlessly. He used the same epithets again and again to fit the metrical constraints of his line. He described stock scenes with the same phrases, and stock episodes (such as battle scenes) in terms of repeated actions.

All these repetitions were a necessity of his mode of composition, but they also become a virtue. The epic style derived much of its grandeur from epithets, phrases, and scenes that recur throughout the poems. What is more, repetition was as useful to the audience as to the poet. Since the listeners never had the opportunity to read Homeric poetry; they had to appreciate and evaluate it at the first hearing. They learned the conventions of that poetry by amassing in the heads the repetoire of stock phrases, scenes, and themes, and they learned the lineage and character of the great heroes (Achilles, Agamemnon, Priam, and so on) by repetition of the same or similar tale. In time they built up a vast network of associations on the language and stories of their poet's tradition. The whole effect of oral poetry depends upon networks of association, the resonance of spoken language in the memory of the listener.

Writing was introduced in ancient civilization in the eighth century B.C., when the Phoenician alphabet was adapted to the Greek language. The invention probably killed the genre of oral epic and eventually contributed to a variety of new forms (sophisticated lyric poetry, history, philosophical dialogues, and so on). Since memory was no longer the sole repository of literature, a new precision and sophistication was introduced into the creative use of language. Reading a

poem (even reading aloud) is a different experience from a hearing a poet recite. The reader can stop at any time and go back; he can reflect upon a line and reread it. The result is usually a more ambiguous and complex poetry, often one that expects its audience to be widely read in a particular literary tradition. Compare Virgil's *Aeneid* to Homer's *Iliad*, and you see at a glance the difference between the associative, repetitive poetry of the oral tradition and the precise and yet equivocal poetry of a literate culture. Virgil never really repeats anything: even the same words take on different meanings in different contexts.

The manuscript culture of the ancient world (using mainly the papyrus roll) and of medieval Europe (using mainly the codex) nevertheless retained some of the qualities of its preliterate past. Because manuscripts were expensive to copy and relatively difficult to use, readers still tended to rely on the memory of what they had once read. Also they almost always read aloud. For both reasons, they were more alive to the resonance and the incantatory power of words than our culture, which has lived for centuries in the silent world of the printed book. A new quality of the manuscript was its uniqueness as an artifact. Each papyrus roll or codex had to be copied by hand, which meant that each manuscript was unique, that each bore to some extent the mark of the scribe who created it. (Mistakes in copying could be unique as well.) Each owner had the opportunity to add his own personality to the manuscripts. It was common, particularly in the Middle Ages, for a scholar to write glosses and comments into his text, and when possible to compare his text that of another scholar. That is, a scribal text was not considered sacrosanct; it might grow and change over time. In general the mania for copyright (claiming ideas and words as one's own property) and for the absolute correctness of a text did not, indeed could not, exist in a manuscript culture. The feeling was rather that each codex was one's personal version of a shared cultural treasure — especially if the text were a venerable pagan or Church author. The ideas contained belonged to everyone in that culture.

The invention of movable type in the fifteenth century changed all this dramatically. An author could now make a thousand exact copies of his work -- even the printer's errors would be the same in every copy. Changing a text meant changing the print, a laborious task. As a result, a printed book had a sense of immutability that a manuscript did not. And the whole notion of plagiarism and copyright now became meaningful (though it did not develop its full legal implications for centuries).

The book also fostered new attitudes toward language and literature. Silent, analytical reading first became popular with the invention of printing. Reading aloud, spelling one's way through a text, is almost a necessity in a manuscript, where the letter forms are too inexact to permit speed reading. The printing press made possible letters that were clean, simple, and uniform, so that words and whole phrases could be read at a glance. While vocalized reading is limited to perhaps 100 or 200 words a minute, silent readers can achieve rates of 600 to 900 -- but with a corresponding loss of immediacy. Silent reading encouraged the distancing of the reader from his text, which in turn encouraged an analytical, rather than rhetorical or poetic, style of thinking. In addition, print fostered new literary forms, in particular the prose novel – a long narrative in relatively colloquial language, a story meant to be followed faster than it could be read aloud.

There is much more that can be said about each of these media. The important point is that each suggested changed attitudes towards language and literature. The electronic medium will do the same. Paradoxically, this new medium is in some sense a throwback, for it has elements in common with manuscript culture (the creation of a personalized and unique version of a general text) and even oral culture (the use of networks of associated themes and images). From its immediate predecessor, the printed book, it borrows and even extends the idea of silent, visual language. With links to so many different traditions, electronic literature will likely be quite eclectic in form and content.

III

Since I want to be specific about the potential of electronic literature, I have devised a computer program (called TEXT) to demonstrate some of the possibilities. TEXT is extremely simple -- a system any computer programmer could put together in a few hours. This is nothing innovative in the technique, only in its application to creative language.

The minimal TEXT system allows the author to create "episodes" and define a number of orders in which those episodes might be read. The reader determines a particular order as he goes, by typing words or short phrases in answer to questions posed by the author. The reader still plays a passive role (as in linear fiction) in that he cannot alter the text of any one episode; he is compelled to read what the author has written. But he can decide which episodes he will read and when, and his experience of the fiction depends on these decisions. If the fiction is a

simple narrative of events, he may "visit" the events in chronological order, in reverse chronology, or in a complicated sequence of flashbacks and returns. He may follow one character through the story, and then return to follow another. He may not visit all the episodes in any one reading. We can imagine a story of vast proportions from which the reader selects only a subplot. Even in this simple system, the reader enters into the making of the story, in a way that is not possible in linear prose. His ordering of the episodes is his "reading" of the story, his creative interaction with the author's intentions making the story fresh, if not unique. For a long work, with a variety of episodes, no other reader may ever duplicate the order and number of episodes one reader chooses. And just as likely, the same reader will produce a different story, if he returns the next day.

