Theodor Holm Nelson

Literary MACHINES 93.1

THIS BOOK DESCRIBES THE LEGENDARY AND DARING
PROJECT XANADU, AN INITIATIVE TOWARD
AN INSTANTANEOUS ELECTRONIC LITERATURE;
the most audacious and specific plan for knowledge, freedom and a better world
yet to come out of computerdom; the original (perhaps the ultimate)
HYPERTEXT SYSTEM.

DO NOT CONFUSE IT WITH ANY OTHER COMPUTER BOOK.

ABOUT THE AUTHOR

Ted Nelson is a rogue intellectual, social critic, and designer; especially, a designer of interactive computer systems for our world of tomorrow. He holds the title of Distinguished Fellow at Autodesk, Inc. (Sausalito, California) and has lately been Visiting Professor of Information Science at the University of Strathclyde (Glasgow, Scotland).

However, it is only recently that his work has been widely recognized as serious. Nelson has been designing computer text systems on his own since 1960, and may thus be considered one of the inventors of word processing. Douglas Engelbart, the original inventor of word processing, gives Nelson equal credit for the discovery of the text link, and full credit for the invention of the hypertext concept.

(Continued inside.)

Mindful Press, 3020 Bridgeway Suite 295, Sausalito CA 94965

(ABOUT THE AUTHOR, continued from back cover.)

Nelson holds degrees from Swarthmore and Harvard, and has taught, consulted and lectured variously. He was the editor of *Creative Computing* magazine in 1980 and 1981. His book *Computer Lib*, intermittently in print, is often cited as an "underground classic."

A dynamic orator, he was an invited speaker at the Eighth World Computer Congress, giving his talk "Replacing the Printed Word," on which this book is based, in Tokyo and Melbourne.

Nelson's ideas have a wide underground following in the computer field. His maverick point of view stresses the art and conceptual integration of screen graphics and other responding environments, and an apocalyptic and millenarian view of a new Golden Age-- a changed and better life to come at tomorrow's computer screens (completely unlike today's).

This is a report on his religion and his life's work, the Xanadu Hypertext System, a scheme for instantaneous publishing and archiving with very broad implications--designed for "children, researchers and heads of state."

(THE HOPE)

The values change every time the universe changes.

And that's every time we redefine a big enough bit of it, which we do all the time, through the process of discovery that isn't discovery, just the invention of another version of how things are.

And yet, in spite of that, we still go on believing that today's version of things is the only right one, because as you've learned from this series, we can only handle one way of seeing things at a time.

We've never had systems that would let us do more than that.

So we've always had to have conformity with the current view.

Disagree with the Church, and you were punished as a heretic; with the political system, as a revolutionary. With the scientific establishment, as a charlatan. With the educational system, as a failure.

If you didn't fit the mold, you were rejected.

But, ironically, the latest product of that way of doing things is a new instrument, a new system, that while it could make conformity more rigid, more totalitarian, than ever before in history, could also blow everything wide open.

Because with it, we could operate on the basis that values and standards and ethics and facts and truth all depend on what your view of the world is; and that there may be as many views of *that* as there are people.

And with this capability of keeping a tally on those millions of opinions, voiced electronically, we might be able to lift the limitations of conforming to any centralized representational form of government (originally invented because there was no way for everybody's voice to be heard).

You might be able to give everybody unhindered, untested access to knowledge. Because the computer would do the day-to-day work for which we once qualified the select few in an educational system originally designed for a world where only the few could be taught.

You might end the regimentation of people living and working in vast, unmanageable cities, uniting them instead in an electronic community, where the Himalayas and Manhattan were only a split second apart.

You might with that and much more break the mold that has held us back since the beginning, in a future world that we would describe as balanced anarchy, and *they* will describe as an open society, tolerant of every view, aware that there is no single privileged way of doing things; above all, able to do away with the greatest tragedy of our era, the centuries-old waste of human talent that we couldn't--or wouldn't--use.

Utopia? Why?

If, as I've said all along, the universe is at any time what you say it is--then say!

James Burke,
The Day the Universe Changed
(BBC-TV series), his final speech.

(THE DARING PROPOSAL)

Next, meet Mr Ted Nelson, gadfly, prophet and self-confessed computer crack-pot, with a lifetime's obsession wrapped up in an enormous program called (after Coleridge's unfinished poem) Xanadu. Boon or boondoggle, nobody is quite sure. But the giant piece of software for steering one's own thought processes (including alternative paths, mental backtracks and intellectual leaps) is hardly lacking in ambition or vision.

Conceived originally by Mr Nelson while a student at Harvard as simply a note-keeping program for preserving his every thought, Xanadu has evolved into a total literary process: creating ideas; organising the thoughts, with traces showing backtracks, alternative versions and jumps to cross-referenced documents; manipulating the text; publishing the results; and logging a share of the royalties to every other author cited.

Every document in Xanadu's database has links to its intellectual antecedents and to others covering related topics. The linked references work like footnotes, except that Xanadu offers an electronic "window" through which they can be accessed there and then. Because the whole process works in a non-sequential way, the inventor calls the output "hypertext."

Mr Nelson looks forward to the day when anybody can create what he or she wants--from recipes to research papers, sonnets to songs--and put it into Xanadu's database and quote or cite anybody else. Royalties and subroyalties, monitored automatically by the host computer, would be paid according to the amount of time a user was on-line and reading a specific document. It sounds pretty wild at the moment, but hypertext could be commonplace before the century is out.

The Economist
(London), 23 Aug 86

THEODOR HOLM NELSON

LITERARY MACHINES

THE REPORT ON, AND OF, PROJECT XANADU
CONCERNING
WORD PROCESSING, ELECTRONIC PUBLISHING,
HYPERTEXT, THINKERTOYS,
TOMORROW'S INTELLECTUAL REVOLUTION,
AND CERTAIN OTHER TOPICS
INCLUDING
KNOWLEDGE, EDUCATION AND FREEDOM.

Mindful Press, 3020 Bridgeway Suite 295, Sausalito CA 94965

STATUTORY NOTES

***Literary Machines 91.1* by Theodor Holm Nelson.**

"As We May Think," by Vannevar Bush, is reprinted by permission from *The Altlantic Monthly*, July 1945.

Back cover photograph by Laura McLaughlin.

BOOKS BY THEODOR HOLM NELSON

Life, Love, College, etc., published by the author, 1959 (originally entitled *We Need a Sociology Department*).

Media 72, unpublished, 1967.

Computer Lib, published by the author, 1974; second edition from Microsoft Press, fall 1987. ISBN 0-914845-49-7.

The Home Computer Revolution, published by the author, 1977.

Literary Machines, published by the author, 1981; *Literary Machines 91.1* from Mindful Press, 1991.

Japanese-language edition from High Technology Communications, Inc., Tokyo, Hachiko Building, 1-34-6 Takadanobaba, Shinjuku-Ku, Tokyo 169; fax 81-33-23-27-396.

Italian-language edition from Franco Muzzio Editore, Viale Sondrio 7 - 20121 Milano, Italy.

MINDFUL PRESS ORDERING INFORMATION

We currently offer:

Literary Machines 93.1, $25 postpaid within USA. Foreign orders add $15 for postage and handling. Purchase orders add $5 handling charge.

The videotape, "Technical Overview of the Xanadu Hypertext System." VHS standard play, 2 hours 40 minutes. SORRY, U.S. STANDARD FORMAT ONLY (NTSC VHS). $50 postpaid. Foreign orders except Canada add $15 for postage and handling ($5 for Canada). Purchase orders add $5 handling charge.

PREFACE TO THE 1993 EDITION

TOMORROW'S LITERATURE

It is over eleven years since I first published *Literary Machines*, a paper book. How ironic. What this paper book is about is the publishing of tomorrow, which will not be on paper. This book is also the story of Project Xanadu, a literary and technical adventure resembling both Camelot and the Manhattan Project.

The first edition of *Literary Machines*, done on a typewriter, appeared in April of 1981. We printed it on a Saxon copier that filled the house with a vinegar smell. But it had a beautiful cover, its white title silk-screened on mirrored plastic. Since that time the book has gone through various editions with different-colored covers, printed by various people with various degrees of permission. The main revision took place in 1987, when I added most of the technical material (*Literary Machines 87.1*). Unless you are reading the Japanese or Italian translation, the only differences between this book and the 1987 edition are this preface, the statutory notes preceding, and the cover.

The purpose of this preface is to tell you what has happened since the book was written in 1987. But since you probably have not read the book yet, presumably you do not know what this is adding *to*. In other words, this is an addition to the book you haven't read yet, which is a problem. Therefore let me create first a context: the story and the vision.

THE STORY

This book tells an unusual story: *a bunch of idealistic, clever guys set out to change the face of literature and civilization with a new computer program.* A computer program intended to make possible a new unified electronic literature, a computer program intended to re-kindle the freedoms of yesterday and extend them into the electronic future of tomorrow, a computer program intended to tie everything together and make it all available to everyone.

Project Xanadu is the name of this work, creating a framework for the new integrated literature of tomorrow; I and various intrepid colleagues have endeavored over long years to bring it to birth. From this group of idealists, and their years of thinking, talking and sketching, has come today's Xanadu™ hypermedia and hypertext system-- a unique new kind of computer program. Xanadu is a new way of organizing the storage of information; it makes possible a new form of literature; and its intended network might just revitalize human life. All this is embodied in an existing piece of software which we are trying to promote, sell and explain. We think that anyone who actually *understands the problems* will recognize ours approach as the unique solution.

THE VISION

There is a vision offered in these pages, simple, unified and sweeping: it is a unified concept of interconnected ideas and data, and of how these ideas and data may be published to the computer screen. Thus we propose two things: a simple-to-understand electronic publishing system for the world, and a new technical way of simplifying and improving the world's data storage. Both of these are easily described.

A) *A vision of electronic publishing.*

Here is the idea.

> At your screen of tomorrow you will have access to all the world's published work: all the books, all the magazines, all the photographs, the recordings, the movies. (And to *new kinds* of publication, created especially for the interactive screen.)
>
> You will be able to bring any published work to your screen, or any part of a published work.
>
> You will be able to make *links*-- comments, personal notes, or other connections-- between places in documents, and leave them there for others (as well as yourself) to follow later. You may even publish these links.

> Royalty to each publisher will be automatic, as materials are delivered over the network. Each piece delivered will be paid for automatically, from the user's account to the publisher's account, when the user receives the piece sent for.
>
> Any document may quote another, because the quoted part is brought-- and *bought*-- from the original at the instant of request, with automatic royalty and credit to the originator.

Some people call this vision crazed and "futuristic" (especially those who don't even try to understand it, or those who have no idea what is technically possible.) Others who are more technically sophisticated often criticize us from the opposite direction: they say it can't be so simple, that the world of tomorrow must be full of horrible complication. (Technical people have a great deal of trouble recognizing, and honoring, simplicity; and it is often hard for them to see the merit of a clean and simple arrangement that could benefit everyone.)

To some readers this may sound like many futuristic descriptions one hears about tomorrow's information world. But I believe the specific details of our plan are very different from those that are heard in talk-shows and written up in the public presses. Read our ideas and see.

Tomorrow's electronic publishing offers many new potential forms of imprisonment; some futurists seem to me to promote these eagerly. For instance, there are those who say electronic publishing will mean selling plastic disks, that electronic publishing will freeze the worst aspects of paper publishing, that the electronic publishing world will consist of highly-capitalized firms selling closed, separate and immutable documents to shallow and unsophisticated users.

Wrong on all these counts.