The system has two elements: episodes and decision points (or links) among episodes. The episodes are simply the author's creation; they can be ordinary paragraphs of prose or poetry. (They could include graphic designs as well -- anything that can be displayed on the computer terminal available). The episodes may be of any length, although in my examples I envision each to be a few paragraphs or pages. Their length will establish the rhythm of the story -- how long the reader will be in his passive role of absorbing language in linear order before he is called on to participate in the selection of the next episode.

The process of the selection is the innovation. At one or several places in each episode, the author inserts his decision points, where the reader is asked to respond to a question or make a choice. Based upon his response the system jumps to a new episode. These decision points link the fiction together in a variety of ways. The fiction, as the author sees it, is a network, rather like a simple road map, of episodes and links between them. The reader travels the map by visiting episodes and choosing particular links to others.

Here is what an episode would look like to the author who creates it:

One path led down the hill into a valley dotted with farmhouses. Far in the west he could see a village and the twin spires of a parish church. It looked idyllic, but he could guess the reality: the dark, damp cottages, the anemic children, the gently numbing hunger of peasant life. But at least there promised to be fellowship. The other path kept to the high ground and soon plunged back into the forest. There was no telling how long the journey would be by that route.

It was time for a decision: the valley or the forest?

* the valley => Vale
* valley
* the forest => Wood
* forest

The last four lines are decision points: program commands which the author writes, but the reader never sees. When the TEXT program displays this episode to the reader, it simply prints each new line on the screen, *unless* the line begins with an "*". On reaching the first asterisk, TEXT waits for the reader to type some input. If the reader types "the valley" or just "valley", TEXT jumps to the episode entitled "Vale". If he types "the forest" or "forest", it will jump to the episode entitled "Wood". (It is assumed that the author has written at least two other episodes and named them "Vale" and "Wood".)

This syntax is practically all that is needed for our simple system. (Details in Appendix 1) The author can invent various ways to build decision points into his episodes: ask the reader to answer a question or express an opinion; give him a wide choice of episodes, or perhaps force him in a direction he has rejected; be honest about the alternatives, or simply trick him. In any case, honestly or through subterfuge, the reader is coopted into making the fiction develop.

Each whole fiction consists of number of episodes: each episode must be given a name by the author (such as Vale or Wood). TEXT uses these names to jump between episodes. The reader may or may not be informed of the names.

IV

Electronic fiction enlists the active participation of the reader in the work. One group of readers who participate most actively in the works they read (or hear) are of course children. Children love to put themselves into the story and to participate (through hearing, speaking, sight, or touch) in the plot. A favorite device of children's fiction is to pick a young child as the protagonist, but authors have many ways to trick young readers into believing they have an

active role to play (think of Tinkerbell's near death in *Peter Pan*). The TEXT program can go further; it can actually respond to decisions made by the child, and in the process create a new kind of children's literature.

Let me illustrate by sketching my own (modest) suggestion for a child's tale. The quest or journey is as popular with children as with adults, so I propose to adapt the classic story of the *Odyssey* to younger readers (say nine or ten years old).

The introductory episode (called "Start" by convention) follows:

> Today you have the chance to take a ride on a sailing ship – far away over the sea. The ship belongs to me, Odysseus, son of Laertes, king of the island of Ithaca, a great hero among the ancient Greeks. I and my fellow Greeks had sailed away from their homes, across the sea to the city of Troy. There we fought a long war against the people of that city. Finally, after ten years of hard fighting, we won and destroyed the city. Now men and I are boarding our ships and setting out for Ithaca, our home. It's only a few days' journey, if the wind blows favorably. But I have a feeling that we will not get home so easily as that. If a storm should come up, there is no telling where we will be blown to. And I have heard tales of giants and witches and magic lands far over the sea. We may see more than our share of adventure.
>
> Now, if all this sounds interesting, you can sail along with me. I could use help on a voyage like this. Would you like to come along? (Type yes, if you would.)

* yes =\> Tale
* y

> I guess you would rather stay home. Perhaps another day.
>
> The End.

If the reader does not type "yes" or "y," then the story ends right there. If he does, then we jump to the next episode, which provides more background. In fact it presents the reader with central issues of the adventure books of the poem

> Good! I was hoping you'd say yes. So you have signed on as one of Odysseus' crewmen. We are about to sail from the smoking ruins of Troy, having sacked the city and taken our share of the treasure. Oh, I should give you two pieces of advice. I am a clever fellow, if I do say so myself, but I have trouble keeping my mind on my business. I am very curious, I admit it. I like to look around; I like to see what the world has to offer. That can get a little dangerous with all the monsters there are over the sea. If I seem to be getting off track, you might give me a nudge. The other problem is the rest of the crew: I don't trust them. They're a greedy bunch, and they do not always listen to their commander. Things usually go wrong, when they disobey him. Let me know, if they start plotting behind my back.

Now let's go.
* =\> Cics

After this introduction, the story of Odysseus' wanderings unfolds. I would imagine about 15

episodes: one each for the adventure tales (Ciconians, Lotus Eaters, Cyclops, Aeolus, Laestrygonians, Circe, Underworld, Scylla and Charybdis, Sirens, and the Cattle of the Sun), one for Calypso, one for the Phaeacians, and several for the return to Ithaca. Each episode would offer the reader several branch points. He would choose to "abort" the episode and move on -- by following the advice given above. He could also omit several adventures by making the right choice. In several cases, he has the opportunity to help Odysseus outwit an adversary. Here is the structure:

1. The raid on the Ciconians is at first successful, but Odysseus' crew refuse to retreat when he orders it. The reader is given the opportunity to help Odysseus (who addresses the reader directly throughout the story) trick the men into retiring. If they succeed, the crew gets back safely, the episode ends, and the ship sails off to the land of the Lotus Eaters. Otherwise, the episode continues with a bloody battle, before branching to the Lotus Eaters.

2. The reader rescues Odysseus who himself falls under the spell of the Lotus Eaters. Then comes the Cyclops. Here there is room for more than one episode. The tale should be complex, allowing the reader to avert the whole disaster of meeting the Cyclops, or to join with Odysseus in defeating the monster (in helping to devise the ploy of Noman, to sharpen the stake, and to hide the men under the sheep). At the end the reader has the chance to prevent Odysseus from shouting his true name to the blinded Cyclops. If he does, the wrath of Poseidon is never incurred by Odysseus, and the crew may all get home safely in the next episode (Aeolus). But if the curse is uttered, they must branch to the Laestrygonians and Circe and end up on the Isle of the Sun, where the crew perishes.

3. So the tale continues: a possible visit to the Aeolus episode (and then straight to Ithaca – #5 below – if the reader prevents the crew from opening the bag of winds) or on the Laestrygonians. Then to Circe, where the reader joins Odysseus in defeating the witch. (One possibility is that the reader goes with the men on the scouting party, and escapes to inform Odysseus of Circe's treachery.) The Underworld is optional, as are the Sirens, but not Scylla and Charybdis, for the sacrifice there must be made. The reader may also try to avoid the Island of the Sun, but he is committed to it, if the episode with the Cyclops has ended badly.

4. The island of Calypso may be a long or short stay. The reader and Odysseus leave by raft and are shipwrecked on the island of Scheria, where the reader too has a chance to stay, ending the story, or to follow Odysseus back to Ithaca.

5. The return to Ithaca begins the final series of adventures. The plot is complex as Odysseus tries to regain control of his household. In all this, the reader takes the role of Telemachus and helps Odysseus kill the suitors and become king once again.

The possibilities for the young reader's involvement here are endless. The reader is asked questions, makes observations, and partakes of the story in a way that is impossible in a printed book. He can read the tale several times with different results. All this should suggest many

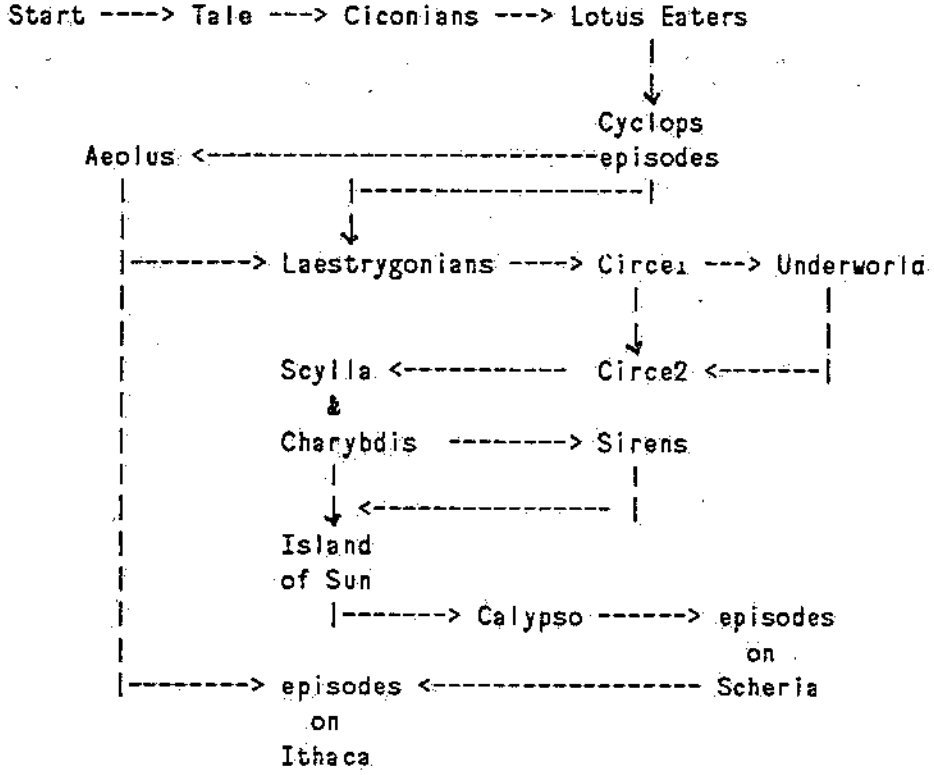
other ideas for children's literature, both for older and for very young readers.

V

Within each episode electronic fiction looks like printed fiction, but the linking of electronic episodes has no counterpart in the previous medium. Printed fiction is one-dimensional: that is, we need only one dimension in order to represent the experience of reading it. The episodes (or chapters, sections, cantos, books, volumes) are realized through time, as we read:

```
Episode 1 --> Episode 2 --> Episode 3 --> Episode 4
```

The "links" between episodes are fixed at the time of writing, and the reader has nothing to say about it: Episode 2 simply starts where Episode 1 ends. Because there is only one directed link between any two episodes, there is only one dimension. On the other hand, electronic fiction allows for multiple links and can only be represented in two or more dimensions. Consider the story of Odysseus, outlined above. The easiest way to grasp its structure is by diagramming it:

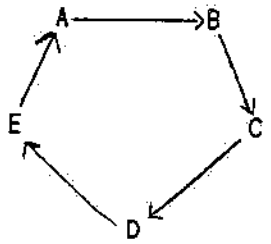


The episodes listed here would each have an abbreviated name known to the text program.

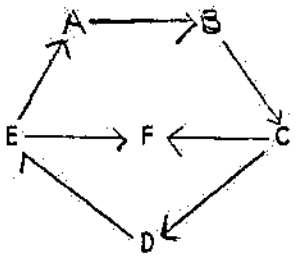
The lines with arrows are possible links among episodes and trace out the design of the story.

In electronic fiction the overall structure becomes one of the central creative elements. Structure has always been important to fiction -- whether it is narrative structure or the structural relationship of scenes, or images, or ideas. But in print the structure can always be represented by an outline (which by the way is also one-dimensional); In electronic fiction, structure becomes a truly geometric entity. The author has literally new dimensions in which to explore the interplay between form and plot, image, or theme. He becomes a geometrician or architect of his computerized "space" (as computer memory is in fact called by programmers); he fills this space with a special pattern of episodes and links. The success of his work may depend in large measure upon the aesthetic or poetic rightness of the pattern. In the child's *Odyssey* above, I have not made any attempt to give a geometric sense to the structure of episodes. I have let the meandering of the episodes reflect the wandering of the hero. Authors in the electronic medium may choose to be similarly casual, or they may find that fixed structures pose interesting problems of their own (like the constraints of rhyme and meter in earlier poetry).