Electronic publishing will mean lower-capital entry (and thus smaller publishers), constant revisability of all documents with linked version update, and finally *open hypertext publishing*-- the growing-together of a great jungle of interconnections among symbiotic documents, under separate ownership, becoming inseparable from the greater whole. And it means building systems for a hypertext and hypermedia constituency whose apex will be the most sophisticated readership and usership civilization has yet seen.

Project Xanadu has long had as its goal the design and development of this publishing system, with automatic royalty on every fragment (and thus freedom to quote between documents without red tape).

Ours is a very specific plan, but so far it has been diabolically tricky to bring it about. Fortunately, no government money is needed, and no laws need to be changed. The system is intended to start on a small scale, with private funding, and grow fast.

This is an invitational plan. Everyone is invited to participate. We invite those who want to use the new service: readers, authors, editors, publishers. We also invite those who want to perform the new service, which will be a new kind of business in the world.

B. *Simplifying the world of data.*

The world of computer data has become tangled and complicated, a mess of disconnected files in which we all wallow today-- even privately, now, in our offices and homes. We propose a new technical way of simpifying that data.

This new way of handling information is to represent *its true interconnections*. We do this with the two forms of interconnection explained in this book: the **link** and

the **transclusion.***

The Xanadu project has been our ongoing struggle to represent this wide web of interconnection, of links and transclusions, in a network of computers.

WHAT HAS HAPPENED SINCE 1987

This book tells what the Xanadu group did before 1987: design software intended to achieve all this, then begin to program it. But the project took much longer than intended, as most software projects do. The version of the Xanadu program described in this book became finalized as a design in 1981, but we had a lot of trouble getting the long-designed software actually completed and running. Even in 1987, when last this book was put together, Project Xanadu had no money; we were hanging on desperately; the project was down to Roger Gregory (in California) and me (in Texas); I was making the speeches, Roger was working on the software. Many who knew us in those days laughed at us. I had at that time been out of the actual development of Xanadu for two years.

---

* "Transclusion" is the term I use now, a word coined since the book was originally written. Transclusion will be a fundamental service of tomorrow's literary computers, and a property of the documents they will supply. Transclusion means that part of a document may be in several places -- in other documents beside the original-- without actually being copied there. This book is concerned in large part with the power this new kind of writing-- with transclusive quotation-- will bring.

In the body of this book, written before I thought of the word "transclusion", I simply use the term "inclusion". I have regretfully left that as is. ***The concept is much better carried by the word "transclusion,"*** so try to say it under your breath when you see the other term.

A lot has happened since then.

The sophisticated computer world was astonished to hear, in 1988, the news that part of Xanadu had been acquired by Autodesk, Inc., of Sausalito. Long had the Xanadu group been called hopeless kooks; now, in what seemed to many a miracle, we were under the sponsorship of a fiercely successful company.

Autodesk's own history is remarkable.* From a partnership of programmers in Marin County less than a decade earlier, it had become a public corporation with roughly a thousand employees, all from the success of its program AutoCAD®, commanding half the world's market in programs for Computer-Aided Design. Thus Autodesk had the sophistication, depth and resources to back the Xanadream.

Under Autodesk's sponsorship, we managed to reassemble most of the 1979 team: Mark Miller as chief architect, Roland King and Eric Hill, as well as some extraordinary talent new to the group, superprogrammers Dean Tribble and Ravi Pandya, in cozy and well-equipped Palo Alto laboratories. We also had the unusual fortune to capture Marc Stiegler, a software manager best known for his hypertext science-fiction novel *David's Sling*.

At the time this book was first written, in 1981, I had been out of the Xanadu development for two years. By the time we received sponsorship in 1988, the technical guys did not particularly want me back. Thus your loyal author was given an elegant title and spacious office up in Sausalito, far north of Palo Alto, so he would not bother the developers too much. I had no influence on the team or on Mr. Stiegler, who was running it.

So for the last four years, 1988 to 1992, I have wandered the earth making speeches about all this, preparing the world for the revolution we intend to wreak, and seeking those software developers who want to use our mechanisms and/or join the dream. Though I had no influence on the team, I was their spokesman and salesman to the world. I repeatedly passed on to my listeners the programmers' promises of when something would be ready, always six months away.

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* Partly told in John Walker's *The Autodesk File* (New Riders Press, 1989; ISBN 0-934035-63-6).

THE PROTOTYPE FINISHED

The technical chapters of this book deal with the remarkable software this group designed before the Autodesk deal. This design was completed in 1981, and described in these pages in 1987; but because of all our difficulties it was not until late 1988 that the group, together once again under Autodesk sponsorship, completed the program described in this book. Thus it is now called the 1988 version of Xanadu.

Now came a hard decision. The software had to be redesigned for various reasons. The program we had was good, but in certain ways would be inadequate for the final purpose of the system, the world publishing repository. Should we sell this prototype, or press on to the more robust version?

It was a painful choice. We wanted to get the system out, to have our work appreciated, to have others begin to use our system and put our ideas to use. But to sell that prototype would mean maintaining it as a product. This in turn would mean putting together a whole new team to market and maintain the old product while we built the new one-- a division of effort we could not afford.

PRESS ON! was the decision. The prototype was filed away, and a total redesign began. With the same objective as before, the team had to start over.

For four years in Palo Alto (later Mountainview), the system was designed and redesigned by Miller, Tribble and Pandya. They say the new design is ready now--that is, ready to finish programming.

Four years of sponsorship was enough for Autodesk, and so now the Xanadu project is currently independent once again. As of this writing I am still at Autodesk, and the fate of the Xanadu project is uncertain. Resources are scarce but suitors are many. We will go on.

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* A functioning back and front end interconnected by the FEBE protocol as specified here.

THE NEW, 1993 DESIGN

The design now on the table has been under development since 1988, and was finalized earlier in 1992. But we call it the 1993 design because that is when we expect it to be finished.

The objective of the new design is just what it always was: a highly general program for keeping track of interconnections, intended to form the building block of the world publishing repository we have described. But for robustness and to meet other criteria, a deeper redesign was needed.

Designing for the large-scale network was an especial difficulty. A different kind of server could have been designed for local service, but the group chose to take the time necessary for the global networking design.

So this new 1993 design has new internal data structures, new modularities, new internal boundaries. It has new features and a somewhat different protocol. All these matters will be revealed when the product specifications are revealed to the world. At this writing the program actually exists and awaits considerable consolidation, performance improvement and ruggedizing.

There are those software designers who say they can do better than Xanadu. They say Xanadu is too cumbersome, too heavy a system. They think they can do better if they just *leave out* a little something from the Xanadu design.

This is failing to understand the problem. There are right and wrong designs for things. For example, the correct number of wheels on a car is *four*. To leave the left rear wheel off the car may save money, but its performance will be considerably impeded.

Similarly, a hypermedia server without generalized links, transclusion or versioning can perform only small and shallow functions. And electronic publishing *without transclusion* is retrograde. (Other designers may think they can design without these features, then add them later. But that kind of designing does not work.)

---

* Just as the design completed in 1981, and described in this book in that year, is referred to as the "1988" system because that is when the implementation was completed.

THE FORTHCOMING PRODUCT

The development team expects to bring out in 1993 the Xanadu™ server program, a network storage program delivering data on request to users and their applications. This will not just be a conventional file server, dishing up text, graphics and other data; it will also manage connections and history. Thus I call it a *connection-and-history server*. It will run on a network, supplying application programs-- if they are set up for it-- with all forms of data and connective information. It will be an industrial-grade office product, running on the 386 PC, the Mac and of course the Sun (on which it was developed).

The computer world is waiting for the marketed Xanadu product. Many wait with interest to see whether it works. Others wait to see how well it performs on today's generation of hardware.

No one waits more breathlessly than I, thirty-two years now since the original idea.

BEYOND NAMES, COMPANIES AND PRODUCTS

In this book I am proud to tell you how far we have come in a very difficult, risky and improbable plan. And I am proud of the brand name associated with it (though the name "Xanadu" has both a magic and a curse; in the film "Citizen Kane" it referred to the never-finished palace of the protagonist.)

But the Xanadu program will soon descend from legend and vaporware to shelf space, becoming a commercial product, in some ways like any other: advertised, marketed, compared with others; a hostage to fortune, intertwined with the policies and situation of a specific company. In some ways this is dismaying to me, since Xanadu has been so long a crystal dream above market and corporate turmoil.

There are those who say that I should now personally distance myself from this product. After all, it is over a decade since I had any influence over the way it was programmed; anything could happen to Xanadu now. And that is true. It might not work. It might be too slow. New corporate sponsors might want it changed in some way that snuffs out the original idea.

But if I were going to quit out of worry, I would have done it long ago. I have committed thirty years of my working life to this project, under this name, and I am not about to slacken this commitment. I haven't come this far to quit.

Yet it is indeed time to separate some of the ideas of this book from the name of Xanadu. These are the ideas that need to be understood for themselves: the ideas of open hypertext publishing, of a unified on-line docuverse, and perhaps most important, of *transclusion* as the central means for organizing our work, clarifying the work of others, and cleaning up copyright.

These ideas are having impact around the world now. They are out there by themselves, unowned and without trademark, inveigling their way into more and more minds. In the long run it may simply be these ideas, under whatever names, that determine the world's informational future.

But I pray that the particular product we have worked on so long will do all the things we have designed it to do. Extraordinary people have created it, and the depth of their design embodies these ideas uniquely. Even more, I have even greater confidence in the people around the world whose minds have caught fire from our idea, and who are also committed to making it happen.

Most of all I have confidence in an idea whose time has come. I look forward to writing a new book about the delivered Xanadu product.

And so I close with our traditional toast:

Next year in Xanadu.

Theodor Holm Nelson
Distinguished Fellow, Autodesk, Inc.

Sausalito, California, November 1992

ERRATUM; AND A NOTE ON THE TERM "INTERACTIVE MULTIMEDIA"

Somewhere in this book, I say that I don't know who coined the term "hypermedia." At the time I wrote the book, I had forgotten. But a reader called me and pointed out that the word actually appeared in my 1965 paper, "A File Structure for the Complex, The Changing and the Indeterminate;" I coined the word myself, and first published it in that article, where I also first published the word "hypertext."

By now the word "hypertext" has become generally accepted for branching and responding text; but the corresponding word, "hypermedia," meaning complexes of branching and responding graphics, movies and sound-- as well as text-- is much less used. Instead they use the strange phrase "interactive multimedia"-- four syllables longer, and not expressing the idea that it extends hypertext.

Why? "Multimedia" is a resurrected term from the sixties, when it meant *slide-shows with sound.* Why bring back such an irrelevant term?

Perhaps because the people who say "interactive multimedia" want it to sound like something new and surprising that nobody had thought of until just recently. To use the term "hypermedia," which has been around for twenty-five years, implicitly acknowledges that someone foresaw these matters when the word was first published. This is precisely the sort of thing that people using the term "interactive multimedia" do not want to acknowledge.

In any case, the best possible way to organize and deliver hypermedia, or whatever you want to call them-- interactive complexes of graphics, text, audio, video, film-- will be that most generalized interconnection system, the Xanadu server.

This book is a hypertext, or non-sequential piece of writing.

It is partly *about* hypertext, or non-sequential writing, and using a hypertext form will, I hope, help communicate some of the benefits of such writing.

PLAN OF THIS BOOK

There is a Chapter Zero, several Chapters One, one Chapter Two, and several Chapters Three.

It is suggested that you read Chapter Zero first; then any of the introductory Chapters One; and then Chapter Two, which is the heart of the book. (Because Chapter Two is long and sequential, its parts are numbered. Other sections of the book are not numbered because they are not, in principle, sequential.) You may or may not feel that you understand it fully.