The simplest geometry is the circle. This can be approximated by a ring of episodes: a ring of episodes will produce a polygon, and adding more episodes brings us closer to the circle. Let's begin with a pentagon:



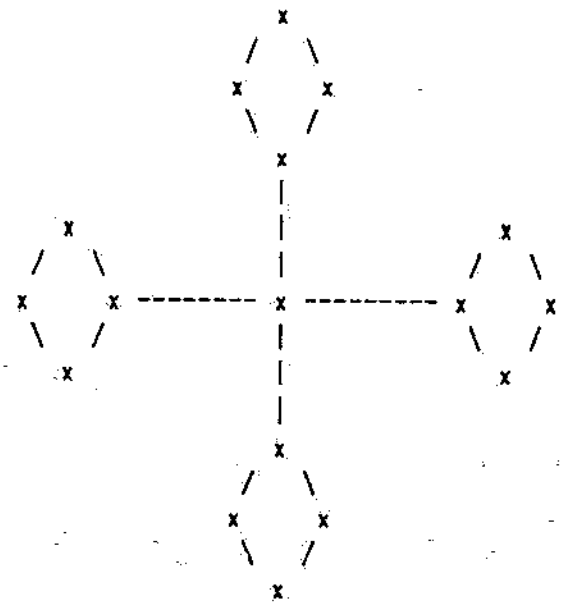
This is an endless story. The reader starts with episode A, and can only proceed clockwise to E and back to A. It is still close to linear fiction, and anyway nothing so new. *Finnegan's Wake* is circular in this fashion, as are other works whose end joins to their beginning. Add a sixth episode, and the story becomes geometrically and thematically more complex:



F, the sixth episode, breaks the endless circle and in doing so creates a variety of possible "readings," but only if the reader is clever enough to choose the right branch at C or E. This kind of geometry would be good for a detective story. The reader joins the detective in helping to solve the mystery. He must begin at A and pass through B, but if he is clever enough to spot a clue in C (and answer a question posed in that episode), he can jump straight to the solution. Otherwise, he has more to learn in D and then another chance in E. If he still fails, he is condemned to make the round of episodes again.

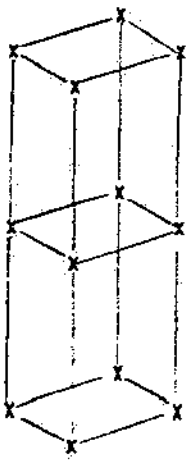
The detective story need not be frivolous. *Oedipus the King* and *Hamlet* are after all detective stories. Any fiction in which there is a fundamental mystery to be understood would lend itself to some geometry like the one above. Establish one or more revelatory episodes, and make getting to them the goal of the reading. The reader takes an active part in the search; his answers carry him nearer to or farther from the goal. Quest literature in general (from Chretien de Troyes' *Quest for the Holy Grail* to Kafka's *Castle*) cries out to be cast in electronic form. There are as many geometric structures as there are variations on the quest theme. The return-to-the-garden is one such motif (realized in print by Alain Fournier in *Le Grand Meaulnes*). Here the reader is presented early with a paradise episode -- it may be perfect familial relations, social utopia, sexual/romantic ecstasy -- and then cast out of the garden. His task is to find the way back, and the author may lead him through a labyrinth of episodes. He may never return; return may be impossible (we think of how Kafka would do it), or surprisingly easy.

Here is a geometry to explore point of view (with x's standing for episodes):



Each of the four rings represents the same four episodes (events). Each ring is the narrative of a different character. The "x" in the center may stand for the objective reality from which all the narratives derive. Telling the same events from different points of view is nothing new, but in the electronic medium the reader is free to explore events in a variety of orders. The directions of the links are not indicated; the author might choose to make them bidirectional -- so that the reader can travel back and forth among episodes. Visiting the same episode several times need not be senseless repetition, because one's experience of the narrative will change, depending upon the other episodes recently visited.

This suggests another possibility -- creating a narrative hierarchy. The author may present the same events from two or three points of view, but in this case one perspective will be definitely superior to another. That is, there may be a divine, a heroic, and a satiric perspective. From the satiric perspective the events are a confusion, as we normally experience them; from the heroic they take on greater clarity and urgency. The divine view is omniscient and also detached, for the heroic sense of engagement is lost. Here the structure can be represented in three dimensions:



Each of the levels contains the four episodes of one perspective. The reader begins on the lowest (the satiric) level, and his task is to break out in a higher realm of understanding. The divine level should clearly be harder to reach than the heroic, and its presentation of events might be so cold and crystalline that the reader may wonder whether this level was in fact worth the effort. In this diagram corresponding episodes at each level are linked. This means that, as the reader is visiting one episode on the satiric plane, he may jump to the heroic plane and instantly see the same event in a new light. Of course, there are many geometries here which the author could employ.

Discrete levels could also be used for modes of presentation. Imagine, instead of three levels, half a dozen -- each representing the same events, but each in a different mode of literary discourse. (Prose, drama, narrative poetry, lyric poetry, and so on.) There is no need to limit the modes to fiction: the events could be described in narrative prose, poetry, historical prose, and scientific prose with mathematics. Each level would concern itself with a different aspect of reality. The fictive level simply describes a man writing a letter at his desk; the poetic concentrates on the raw morning air just now warmed by the coal fire he has stirred up; the historic discusses the politics of Victorian England (the contents of the letter); and the scientific explains the combustion of coal or the process of making ink. The trick would be to tie these observations into some coherent whole (or not, depending upon the author's intentions). In any case, the levels allow the author to refract reality into a rainbow of different perspectives (just as the modern intellectual enterprise has done) without destroying the rhythm or comprehensibility of his work. The reader does not have to contend with all facets of any one event at once.