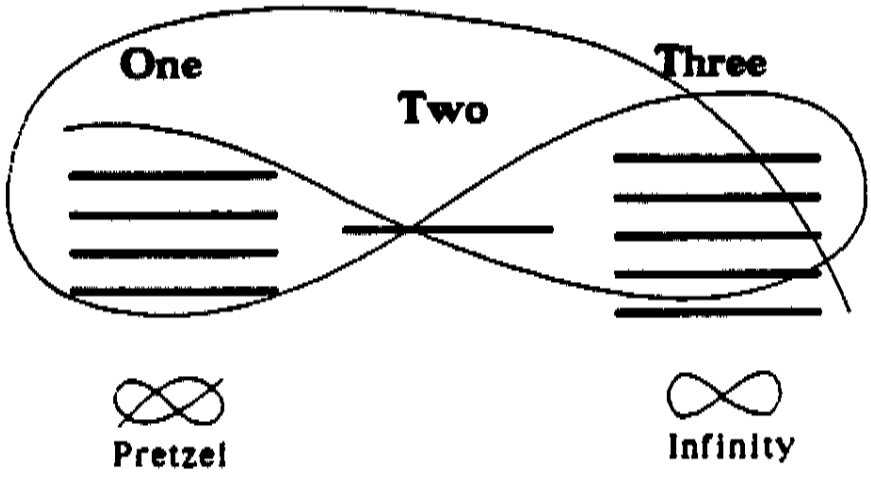
It is suggested that you then read one of the closing chapters. This will help you see what the future of the system is supposed to be about.

At this point it is suggested that you read another of the introductory Chapters One, and look over Chapter Two again. You will almost certainly understand it better.

Continue in this vein, passing repeatedly through Chapter Two, until you understand this book.

Pretzel or infinity. It's up to you.

There are also several Chapters Four, which deal with certain technical aspects of the system, and several Chapters Five, which deal with certain business aspects. No instruction for reading these chapters is provided.



Whenever a work's structure is intentionally one of its own themes, another of its themes is art.

Annie Dillard

1981 DEDICATION

This book, and the system it foretells, are dedicated to

Eric Blair (1903-1950)

better known by his pen-name

"GEORGE ORWELL;"

an acute, sad and bitter observer and prognosticator
who understood tyranny perhaps better than any tyrant,
who understood information control
long ahead of the rest of us;
and who left us cunning, elegant and timely warnings.

Somehow many take his name to stand for
all that he despised;
so that the word "Orwellian,"
meaning tyrannical, oppressive, mind-controlling,
and futuristically threatening,
is itself the perfect example of the twisted Newspeak he foresaw.

**May his simple, honest, angry devotion
to truth and human freedom
live forever.**

1987 DEDICATION

This book in its present version is dedicated to

DOUGLAS C. ENGELBART,

visionary of what he calls
The Augmentation of Human Intellect by Computer;
and, as part of that, the inventor of what we now call
"Word Processing,"
"Outline Processing,"
"Screen Windows,"
the mouse;
and (what this book is largely about)
THE TEXT LINK;
a man whose warmth and gentle determination
are an inspiration to all who know him.

**May his simple, honest, saintly devotion
to the uplift and empowerment of the human mind
live forever.**

Posterity is the religion of the intellectuals.

Woody Allen

Words without thoughts
never to Heaven go.

Hamlet

Litera scripta manet.
(The written word remains.)

Horace

Extremism in the defense of liberty
is no vice.

Barry Goldwater

Give me a lever long enough
and I will move the world.

Archimedes,
as generally misquoted

Toto, something tells me
we're not in Kansas anymore.

Dorothy
(The Wizard of Oz,
MGM version)

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TECHNICAL CHAPTERS FOUR

BUSINESS CHAPTERS FIVE

AFTERCHUNKS

CHAPTER ZERO
(added for Edition 87.1, May 1987)

HYPERWORLD

All men dream, but not equally.
Those who dream by night,
in the dusty recesses of their minds,
wake in the day to find that it was vanity.
But the dreamers of the day are dangerous men,
for they may act their dreams with open eyes
to make it possible.

T. E. Lawrence

HYPERMEDIA AT LARGE

Suddenly, everyone is talking about hypertext. You hear the word on every side. At a conference in March 1987 I overheard the word nine times walking through the lounge.

Similarly, in the new area we may call Interactive Show Biz--where they are now creating branching videodiscs and other interactive productions--the word of the hour seems to be "hypermedia."

I am bemused by this, and find it somewhat ironic. I coined the term "hypertext" over twenty years ago, and in the ensuing decades have given many speeches and written numerous articles preaching the hypertext revolution: telling people hypertext would be the wave of the future, the next stage of civilization, the next stage of literature and a clarifying force in education and the technical fields, as well as art and culture. Same for "hypermedia" (a term first published somewhat later).

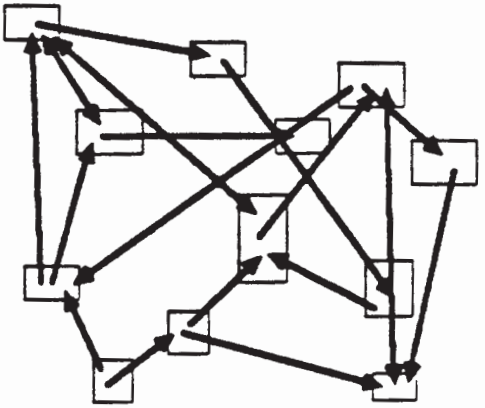
For years I got the impression that no one had heard or read any of this at all. And now, abruptly, it seems that many people did indeed hear, and many have begun to agree. (The first hypertext conference not my own doing is scheduled for November 1987.) The strange thing is that all this took so long and then happened so suddenly.

But what is it all about?

Well, by "hypertext" I mean *non-sequential writing*--text that branches and allows choices to the reader, best read at an interactive screen.

As popularly conceived, this is a series of text chunks connected by links which offer the reader different pathways.*

"ORDINARY" HYPERTEXT



*This is the structure, for example, of the "Notecards" system, programmed by Frank Halasz and Randy Trigg at Xerox Palo Alto Research Center and offered by Xerox on its D-class computers. It is also the structure offered on the Hypertext Abstract Machine under development at Tektronix by Mayer Schwartz and Norm Delisle.

I will not argue with this definition here, but I hope it will become clear throughout the book how much more I think hypertext can be.

MOST GENERAL WRITING

Hypertext can include sequential text, and is thus the most general form of writing.* Unrestricted by sequence, in hypertext we may create new forms of writing which better reflect the structure of what we are writing *about*; and readers, choosing a pathway, may follow their interests or current line of thought in a way heretofore considered impossible.

This generality is a vital aspect of the idea. Because computer text systems are in a calamitous state.

The world of paper is at least unified and compatible. Objects can be easily mixed and matched. Books, manuscripts and notes can be stored on the same shelf, opened on the same desk. You need not start up, initialize or insert a disk before opening a magazine.

But now enter the world of computer text systems. There is "word processing" and "outline processing," "teleconferencing," "networks," bulletin boards, "videotext" (in whose name true atrocities have been proposed), electronic mail, version control systems, pop-up note pads, electronic sticky notes, and now various systems called "hypertext."

Even among nonlinear text systems, quite a variety are now available for the desktop computer. They variously offer jumps around text, outlining and text expansion; the ability for different users to put separate notes onto linear documents; the categorization of messages according to social-strategic type (inquiries, commitments, fulfillments).

This variety of innovations is laudable. The dark side, however, is the general incompatibility of it all. These colorful and varied facilities cannot be combined or used at the same time, let alone have their contents easily shared and combined and displayed side-by-side. No longer on the same shelf, these things must be turned on differently, at different times, used on different computers and stored on different disks--and the user typically must *keep paper notes* as to their particulars. Not only the different kinds of disks must be saved, and directions as to their use, but also *papers to tie them all together.*

At least there is a background sense of openness and pluralism. Though incompatible, the different text systems have a point of view in common: that the different contributions of different users are important, and so they offer new pluralistic styles based on many people adding to the body of writing. The initiatives and contributions of many peole are assumed to be worthwhile.

*In one direction of generalization, it is also the most general form of language.

But there is at present no way to gather, and save, and publish, the many documents and scraps that people are writing on screens and sharing through an immense variety of incompatible systems.

Such incompatibilities are only one aspect of the dismal state of the computer field.* The computer, and now the personal computer, have opened whole new realms of disorder, difficulty and complication for humanity. With so-called "computer basics" and so-called "computer literacy," beginners are taught a world of prevailing but unnecessary complication. Nearly everything has to be fitted into oppressive and inane hierarchical structure and coded into other people's conceptual frameworks, often seeming rigid and highly inappropriate to the user's own concerns. The files in which we must keep things on conventional computer systems are detached from their relationships and history, and (for many if not all users) entwine like wire coathangers in a tangle of unknown relationships and increasing disorder.

MORE GENERAL HYPERMEDIA

In the realm of the more high-bandwith hypermedia--interactive movies, graphics, sound and music--even more confusion reigns. There is great momentum behind interactive videodisc, especially things called CD-ROM, CDI and DVI. These have not caught on or even been seen, but they are being pushed by Big Corporations with Big Track Records.

Supposedly when they come out these media will be mass-marketed disks, sold only in a final form, and thus, like phonograph records, delivered by the Information Lords to the Information Peons. This is rather unlike the prevailing thought among computer-text-system people, where everyone's contribution is thought to be valued.

Some people like all this incompatibility and complication, and say it is the new world we must learn to live in. Others, already hating computers, correctly dread these matters and hope vainly to stop the computer tide. I propose a third approach: to unify and organize in the *right* way, so as to clarify and simplify our computer and working lives, and indeed to bring literature, science, art and civilization to new heights of understanding, through hypertext.

As the most general form of writing, hypertext will not be "another type" of obscure structure, but a framework of reunification. (Note that in the original hypertext system of Douglas Engelbart, who invented electronic text systems, it *was* all together; it is the others who have torn it all apart into incompatible pieces.)

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*For continuing remarks in this vein, see my book *Computer Lib*, second edition from Microsoft Press, fall of 1987; especially the early chapter, "A Field of Rubble."

For I believe that the potential for a new Golden Age, through such a unification of electronic text systems, lies before us, and just in time, too.

PROJECT XANADU

Project Xanadu, which this book is about, has been a long-term venture to develop a hypertext system to support all the features of these other systems, and many more. Project Xanadu began in the fall of 1960,* and put a prototype on line for experimentation in January of 1987. We hope to offer a commercial version in 1988, at three levels: a single-user version; a network server for offices; and a public-access system to be franchised like hamburger stands. All this will be discussed later.

The reason it has taken so long is that *all* of its ultimate features are part of the design. Others begin by designing systems to do less, and then add features; we have designed this as a unified structure to handle it all. This takes much longer but leads to clean design.

The problem is not hardware. It is *generalized, clean software design.* And when the problems above, in their generality, become clear to others, we think they will see that it makes much more sense to adopt an existing, unified solution than to keep nailing features where they weren't originally planned.

THE STRUCTURE

The Xanadu system is a unique form of storage for text and other computer data. The system is based upon one pool of storage, which can be shared and simultaneously organized in many different ways. This makes it possible easily to *make new things out of old*, sharing material between units. Described simply:

> all materials are in a shared pool of units, but every element has a unit in which it originated;
>
> new units can be built from material in previous units, in addition to new material;

---

*This is the first hypertext system to be so called (though Engelbart's NLS system at Stanford Research Institute was *really* the first hypertext system).

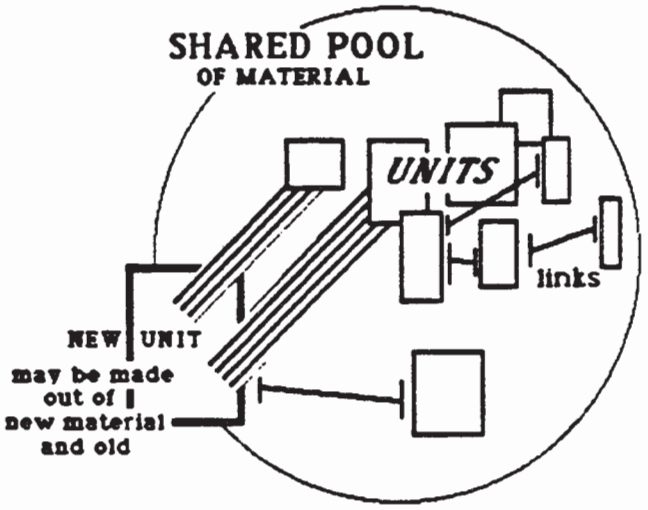
After approximately fifty man-years of effort, the Xanadu program is operational in prototype and available for experimentation at the end of a phone line. The back-end program presently runs on a Sun Workstation under Unix. It is written in C and presently (May 87) compiles to about 137K of 68000 native code on the Sun. This does not include buffer space, of which the more the merrier (1 megabyte and up recommended).

Front-end programs should include our protocol manager, a module which handles sending and receiving in the FEBE(tm) Front End-Back End protocol. It presently compiles to about 30K on the Sun.

there can be arbitrary links betwen arbitrary sections of units.

We call this "xanalogical storage" (not a trademark).*

XANALOGICAL STORAGE



There are three basic relationships in xanalogical storage: *origin*, the parts where elements begin; *commonality*, the sharing of elements between units; and *links*, which mark, annotate and connect portions of units.

Explaining and exploring this, and our particular methods, will take the rest of the book, especially Chapter Two and the Chapters Four.

THE ASPIRATION

The Xanadu system, designed to address many forms of text structure, has grown into a design for the universal storage of all interactive media, and, indeed, all data; and for a growing network of storage stations which can, in principle, safely preserve much of the human heritage and at the same time make it far more accessible than it could have been before.

From this you might get the idea that the Xanadu program is an enormous piece of software. On the contrary: it is one relatively small computer program, set up to run in each storage machine of an ever-growing network.

And rather than having to be run by the government, or some other large untrustworthy corporation, it can be dispersed under local ownership to serve entire nations and eventually the world.

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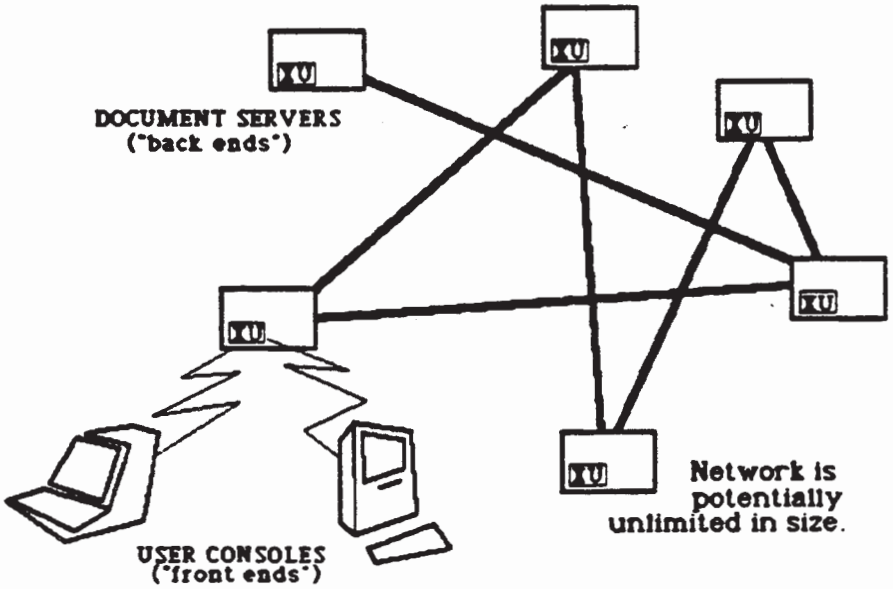
*Just as Xerox Corporation created the term "xerography" as a generic term for its new type of copying, we propose this as a generic for our new conceptual structure of storage. The *particular* way we do xanalogical storage will be discussed in excruciating detail later.

A SINGLE PROGRAM, RUNNING THROUGHOUT A NETWORK

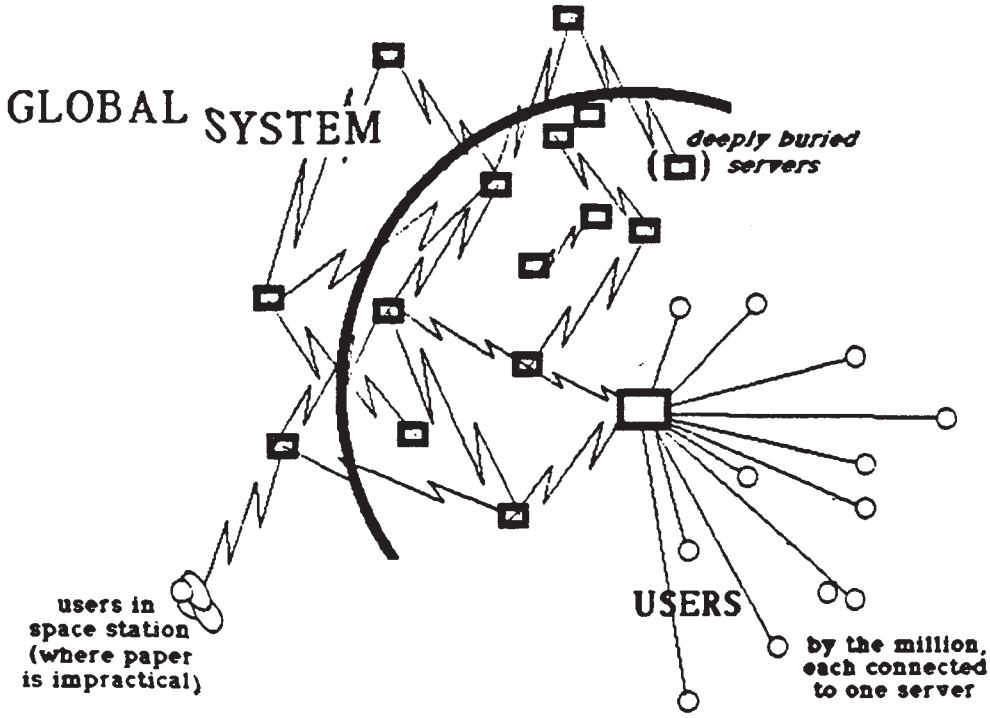


THE SMALL IMPORTANT USES

The sweeping character of Project Xanadu has sown confusion: because of its long-term ideals, its immediate uses in miniature have not been noticed by many people.

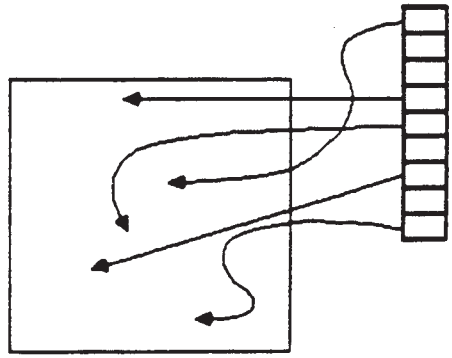
Because the system is based upon one pool of storage which can be shared and organized in many ways, materials can be reorganized constantly without losing their *previous* organiztion.

LITERARY 0/7 MACHINES



REORGANIZATION IN PLACE

This means that all materials--whether they are bodies of writing, computer files, company records--can become better and better organized, in ways which better and better reflect their true structure. Thus order becomes *cumulative*--unlike most computer systems, in which *dis*order easily becomes cumulative.



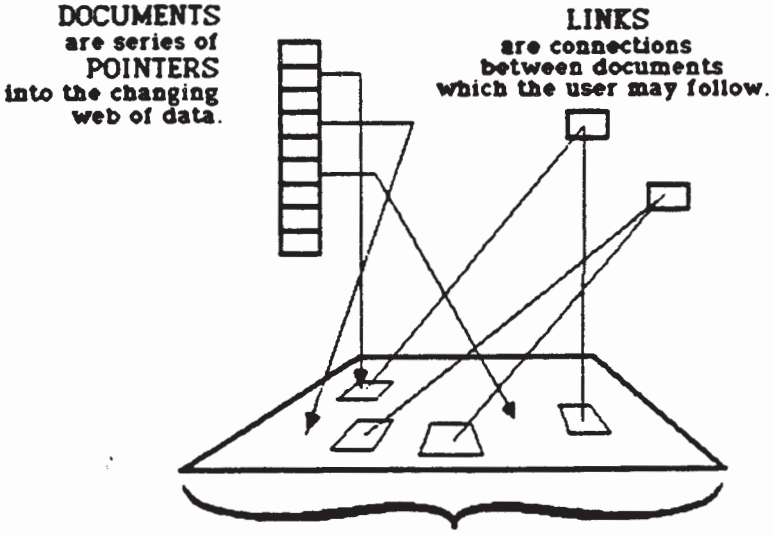
LITERARY 0/8 MACHINES

For a single computer user or office, this new form of storage creates a unified storage structure for all text and numerical information, without the proliferation and scattering of detached files whose origin and meaning become lost.

THE STRUCTURE EXPLAINED

And it is this same structure of continually reorganizable materials, in a stored pool, that we propose as a public utility for the storage of personal and

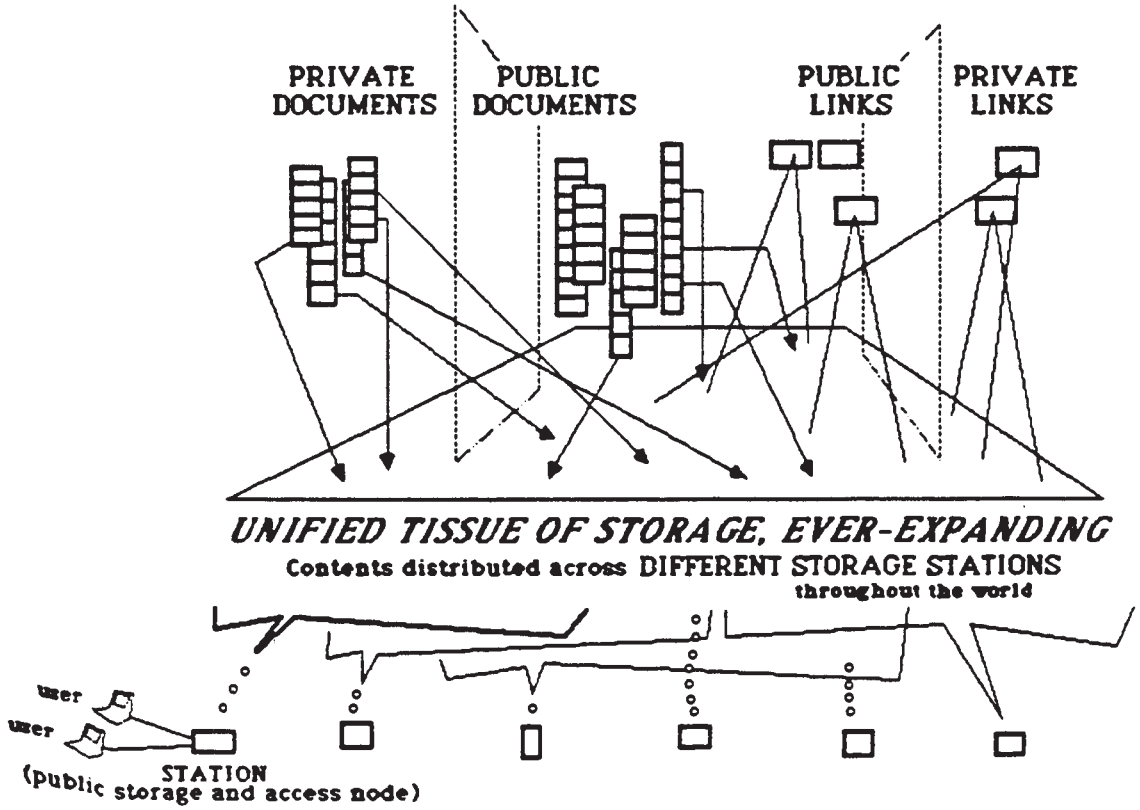
IMPROVED ORGANIZATION FOR SINGLE USER OR OFFICE



company information. Why should any individual have to worry about the safety of all those floppy disks--let alone lose precious family photographs--when they can be safely stored in a public utility? Just as the "Mini Self-Storage" facility now proliferates across the country, this will be a public-access facility for recordings, writings, pictures, audio and video and movies, and whatever other data people want to use it for.