VI

Unlike the printed book, which is fundamentally serious and monumental, the electronic medium is impermanent, even fragile. The fiction realizes itself on the screen of the computer terminal and then "scrolls" up and out of sight and is gone. You may call it back again, if your terminal has its own memory, or you may produce the same fiction on the next day. But for any large structure of episodes, exact repetition is unlikely. Electronic literature is not timeless; it exists in "real time," as computer specialists say. Once readers have developed an aesthetic sense for this new medium, they will no longer care about perfect repetition or long preservation.

On the other hand repetition and return will take on a new significance. The computer is capable of endless repetition. Notice in some of the geometric structures above that a reader could visit the same episode several times. Of course, each visit is different; even traversing a familiar route a second time will be a unique experience. If the author is clever, he can arrange it so that his reader can seldom duplicate a previous fiction, but can always have something like it again. We may even judge the success of a work, by its ability to adapt to new readings and still preserve its essence. It may be with readings as with dreams; the important ones never return, but they are never really lost either. In any case, the computer author will not claim to have erected a monument more lasting than bronze; he will delight in the impermanence, the adaptability of his work.

Along with impermanence, playfulness will be a defining quality of this new medium. Electronic literature is a game (just as computer programming and indeed the computer itself are games). It grows out of (but far surpasses) the simple-minded video games that are so popular today. In the video games the player competes against the programmer, who has defined goals and put obstacles in his path. But the emphasis is on the player, not the programmer, who is an anonymous employee of some software firm. In the simplest form of electronic fiction described above, the programmer/author is at least as important as the player/reader, and the relationship between author and reader may take a variety of forms. They may work cooperatively (like a musical composer and his interpreter) to bring a fiction to life. Or there may be a real sense of competition: the author may establish some clear goal for his reader and provide obstacles along the way. There is enormous scope for the reader to "learn by suffering," as Aeschylus put it.

Although the author can control the reader's path through the episodes to any degree he wishes, in the simple act of choosing episodes the reader takes on responsibility for the path he travels, and that a responsibility will define his whole experience of reading.

No matter how competitive, the experience of electronic fiction remains a game, rather than a combat, because it has no finality. The reader may win one day and lose the next. The computer erases the program and offers the reader a fresh start -- all wounds healed, all failures already fading from the reader's memory as they have ceased to race through electronic memory. Anyone who has written a program knows that the computer (or its human agent) has a genius for getting completely and hilariously off track; fortunately it will always be possible to drop everything and start over. This quality will carry over into electronic literature itself: it is always possible to erase the TEXT program and start again. The very impermanence of electronic literature cuts both ways: if this is no success that lasts, there is no failure that needs to last either. By contrast, there is a solemnity at the center of printed literature (even comedy, romance, and satire) -- because of the immutability of the printed page. This solemnity will become apparent as soon as electronic literature -- with its playful, almost frivolous essence -- begins to flourish.

Various quest games are popular on computer installations throughout the country -- electronic versions of Dungeons and Dragons. The computer takes the role of the dungeonmaster, presents a maze and charts the player's course through it. In each room or setting, there may be treasure or monsters or both. The computer paints the scene, the player types in his decisions about where to go and what to do, and then the computer gives him the results. This could all be done with the minimal system described above.

The quest is one of the great European themes; why not bring some of its complexity into the electronic medium? We can envision a quest game in which the player must win his way through Western culture. Instead of weapons he must use his knowledge of history, art, science to overcome the obstacles he meets. Instead of rooms in a dungeon, the player move through rooms in an art gallery or in a library, answering questions about the picture or books that he comes upon.

If this seems too academic, we can envision a more active setting. We can go back to the clear

source for Dungeons and Dragons itself: J.R.R. Tolkien's *Lord of the Rings*. This is highly eclectic, but effective fantasy literature -- with a more or less medieval setting and characters whose attitudes and emotions reflect the nineteenth century. Tolkien's world is intellectually far more stimulating that that of Dungeons and Dragons, and it would carry over nicely into the electronic medium. The player would have a higher goal than mere booty -- to deliver a ring of power, to find the answer to some great question, or to meet a wise man of an earlier age in a far off land. Along the way he would have adventures that could call for practical wisdom, skill, and academic knowledge. He might have riddles to solve (as Bilbo does in *The Hobbit*), messages to translate from known (or imaginary) languages. He might learn lessons in one episode that help him in another. He might return at the end of this journey to find that his home has changed during or because of his absence. In short, a simple TEXT program has the potential to create a fascinating game with real literary merit.

VII

In the minimal TEXT system, I have suggested that literature becomes a game with the author as gamesman and the reader as player, but with more advanced systems the division between author and reader would begin to dissolve, and both would become players. In the age of print authors and readers were different species. A printing press concentrated the power of communication in the hands of a few; it was a relatively expensive and laborious process to set a book in type and run off copies. Only especially good, important, or popular works earned such treatment. Authors were those special people who succeed in persuading publishers to make such an effort, and their books stood as monuments to the whole process. Readers were the rest of us who came to pay homage to the monument.

In the age of papyrus or codex, by the way, the proportion of authors to readers was probably much higher. Being an author was no enormous production. One wrote a manuscript, had a few copies made, and sent them to friends. In the early periods of the Roman empire, for example, many of the senatorial and equestrian class considered authorship part of their social obligation. Speeches, collections of letter, epic poems, philosophical tracts, treatises on special subjects -- all these were executed with relative ease, according to the rhetorical traditions of the day. People exchanged manuscripts almost as we exchange Christmas gifts. Of course, much of this literary production was probably of low quality; at least, the stuff was quite predictable. But it is also

true that educated Romans had such a fine ear for rhetorical Latin, precisely because there were all authors as well as readers.

In electronic literature, as the reader begins to take part in the process of creation, it becomes harder to distinguish him from the author. In the minimal system, he affects only the choice and order of episodes, but this already can give one work many different faces. Anyone familiar with text editing by computer will realize that this is only the first step. Beyond the minimal system, there is no end to the ways in which the reader may affect the text. I have not put any of this power into the minimal system, because I want to explore the restricted case before going on to the more general. (Already the possibilities of the minimal system seem vast.)