PUBLIC REPOSITORY SYSTEM WITH PLURALISTIC RE-USE,

publication by users



LITERARY 0/10 MACHINES

Just as the small system promotes cumulative order, the larger system promotes the coexistence and resolution of many viewpoints, through the sharing of private documents and comments, and the publication of hypertext complexes *whose interrelationships remain orderly.*

"THE FUTURE IS NOT WHAT IT USED TO BE"

Envision the world of the future (say, the year 2020, a convenient time when talking about vision). It is not a pretty place.

There is every reason to suppose that even if humanity survives the next century, it will be in ever-more horrific circumstances, a dungheap, more and more filled with spreading slums--the *favelas* of Brazil, the *barrios* of Mexico, the South Bronx of New York; the natural world in retreat, the jungles turning to desert and today's deserts growing, the waters poisoned and growing areas of land turned unsafe by chemicals.

None of this can be stopped. But there is some hope in the realm of human mental affairs, upon which the survival of humanity, and the better parts of human culture, depend.

For facilities to aid the mind, and share its products, have reached a new richness. But they must become unified and available to all, quickly.

THE CRYSTAL PALACE

We stand at the brink of a new age, a new time, when the handling of the written word will change very deeply, and civiilization will change accordingly.

Electronic networking and publishing already come in many flavors, but in a chaotic and Balkanized fashion. A universal repository hypertext network will change that: it will make stored text and graphics, called on demand from anywhere, an elemental commodity, like water, telephone service, radio and television.

Offices will be paperless, as soon as people figure out what this means. (Hint: new ways of structuring to map the *true* connections of documents.)

Education, now pressing in new and uncertain directions, can leap forward into new curricular structures that eliminate sequence and promote initiative and understanding.

And publishing--ah, consider what publishing will become.

Paper printing will soon be prohibitive: not only the cost of the paper, but the increasing cost of its transportation (from forest to mill to printer to warehouse to the bookstore/newsstand to consumer), spell the phasing out of print. But electronic repository publishing can replace that.

A NEW UNIVERSAL MEDIUM

There is an alternative. That is to create a system that unifies the others, providing both a form of storage and an indexing system for storage that is now in place--and a new layer of user ease. An open hypertext network. (For the meaning of "open hypertext," see "The Problems of Hypertext," a Chapter Three.)

As a new layer able to create compatibilities between existing sytems, it will tear down the walls (many of which were put there intentionally by certain companies). It can recombine what should never have been separate: "word processing," "outline processing," teleconferencing, "electronic mail," electronic publishing, archiving.

Such a system will represent at last the true structure of information (rather than Procrustean mappings of it), with all its intrinsic complexity and controversy, and provide a universal archival standard worthy of our heritage of freedom and pluralism.

Publishing in the new medium will be the storage of text (and other material) in repositories. Readers will call what they want to their screens as easily as turning pages.

And such a simplification is what everyone is yearning for.

Actually, the best comparison is the phone system--in its simplicity, universality, clarity and fundamental character.

What will happen to existing institutions is by no means clear; libraries, the schools, publishers, advertising, broadcast networks, government, may all try to fight these developments; which could impede progress for a while, but not indefinitely. Or they may recognize in them the new shape of their proper work.

THE 2020 VISION

Forty years from now (if the human species survives), there will be hundreds of thousands of file servers--machines storing and dishing out materials. And there will be hundreds of millions of simultaneous users, able to read from billions of stored documents, with trillions of links among them.

All of this is manifest destiny. There is no point in arguing it; either you see it or you don't. Many readers will choke and fling down the book, only to have the thought gnaw gradually until they see its inevitability.

The system proposed in this book may or may not work technically on such a scale. But some system of this type will, and can bring a new Golden Age to the human mind.

WE NEED YOU

The Xanadu group still needs brilliant people looking for adventure and a challenge, long hours, low pay, accidental food, and a small chance of fame and fortune. We have to save mankind from an almost certain and immediately approaching doom through the application, expansion and dissemination of intelligence. Not artificial, but the human kind. To humankind.

HYPERTEXT

Spoken language is a series of words, and so is conventional writing. We are used to sequential writing, and so we come easily to suppose that writing is intrinsically sequential. It need not be and should not be.

There are two outstanding arguments for breaking away from sequential presentation. One is that *it spoils the unity and structure of interconnection.* The other is that *it forces a single sequence for all readers which may be appropriate for none.*

1. *Spoiling the Unity and Structure*

The sequentiality of text is based on the sequentiality of language and the sequentiality of printing and binding. These two simple and everyday facts have led us to thinking that text is intrinsically sequential. This has led to the fallacy that presentation *should* be intrinsically sequential. Marshall McLuhan even put this fallacy at the center of European thought, and perhaps he was right, perhaps it is.

But sequentiality is not necessary. A structure of thought is not itself sequential. It is an interwoven system of ideas (what I like to call a *structangle*). None of the ideas necessarily comes first; and breaking up these ideas into a presentational sequence is an arbitrary and complex process. It is often also a destructive process, since in taking apart the whole system of connection to present it sequentially, we can scarcely avoid breaking-- that is, leaving out-- some of the connections that are a part of the whole.

Of course, we do this kind of simplifying sequential breakdown all the time, but that doesn't mean we *should*, it just means we *have to.*

(Some thinkers, of course, really *do* believe that certain of their ideas are primary and that the rest follow from them, and that's fine. I criticize merely the presumption that all systems of thought have an intrinsic sequence, or should be made to.)

2. *Forcing Simple Sequence Inappropriate for All Readers*

People have different backgrounds and styles (as I said of the Noids and Fluffies in Chapter 1.3). Yet sequential text, to which we are funneled by tradition and technology, forces us to write the same sequences for everyone, which may be appropriate for some readers and leave others out in the cold, or which may be appropriate for nobody. (This book, too, is hardly everybody's cup of tea, since there is not very much *choice* among its sequences.)

Thus it would be greatly preferable if we could easily create different pathways for different readers, based upon background, taste and probably understanding. Now, in normal circumstances this is handled by writing different articles (and books) about the same subject, and publishing them in different places (or ways) for different audiences. This will give readers many choices in approaching the same work.

In the computer world this will change, especially if-- as I foresee-- there will be one great repository, and everything will be equally accessible. This means that "different" articles and books will more likely be *different versions of the same work*, and *different pathways through it for different readers*.

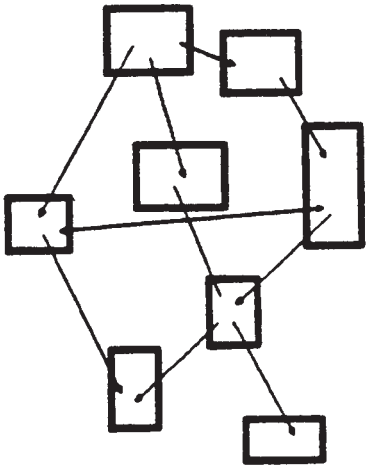
THE ALTERNATIVE: NONSEQUENCE

Nonsequential writing on paper can be all sorts of things-- magazine layouts, funny arrangements of poetry, pieces of writing connected by lines, or many other things.

As we go in this century from paper to the computer screen-- and tomorrow's computer screens will have the richness and resolution of paper-- all these nonsequential forms, and more, are possible. And we must discover and invent them.

Some are obvious. The most obvious is that which simply connects chunks of text by alternative choices-- we may call these *links*, of which more later-- presented to the user. I call this simply *chunk style hypertext*. The user, or reader, moves through it by reading one chunk, then choosing the next.*

CHUNK STYLE HYPERTEXT



Another form of text that is becoming increasingly important is *compound text*, where materials are viewed and combined with others. (This term too has recently become common.) A good way of visualizing this is as a set of windows to original materials from the compound texts themselves. Thus I prefer to call this *windowing* text.

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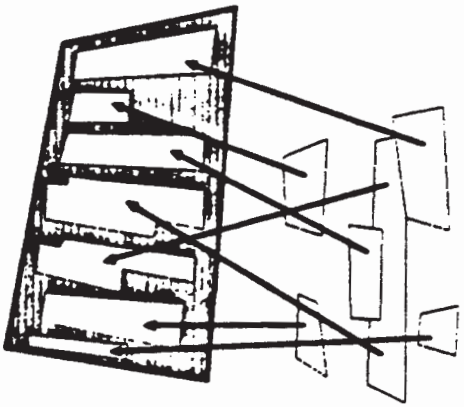
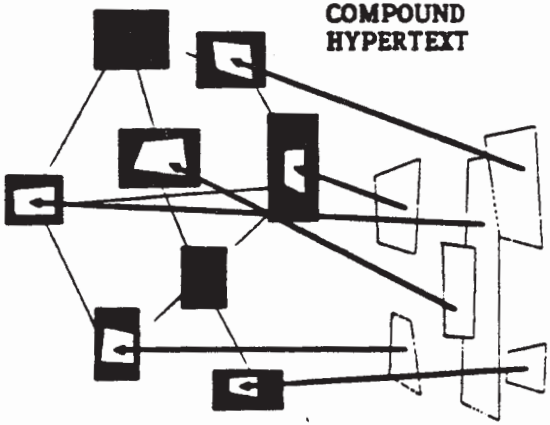
*Note that if the connections to be followed are given different types, we may call these *colored links*. (This is the mathematical usage, where connections are called "colored" if they are of different types.)

WINDOWING OR
COMPOUND TEXT



Extending the notion slightly, we get *windowing hypertext*-- where nonsequential writings-- hypertexts-- window to other stored materials.

COMPOUND
HYPERTEXT



It is this notion, then, of windowing or compound hypertext-- which we foresee as the vital and basic new information system of the future-- that has charged and inspired the present work.

Unfortunately, for thousands of years the idea of sequence has been too much with us,* because nothing else has been practical; and indeed, creating a system subtle and profound enough to meet our real needs has proven to be an extensive task indeed.

The structure of ideas is never sequential; and indeed, our thought processes are not very sequential either. True, only a few thoughts at a time pass across the central screen of the mind; but as you consider a thing, your thoughts crisscross it constantly, reviewing first one connection, then another. Each new idea is compared with many parts of the whole picture, or with some mental visualization of the whole picture itself.

It is the representation of whole structures of ideas, and placing them on the page for others to understand, that we call *writing*. Writing is the representation and the presentation of thought.

(So are pictures and diagrams; but they are intrinsically nonsequential, and so not relevant to the present argument.)

---

*Except for the Talmud. This is an extraordinary hypertext, a body of accumulated comment and controversy, mostly on the Torah (the Hebrew Old Testament) and on life in general, by Jewish scholars of old. It has been accreted over centuries with commentaries on commentaries. This hypertext is a fundamental document of Jewish religion and culture, and the Talmudic scholar is one who knows many of its pathways.

HYPERTEXT DEFINED

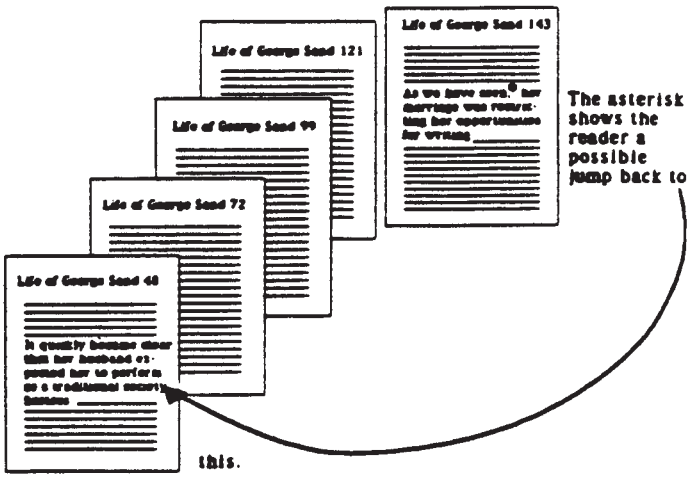
By hypertext I simply mean non-sequential writing. A magazine layout, with sequential text and inset illustrations and boxes, is thus hypertext. So is the front page of a newspaper, and so are various programmed books now seen on the drugstore stands (where you make a choice at the end of a page, and are directed to other specific pages).

Computers are not intrinsically involved with the hypertext concept. But computers *will* be involved with hypertext in every way, and in systems of every style. (Ideally, you the reader shall be free to choose the next thing to look at-- though repressive forms of hypertext do turn up.)

Many people consider these forms of writing to be new and drastic and threatening. However, I would like to take the position that hypertext is fundamentally traditional and in the mainstream of literature.

Customary writing chooses one expository sequence from among the possible myriad; hypertext allows many, all available to the reader.

In fact, however, we constantly depart from sequence, citing things ahead and behind in the text. Phrases like "as we have already said" and "as we will see" are really implicit pointers to contents elsewhere in the sequence.



WHAT'S HARD ABOUT WRITING

There are basically two difficulties in writing sequential text: deciding on sequence-- there are so many possible connections!-- and deciding what's in and out. Both of these problems go away with hypertext. You no longer have to decide on sequence, but on *interconnective structure*, which provides much greater flexibility. You no longer have to decide what's in or out, but simply where to put things in the searchable maze.

WHAT'S TRICKY ABOUT READING

In reading works of non-fiction, the active reader often skips ahead, jumps around, ponders about background material. These initiatives are useful and important; if we provide pathways to help active reading, it will be possible to enhance initiative and speed comprehension.

TWO STYLES OF HYPERTEXT ORGANIZATION

1. *Presentation and Effect*

One style of hypertext organization is based on its possible effect on the reader. The connective structure is a system of *planned presentations* which the reader may traverse. Variant sequences and alternative jumps will be contrived for how they look, feel and get ideas across.

2. *Lines of Sructure*

The other style of hypertext organization is based on simply representing the structure of the subject, with possible directions of travel mapping the relations in the network of ideas being presented. The internal relations of the subject are thus represented in the connective relations of the hypertext. This is simpler than calculating the effect on the reader, since the author is only concerned with analyzing and representing what the structure really *is*, and the reader is exploring the structure as he or she explores the text.

Actually, both styles of organization will probably blend, since the ideal presentation will follow lines of structure, and the mere representation of structure will presumably need enhancement by showmanship.

THE PROBLEM OF ORIENTATION

There are tricky problems here. One of the greatest is how to make the reader feel comfortable and oriented. In books and magazines there are lots of ways the reader can see where he is (and recognize what he has read before): the thickness of a book, the recalled position of a paragraph on the left or right page, and whether it was at the bottom or the top. These incidental cues are important to knowing what you are doing. New ones must be created to take their place. How these will relate to the visuals of tomorrow's hot screens is anybody's guess, but it is imperative to create now a system on which they may be built.

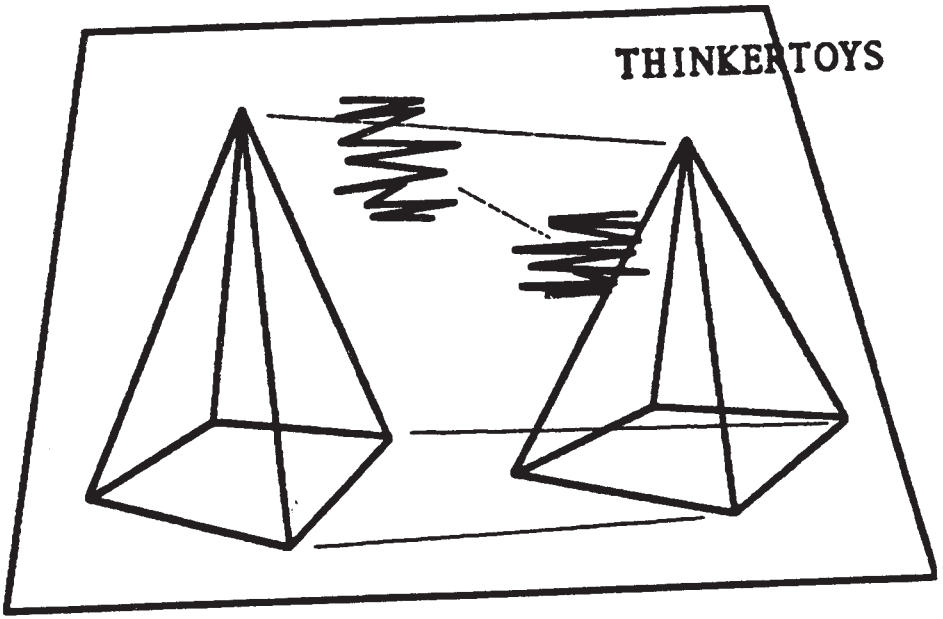
THE IMPROVED REPRESENTATION OF THOUGHT

It is my belief that this new ability to represent ideas in the fullness of their interconnections will lead to easier and better writing, easier and better learning, and a far greater ability to share and communicate the interconnections among tomorrow's ideas and problems. Hypertext can represent *all* the interconnections an author can think of; and compound hypertext can represent all the interconnections *many* authors can think of, as we shall see.

THINKERTOYS

This work began in 1960 with the problem of intercomparing complex alternatives-- of looking at two alternative structures, paragraphs or arrangements on the screen side by side, and noting in detail their differences and advantages.

Such intercomparison systems, I still believe, will become a vital aspect of our working lives-- once they are easy to use. I do not know of anything on the market yet that does this.



CHAPTERS ONE

[Introductory Chapters]

An Obvious Vision

Computers do what we request them to do, some ”technoids“ mislead the world pretending the way computers are now is they ”nature.“ We should use computers to assist us on our daily lives. We should be able to read from vast libraries of interconnected writings and ideas on the computer's screens.

Hope 1: Simplicity

Things are getting more and more complicated, instead of being simplified. The computer world lacks a sense of urgency about this.

> No Computer school teaches simplicity. Is it beneath them? Or do they simply not imagine it, believing that to teach Complication is their job? [p. 1/3]

Simplicity is the result of hard work on good unified design. Design begins with the seeming of the intended system.

Hope 2: Access to Ideas

Access to ideas should be generalized. There should be a rebirth of the traditional American ideals of liberty, pluralism and accessibility of ideas.

> Imagine a new accessibility and excitement that can unseat the video narcosis that now sits on our land like a fog. Imagine a new libertarian literature with alternative explanations so anyone can choose the pathway or approach that best suits him or her; with ideas accessible and interesting to everyone, so that a new richness and freedom can come to the human experience; imagine a rebirth of literacy. All that is what this book is about. [p.1/4]

[Precedents]

This book is a new, computerized form of the Memex proposed by Vannevar Bush. It bases also upon the work of Doug Engelbart, that not only invented word processing and the mouse, but hat also a vision of instant text access on screens.

The Sense Of Wonderful Developments

Some new technologies are available such as videotext, videocable, networks (ARPANET, USENET, Compu-Serve). They are complicated and incompatible. It is clear that the future of the written word is electronic publishing, but it is unclear what it will look like. This book proposes a unified, simple approach to this.

I believe there exists a clean, complete and thorough solution. And that is what will be described here. [p. 1/10]

Two Cultures Face The Future

The two opposing cultures stressed by C. P. Snow, humanities and technology, share a false notion of computers as being inhuman and reductionist, even though the later endorse and the former dismiss it. Let us call them the ”fluffies“ and the ”noids.“

The ”noids“ have a rigid and punitive notion of ”logic,“ they love intricacies and complication and are inhuman.

My favorite example is the typical Technoid insistence that you can't type a number into a computer using the letter Oh, you have to use the numeral Zero, because otherwise it isn't Logical. This despite the fact that a computer can easily be programmed to recognize that when you type Oh in the middle of a number you mean Zero, just the way a program can distinguish between a decimal point and a period, or a hyphen and a minus— contextually. [p. 1/11]

The ”fluffies“ do not understand computing at all, despite its importance for literature.

And they do not like computers or the idea of screens. ”I love books,“ ”I hate computers,“ ”It sounds so cold,“ ”I can't see cuddling up with a CRT in bed,“ ”I can't take it on the train (in a hammock, into the woods),“ etc. They have no conception of the importance and immediacy of creating an electronic literature that embodies what they believe in. [p. 1/12]

Both groups see each other as occupying a little corner and oneself in the ”real“ world — the real world of technology, respectively of history.

There is a third option, to be a *systems humanist*.

We who believe this are *systems humanists*, striving to further the ideals of the humanist perspective by the best available means. This means finding the ways that human literature, art and thought —including science, of course— may best be facilitated, preserved, and disseminated. [p. 1/13]

This book proposes a basic infrastructure such as running water, the availability of literature for everybody anytime, to aid the fluidity of thought.

Hypertext

Writing is not intrinsically sequential. Sequential writing spoils the unity and structure and forces a single inappropriate read sequence.

A particular sequential structure might be appropriate for someone and inappropriate for someone else. It would be preferable to easily create different pathways for different readers.

Non sequential alternatives:

- *Chunk style hypertext*. One sees a chunk of text at a time and can jump to another one following a link.
- *Windowing (or compound) text*. Materials are viewed and combined with others.
- *Windowing hypertext*. Its generalized form: non sequential writings (hypertexts) window to other materials. This is the notion developed at the present book.

The sequential structure has been too much present for thousands of years. It does not correspond to the structure of ideas and thought processes.

”Computers are not intrinsically involved with the hypertext concept.“ [p. 1/17]

The hypertext is not a totally new phenomenon, though, it is fundamentally traditional and in the mainstream of literature. Example: citing ahead and behind (”as we have already said“) one sets implicit pointers.