Imagine an expanded system in which text can be manipulated as well as displayed -- either by the author or by his reader. A trivial example would be to insert a name into the prepared text. The reader is asked for his name at the beginning of the story, and that name is added at appropriate points in each episode. This is useful, by the way, for children's literature: a young reader loves to be included in the story he reads. Various kinds of stories for children would be ideal candidates for the electronic medium, as I have demonstrated above.

More substantial textual manipulation is possible. Most obviously, letter substitutions and various word manipulations could create special visual and sonic effects. In fact, concrete poetry and such literary movements as Oulippo (in France) actually belong on the computer: their tricks are calculated assaults upon the linear structure and the silent reading of printed prose. An electronic editing program can create patterns of words on a page far more effectively than a typewriter, as well as interesting sound effects and experiments with the iconography of words.

Even the technique of letter substitution has possibilities, for it suggests ways of heightening our experience of language through a kind of coding process. The reader, as well as the author may take part in the coding or decoding. In the simplest version the reader might simply have the task of decoding the author's message -- getting the answer to the riddle posed by the text. But we can imagine the author providing the reader with a number of transformation functions, which he may apply freely to the text. The result is product of both the reader's and the author's ingenuity. Here we are getting close to some contemporary music -- where the composer specifies (often broad) limits of sound and time and the interpreter produces any of a variety of

musical possibilities with those limits.

This is the direction in which I suspect the medium will develop. The author will provide functions and texts; the reader will generate what he reads. Both will be creative according to their lights.

VIII

Let me follow up the idea in the last section and demonstrate how the computer offers a medium for rendering language mallealable and creating idiolects (such Joyce and his followers created.) The notion of using computer programs to help transform one's prose now seems radical, but may well become a defining quality of fiction in the future. Please note that I am *not* advocating that the computer should or can take over the creative aspects of writing. Computer programs offer mechanical manipulations of language; it is the author/reader who must be creative in his use of these mechanisms.

Here is the simplest example of how the computer, through purely mechanical changes, might whet the author's own creative appetite. Start with the following passage:

> Once upon a time there was a musician, whose name was Meyn, who played the trumpet beautifully. He had an apartment on the fourth floor, under the roof, kept four cats, one of whom was named Bismarck, and drank from morning to night from a juniper hipflask. This he did, until a misfortune left him sober.

We will subject this passage to a series of deformations by running a substitution program: substituting one letter (or cluster) for another. This kind of experiment is easy with a standard text editor. First change all the o's to u's.

> unce upun a time there was a musician, whuse name was Meyn, whu played the trumpet beautifully. He had an apartment un the fuurth fluur, under the ruuf, kept fuur cats, une uf whum was named Bismarck, and drank frum murning tu night frum a juniper hipflask. This he did, until a misfurtune left him suber.

The kind of misspellings that crop are suggestive. They remind us of dialect forms, or sometimes of a different word altogether. That new word may resonate in the sentence. For example, "four cats" becomes "fuur cats," which reminds me, at least, of stuffed animals. We continue by changing the s's to z's. (Changing voicless consonants to voiced often seems to give interesting forms, reminiscent of dialects.)

> unce upun a time there waz a muzician, whuze name waz Meyn, whu played the trumpet beautifully. He had an apartment un the fuurth fluur, under the ruuf, kept fuur catz, une uf whum waz named Bizmarck, and drank frum murning tu night frum a juniper hipflazk. Thiz he did, until a mizfurtune left him zuber.

And again t and th to d:

> unce upun a dime dere waz a muzician, whuze name waz Meyn, whu played de drumped beaudifully. He had an apardmend un de fuurd fluur, under de ruf, kepd fuur cadz, unc uf whum waz named Bizmarck, and drank frum murning du nighd frum a juniper hipflazk. diz he did, undil a mizfurdune lefd him zuber.

Now I will stop the process and go through the text by hand, refining the suggestions the mechanical process has made and adding my own sense of direction. In particular, I mean to introduce Germanic words into the text, since the changes have already suggested a Germanic character. The theme should remain: the conflicting demands of art and material survival.

> Ounce upon a dime there waz a Musecian, namens Meyer, who played de drumpet bountifully. He had an apartmend on de dirt Flor, under D. Roof, kept fur katz, ein of whum waz named Bizmarck, and trank from mourning Du nicht from a juniper hipflask. Daisy did, until a missed fortune left him Zauber.

I would not hold this up to comparison with any seven lines of Joyce. But as a modest experiment with language, it is personally satisfying. The computer medium is ideal for the amateur -- because it is neither monumental nor expensive and because it fosters in the user whatever small portion of talents he may bring to it. What does the computer add to this kind of experiment? Its ability to transform the characters so rapidly allows the user to try various avenues and abandon those that are not promising. It shakes up language in surprising ways and therefore jogs us into looking at old words with new eyes. Something that Joyce could do by instinct, the computer helps us to do with artifice.

Clearly, these simple letter transformations are only the beginning. Many programs are possible to be used by would-be authors, or be readers as they approach an author's text.

Appendix 1: TEXT -- A program to present electronic literature.

In the TEXT system each text consists of episodes and links. The episodes are passages of prose (or poetry) written by the author and unchangeable by the reader. The links are decision points in the episodes; they determine, based upon the reader's responses, what episode will be presented next. Each episodes consists of display lines and decision lines. The latter must begin with an asterisk; display lines may begin with any other character (and have asterisks in any but the first column).