Hypertext simplifies writing by freeing the writer from stipulating a sequence.

Hypertext aids active reading by supporting multiple pathways inside the text and into background material.

There are two styles of hypertext organization: connections as planned presentations or connections following the inner structure.

Orientation is a problem that is becoming apparent. The location one is reading is in a book or a magazine always clear by physical means, for hypertext the means must be invented.

Hypertext will lead to a better representation of thought because it can show all interconnections one can think of.

Intercomparison systems for comparing alternatives will become a vital aspect of our working lives.

The School Problem

The curriculum oversimplifies subjects putting them into a sequential structure.

Teachers become feudal Lords of a territory and impose their own style and personality on it. They have absolute power and control access.

Whatever is taken in school gets hence uninteresting.

Thus follow both the dreariness of education and the crippling of the mind as we see it everywhere today. Education is typically the process of successively ruining subjects for you, and the last subject to be ruined determines your profession. An educated person is someone who says, ”I don't know anything about that, I never took it.“ Whereas a free-minded person can become excited about a new idea, in any subject, whether or not he or she ever heard about the idea or the subject before. [p. 1/20]

As a consequence of this system everyone believes that the world is divided into ”subjects“ and that these are well-defined and well-ordered.

That crushes people's mental spirits.

A Brief History Of The Xanadu Caper

The project started as a one-man's dream. While studying the author was seeking for a way to organize all his notes for writings. In graduate school he took a course in programming and worked as term project in a computerized writing system; that was the first design, 1960. The second design introduced the chunk style hypertext and elements of computer assisted instruction. The third design (1965) concentrated on ”zippered lists,“ a data structure consisting of indexes.

In the 1970s some people joined the project and made important contributions to its design, such as the ”enfilades“ and ”tumblers.“ In the 1980s the work is going on.

”As We May Think“ by Vannevar Bush

Reprint of Bush's article As We May Think (1945).

CHAPTERS THREE

SUMMARY OF THE XANADU™ HYPERTEXT SYSTEM

People mistake generality for vagueness.

Roger Gregory

While the system is conceptually simple, it is amazing how many different ways there are to think about it and describe it. We take this as indicating its generality.

Some of these descriptions are listed below, both as one-liners and in an essay form. Readers may find them useful for communicating to others, or for reviewing their own understanding of the system.

SUMMARY OF THE XANADU™ HYPERTEXT SYSTEM:

ONE-LINERS

"A literary system of authorship, ownership, quotation and linkage."

"A pluralistic publishing and archiving medium with open hypertext and semi-closed framing."

"A distributed repository scheme for worldwide electronic publishing."

"A system to promote cumulative order and the equitable coexistence of many viewpoints."

"A vessel for the true shape of information--without having to cut it or jam it."

"A mapping system between storage and virtual documents."

"A distributed server network for documents made out of pooled boilerplate."

"A storage arrangement for linking between arbitrary collections of material."

"A seamless data architecture for linked electronic publishing."

"A linking system for keeping track of anything."

"An applicative virtual document system for applying sequential and non-sequential structure to material that arrived out of sequence and unstructured."

"A grand address space for everything, parts of which can be in different places at once."

"A way of tying it all together and not

losing anything."

"A way of including anything in anything else."

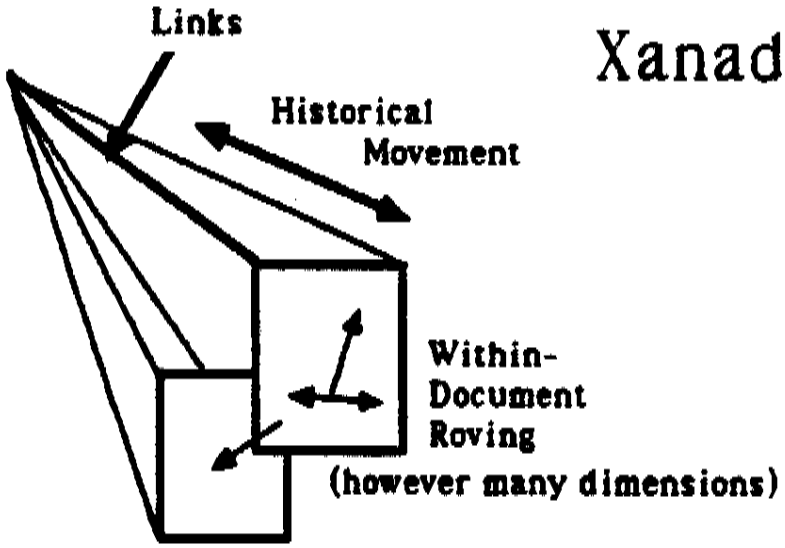
(See also the various generic descriptions under "The Trademarks," a Chapter Five.)

SUMMARY OF THE XANADU™ HYPERTEXT SYSTEM:

SHORTEST DESCRIPTION

The Xanadu™ Hypertext System is a form of storage: a new computer filing system which stores and delivers new kinds of documents. These documents may have any form and contents, but may also have links and inclusions from other documents. A user may request parts of documents or may follow links, both within and between documents. The user may easily see highlighted intercomparisons between documents.

This structure is the same regardless of size: a small Xanadu system will hold and clarify an individual's work, the full network is intended to supply millions of documents to millions of simultaneous users, all following links and windows throughout the growing body of hypertext.



Xanadu Document

A document has its conceptual dimensions plus three:
LINKS, ALTS, HIST

SUMMARY OF THE XANADU™ HYPERTEXT SYSTEM:

MEDIUM-LENGTH DESCRIPTION

The Xanadu™ Hypertext System is a new form of storage intended to simplify and clarify computer use, and make possible new forms of instantaneous electronic publication.

Running on a single computer, it is a file server for the storage and delivery of text, graphics and other digital information with previously impossible arrangements and services. These new arrangements include links and windows between documents, as well as non-sequential writing (hypertext).

It will also reveal and clarify commonalities between documents and among versions, simplifying both storage and comprehensibility. Thus even running on a single computer, it will simplify computer operations, clarify storage, and clarify and simplify office and document work for individuals and corporations.

In the full world-wide network, it will permit the publication and instantaneous world-wide delivery of interconnected works having immense new power to huge numbers of users.

SUMMARY OF THE XANADU™ HYPERTEXT SYSTEM:

EXTENDED DESCRIPTION

The Xanadu™ Hypertext System is software for the unique organization of computer storage and the rapid delivery of its contents to users. All forms of material--text, pictures, musical notations, even photographs and recordings--may be digitally stored on it. Most importantly, the new forms of interconnection this makes possible among these materials are profound and revealing.

It is a system for the rapid delivery of linked documents (which may share material) and the assimilation and storage of changes. System facilities permit promiscuous linkage and windowing among all materials; with special features for alternative versions, historical backtrack and arbitrary collaging. It is based on new technicalities which are of no concern to the user, and materials are stored in locations the user need not know about.

Any forms of data will eventually share these facilities of linking and inclusions, although each needs separate implementation. Bit-map graphics will be stored in such a way as to allow panning (graphical scrolling) and zoom (continuously increasing or decreasing magnification) as incremental data deliveries. (How your screen machine will show them is another matter.) Three-dimensional objects, when implemented, may be collaged by users into compund objects, scenes from history, enactments and artwork.

It's exactly one system that comes in small, medium and very large. In all cases it is a back-end storage feeder--or "file server,"

in the current vernacular--for holding and sending out documents which are connected in any possible way (arbitrary topology).

Single-user and multi-user versions for individual and coprorate uses will simplify and clarify the user's storage and the interrelations of data--helping your information evolve toward better organization by small increments.

The single-user system will run on personal computers (such as the extended-memory PC clone and the megabyte Macintosh). The multi-user version will provide document services to a network of computers among corporate users.

Custom front ends of any kind are possible. While any sort of terminal may be connected to the system, its best operation requires a full computer in the user's terminal, programmed to handle display functions, interchange protocol, and other work. A front-end program is any program, running on a user's screen machine or other computer, for any purpose and behaving in any manner, which delivers to and extracts from the Xanadu storage system.

A complete network of publishing with royalty has been carefully planned. All users will have access to all public documents instantaneously (not counting network delays). Every byte delivered to the user will return a minute royalty to the document of origin.

In this expected publishing network, Xanadu storage will provide linked access to new and powerful forms of interconnected data and writing in compound documents, the storage of which may be distributed.

Its unique facilities of backtrack, linkage and windowing will allow the creation of new forms of multi-level, explorable collections and collages of material--without losing the well-defined authorship and ownership of all parts.

Anyone may publish collaged and windowing documents having finely-divided ownership. There are simple categories of publication (private and public) and low, comparatively flat costs of usage.

Any part of any available document will be accessible from any port on any computer in the net at any time, at prices comparable to storage on other computer systems.

Users may connect their home or office computers of any kind to this network, whether by dialup, GTE Telenet, leased line, twisted pair, or nearby wink-laser. (Each machine will need its own front-end program, however.)

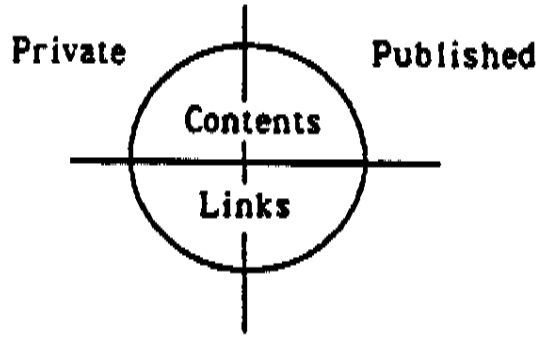
Services will be differentiated mainly with respect to speed of terminal (1200 baud the minimum). No users will be restricted as to what public documents they may access, though private documents will be restricted as specified by their owners.

The system's contents will be supplied

by customers only. There will be no participation by the Xanadu enterprise in the publishing process itself; neither contents nor indexing will be provided by the system, these being rightful endeavors of the customers.

The system will exert no supervision or censorship on stored or published materials, and court orders will be required for the removal of any material held in a stable account. However, publishers and individuals will be thoroughly warned about legal exposure and pitfalls.

Publishing requires an up-front payment of one year's disk rental. A secondary publisher using windowed material need only pay the cost of pointer storage.



Private documents are available only to the owner and the owner's designees. Published documents are available to anyone, and yield a royalty to the owner; they may be updated at will, but the earlier contents remain available. They may not be withdrawn from publication except after six months' notice or court order. "Privashed" documents are available to anyone, and may be changed at will, but yield no royalty.

We believe this will make possible a whole new universe of knowledge and understanding.

It is presently on line as an experimental prototype. Later, we expect to offer it in object form to users for both personal and corporate computers, first in single-user, then multi-user configurations. After that comes the network with publishing royalty, which we believe can grow as fast as demand.

In one business scenario, the intended public operation of the publishing system will be out of a chain of suburban or roadside stations, called Silverstands™. New users will learn the operation of the system at such stands, and local users may dial into their nearest Silverstand. Silverstand personnel ("Conductors") will include both local people and an itinerant corps of circulating smarties.

The actual code of the system is a medium-sized program in the C language, currently running under the Unix operating system.

"HOW IS IT DIFFERENT FROM THE SOURCE?"

Many public-access computer systems now offer text services. One of the best

known is The Source, so we often get this question.

Unlike general-purpose time-sharing systems such as The Source, which can run many kinds of programs and furnishes text services simply as one class of available program, ours is a *specialized* storage form for what we believe is the *most generalized* form of storage. Our system does not permit the running of user programs.

The Source, and other currently available text services, do not support linkage, windows, alternative versions or historical backtrack as they supply their stored documents, let alone maintain these connective structures as documents change.