Here is a sample episode (part of the adventure of the Cyclops in the *Odyssey*):

It is early in the morning and foggy, when our ship glides into the harbor. Everything is still, and yet our ship floats up to the beach as if blown by the breath of some god of the winds. We have come to an island, but one very close to the mainland. After breakfast, I say to you: "There's nothing on this island of interest, just a few goats. But I think I see smoke on the mainland. There might be a city there, and people to welcome us and give us gifts. Shall we go across and look?"

```
* yes => Shore
* sure
* y

    I guess you are right. We shall just get some fresh water here, and some goats, and set sail.

* => Aeolus(2

    )
```

The author writes up the episode in just this form. When the reader comes to this episode, the TEXT program begins presenting the lines on his screen. TEXT simply prints out the episode line by line, until it encounters the asterisked line: "* yes => Shore". This is a decision line; it is not printed, but rather executed by the program. It gives TEXT the instructions: Wait for the reader to type something on his terminal. If he types "yes," then jump out of this episode and into the episode entitled "Shore". (All episodes have names, which the author must determine in advance.) If the reader's response does not match "yes," TEXT goes on to the next line. As long as the lines begin with an asterisk, TEXT continues to regard them as decision points. The first line has set the goal of jumping to the episode "Shore," and TEXT is trying to match the reader's response in order to make the jump. It tries to match the reader's response to the word "sure" and then simple to "y." If it succeeds, then it still jumps to "Shore." If all matches fail, TEXT switches back to display mode and goes on printing out the story.

The next asterisked line is "* => Aeolus." This time TEXT does not wait for a reader response (because no response is given before the arrow. TEXT jumps directly to the episode "Aeolus." The number in parentheses in the paragraph number; in this case TEXT jumps directly to the second paragraph in the Aeolus episode. (The first paragraph is read only is the reader approaches from another episode.) This ends the episode.

The complete operation of TEXT may therefore be summarized:

1. TEXT has two modes: display mode and decision mode. It begins in display mode, taking in lines from an episode and displaying them at the user's terminal.

2. When an asterisk is encountered in the first column of an input line, TEXT enters decision mode; it remains in that mode until an unasterisked line is encountered. A sequence of lines each beginning with an asterisk is called a "decision group."

3. The asterisked lines have the following syntax:

* response string => episode name(paragraph #)

If a response string is present in the first decision line, TEXT pauses to get a response from the reader. It then executes the decision lines in order, trying to match the reader's response. At the first match, TEXT jumps to the episode named on the right side of that decision line. If a paragraph number is given in parenthesis, then TEXT will jump directly to the appropriate paragraph in the new episode.

4. If TEXT comes to the end of an episode without any jump instructions, the program terminates

There are various special features of the

1. If a previous line has set the episode name, subsequent lines need not do so. For example:

```
* yes => Star
* Indeed
* planet => Earth
```

In this case the response "yes" will cause a jump to the episode "Star"; the response "indeed" will also cause a jump to "Star", named in the previous line. But the response "Planet" will cause a jump to the episode "Earth."

2. The episode name can be omitted, but a paragraph number given; "... => 4" is taken to mean paragraph four of the current episode – the one now being processed by TEXT.

3. The response string can be omitted, but the episode name or number given; "* => Star" is a command to jump directly to the episode "Star" without waiting for a reader response.

4. Everything but the arrow may be omitted: "* => " may come at the end of a decision group and commands TEXT to jump to the beginning of that decision group, wait for a new response from the reader, and execute the decision commands again. It allows the TEXT program to "loop." For example:

```
* yes => Star
* indeed
* planet => Earth
* =>
```

is like the example above, except that if the reader does not give any of the three expected answers, TEXT loops around and waits for the reader to type a new response. The response is again compared to the three possible.

When looping, it may be better to include a repeated text to prompt the reader. This can be done by looping around to the previous paragraph:

```
Shall we head for the star or the planet?
* yes => Star
* indeed
* planet => Earth
* => 4
```

This assumes that the line "Shall we head for the star or the planet?" is paragraph #4. In this case this line will be repeatedly displayed until the reader gives the right response.

There are many other features, which may be included in implementation of this program. These include display features that take account of the particular terminal being used, more complex jumping and labeling facilities, graphics capabilities, and even interfaces to laser disks or acoustic synthesizers. TEXT is simply a beginning.

Appendix 2: The TEXT algorithm

For those who know some programming, here is the algorithm for the TEXT program, written in a notation resembling a high-level language like PASCAL. This skeletal algorithm is meant to suggest how a real program could be written: I have not put in details that would depend upon the language, operating system, and computer being used. Commands in {} are descriptions of what the code must do at that point: in a real program they would be a few instructions or perhaps a subroutine. Comment lines are preceded by a tilde:

```
~The following variables are needed; they are set to
~null (or 0) at the time of declaration.

declare
  line character(80)              ~current line of text from episode
  episode character(10)           ~name of current episode
  new-episode character(10)       ~name of next episode for jumping
  response character(20)          ~response in decision line
  reader-response character(20)   ~response given by reader at CRT
  paragraph character(2)          ~paragraph number in decision line
  linecnt fixed binary            ~current line in episode

~Set the episode variable to the name "Start"
~and fetch that episode.

    {set active episode to "Start"}

~Process active episode line by line:
~If the line is a display line, display it and continue.
~If it is an decision line (*), enter decision mode:
~ get a reader response, seek to match it, and jump
~ to a new episode accordingly.

    loop (forever)
      {Read next line in active episode into variable line}

      ~If the line does not begin with "*", then display mode.
      if  line(1) /= "*"
        begin
          {Display line on user's terminal}
          linecnt <= linecnt + 1
        end
```

```
~If the line does begin with "*", then decision mode.
else
  begin

    {Process decision line: set response,
      new-episode and paragraph number}

    if response /= ""
      begin
        if reader-response = ""
          {get reader-response from terminal}
        if response = reader-response
          episode <= new-episode
      end

   {set active episode using variables episode, paragraph, line}
   {reset variables as needed}
  end

repeat loop
```

Two additional points:

1. If the active episode ends without a jump instruction, the file processing function should raise an endfile condition and terminate the program.

2. I assume there would be a routine to set the active episode. It should determine the active episode base upon the value of three variables: episode, paragraph, line. There are two possibilities:

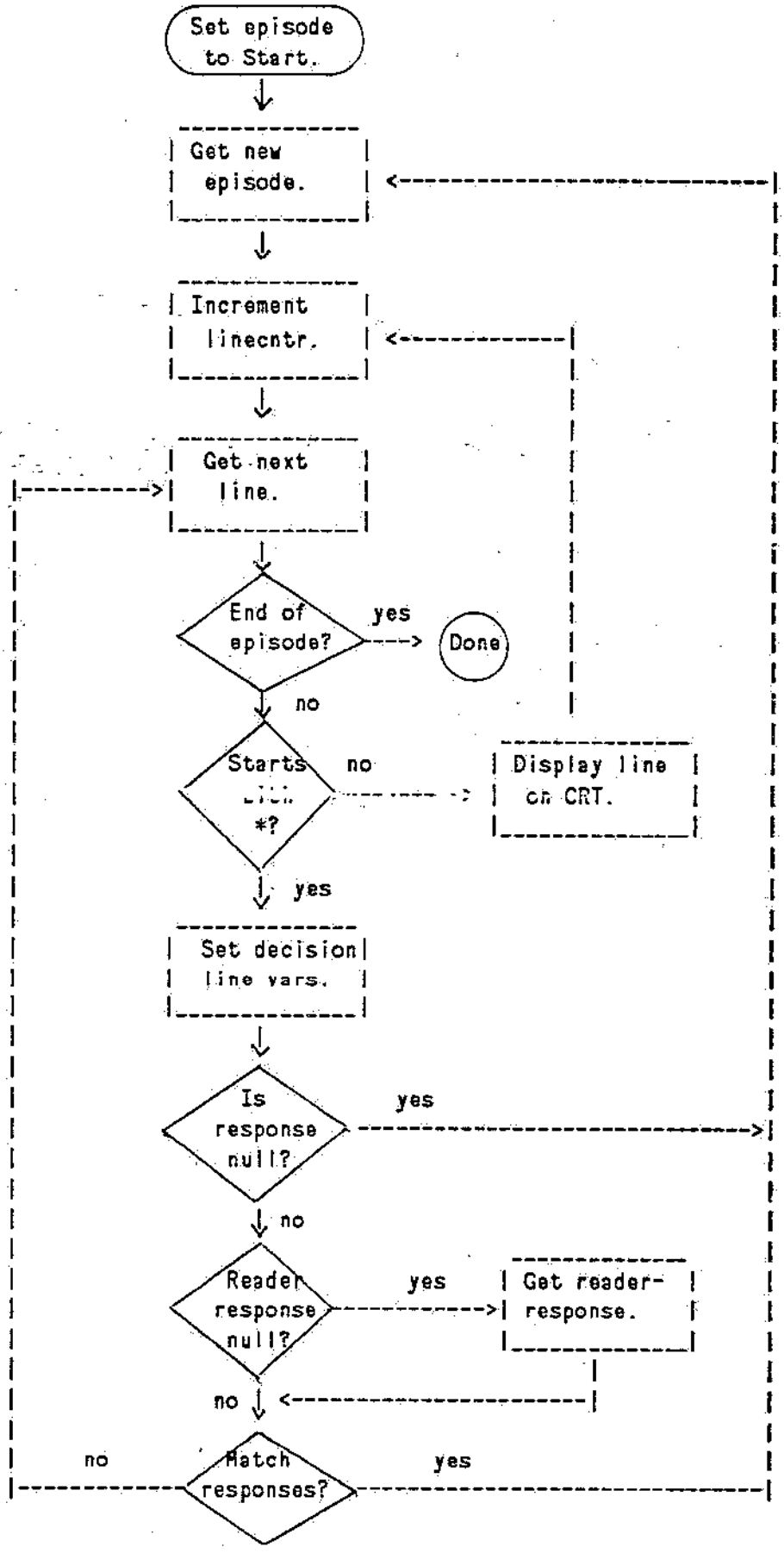
a. If the episode name has not changed since the last invocation, the routine assumes that the current episode is still active. It then looks at the paragraph number and moves to the paragraph represented. It that is blank, then it looks at linecnt to determine then next display line in the current episode.

b. If the episode name has changed, then the routine jumps to the new episode. If a paragraph-number also exists, it jumps to that paragraph. Otherwise it starts at the beginning and resets variables accordingly.

This idea is simple enough to be implemented on most any mini- or microcomputer. With a few weeks' experience, a humanist should be able to turn the algorithm above into a working program. An experienced programmer would need only a few hours. Computing time could hardly be a problem on even the smallest system, because there is very little processing involved

-- merely a few string matches. Storage space might be a problem for really long fictions. But a floppy disk that can hold 256,000 characters would accommodate perhaps a two hundred page work. This might be a convenient limit for early experiments. Large computing systems (those connected in networks with fixed disk drives) would exhaust the author's creativity much sooner than their own capacity.

Flowchart for the TEXT program



Appendix 4: total programming system

Beyond the TEXT program itself, one can easily design a programming system, within which the author and the reader can experiment freely. The author needs a text editor in order to compose his fiction and programs. The reader needs a facility for reading at a computer terminal. One must be able to create functions for modifying or manipulating text and to call these functions easily in the course of reading a fiction.

1. Text editor: These are available on mini and microcomputers. They allow you to create and delete files (episodes or whole texts) and to display and alter the contents of files.

2. Programming language: The author needs a language in which he can write text-manipulating functions or indeed the TEXT program itself. Any language will do which has good facilities for handling "character strings".

3. File handling: the system should allow easy and graceful access to a number of files. Because I envision programs that will need to jump silently from one file to another. This may be a problem on some microcomputers with tiny floppy disks.

4. Tools: Tools are programs that the author or reader will use often for operating upon texts. There should be a suite of standard tools -- perhaps a package for generating concrete poetry and Joycean prose, or a search program that allows the reader to search through episode, thereby defining his own links in an author's text. The author should be able to write new tools easily, which both he and his readers can then use.

While many small computers could be used for electronic fiction without modification, it would be useful to tailor a system to provide these facilities for author and readers.