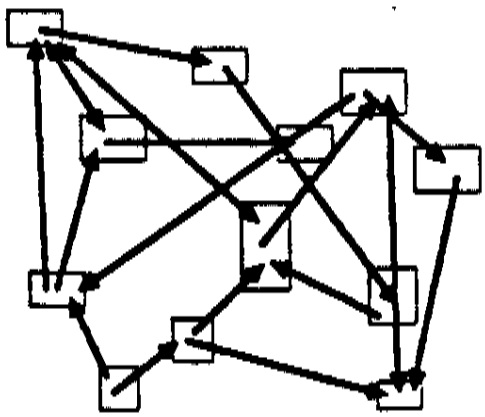
PROBLEMS OF HYPERTEXT

In this chapter I will discuss problems of hypertext; indeed, the problems faced by some current hypertext systems.

Everybody gets the idea of hypertext now: that you can write sections of text on screen, and attach them together in ways that affect the structure of the subject, your mental associations, and more.

Hypertext is also the most promising way of understanding complex structure. For instance, on-line aircraft maintenance documentation is already being put onto hypertext systems. In fact this is the only way to document large systems usefully, once they get to a certain level of complexity.

"ORDINARY" HYPERTEXT



And everyone says at the beginning, Hypertext is easy! All we need is a way to read and write a lot of pieces, and connect them together.

That's all you need for a day or two. The problems go much deeper.

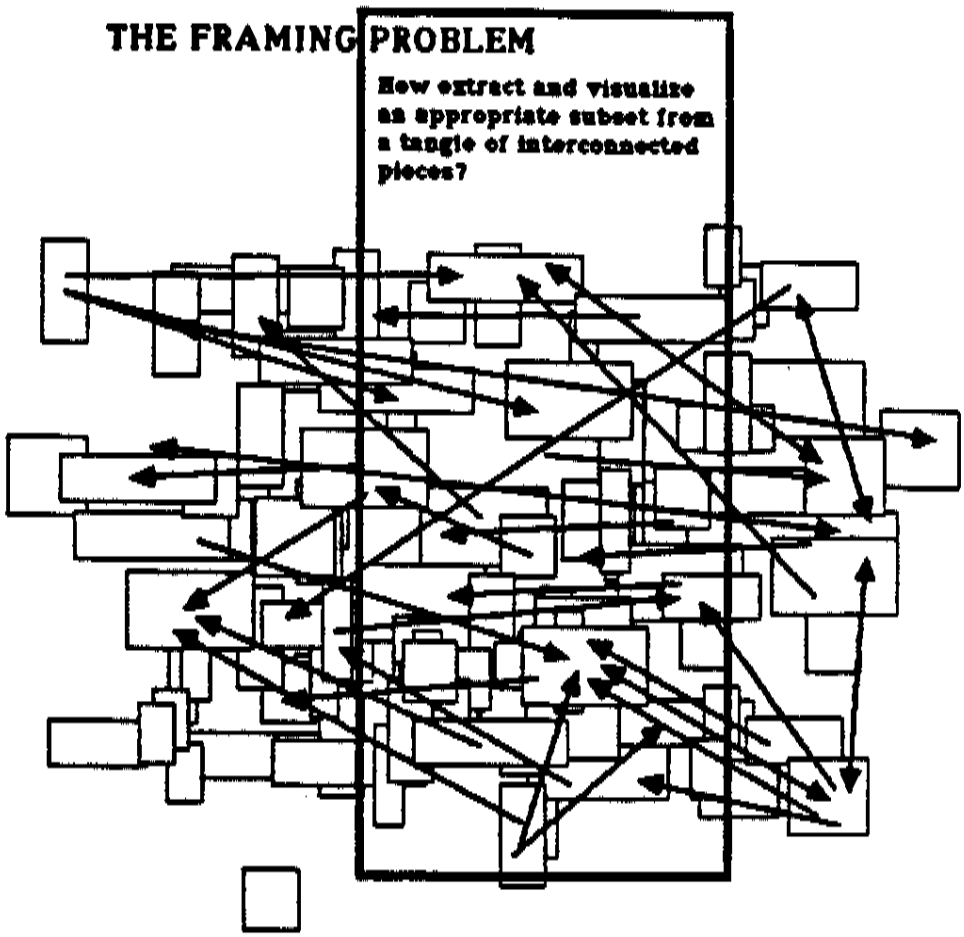
THE FRAMING PROBLEM

As collections of material grow, being able to isolate subcollections is very important.

This is a deep conceptual issue. As the number of interconnected parts of a hypertext grows, how can we restrict our concerns to any subsection? How can we cut down the size of the subject, when all those interconnections crisscross in so many ways? Even when you know what you want to consider, how can you *turn off* the rest? You would like to create your own *arbitrary closed context* from larger complexes of materals.

(Of course, somebody could decide *for* you what was relevant, but that wouldn't be hypertext.)

I call this the *framing* problem: being able to frame only a part of a large complex, to close a shell around a subset and make it seem like the whole world.



COMPLEX ALTERNATIVES AND INTERCOMPARISON

One of the most important things that the computer workstation can do is help the user *understand complexity*. As designs and structures evolve, it is vital to see how they relate to complex alternatives.

A vital aspect of this is to show and highlight different versions, parallel structures, alternative designs--*the detailed resemblances and differences* between complex structures.

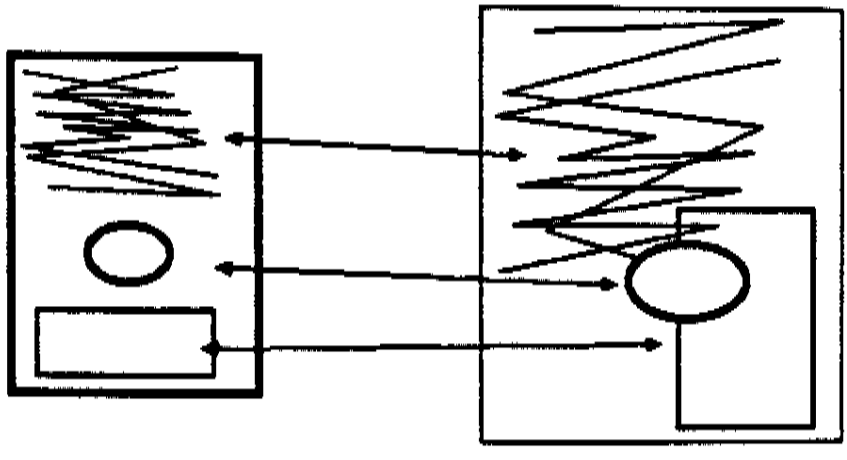
These alternatives may be different designs for future growth; they may be

alternative strategies; they may be different interpretations. In *Computer Lib* I called such intercomparison systems "Thinker-toys," expecting them to become common, but as yet no such systems have been built in the general case.

FRAMING AND INTERCOMPARISON COMBINED

Taking the two problems of framing and intercomparison in combination, we get a more complex issue: how can we

THE NEED FOR INTERCOMPARISON OF COMPLEX OBJECTS



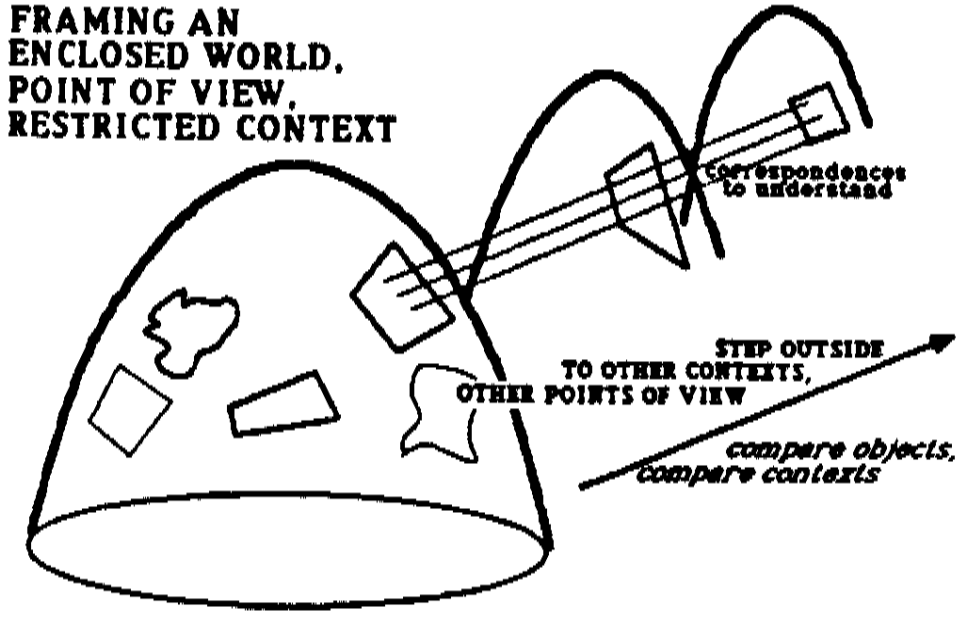
designs, plans, negotiations ...

LITERARY 3/10 MACHINES

intercompare the details of framed, closed contexts? This will be important wherever there is controversy and difficulty in handling large bodies of interconnected materials.

LINK TYPES

As complexes of connected materials grow, the number of links begins to drown

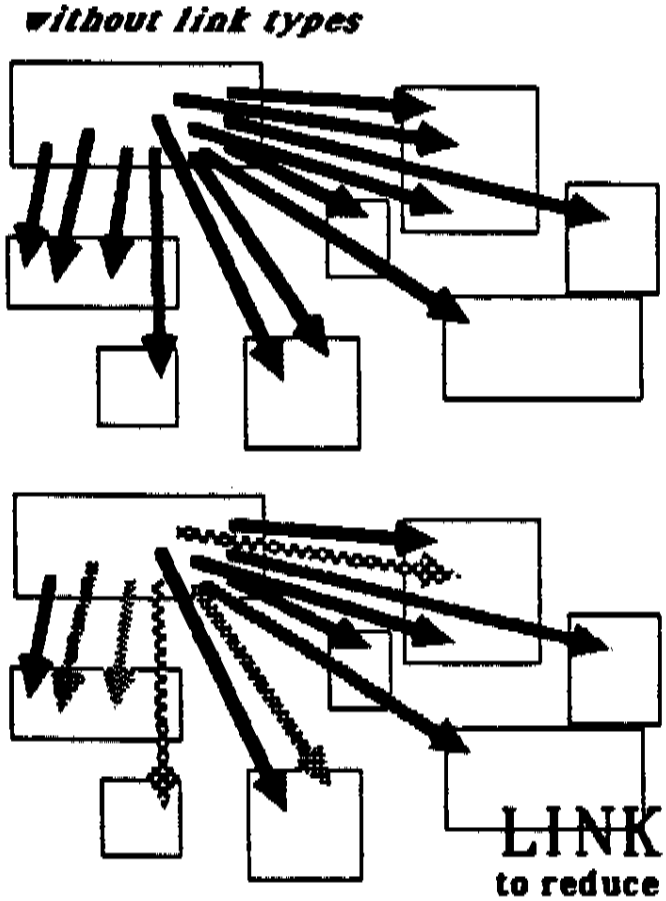


us rapidly. Allowing *link types* is one way to clarify the system: typed links allow the user to reduce the context of what is shown.

VERSIONING AND HISTORICAL BACKTRACK

We often have to keep similar files organized in several different ways: for instance, the same program set up for different computers. Or it is desirable to maintain several possible designs or plans at once. These are examples of the *versioning* problem.

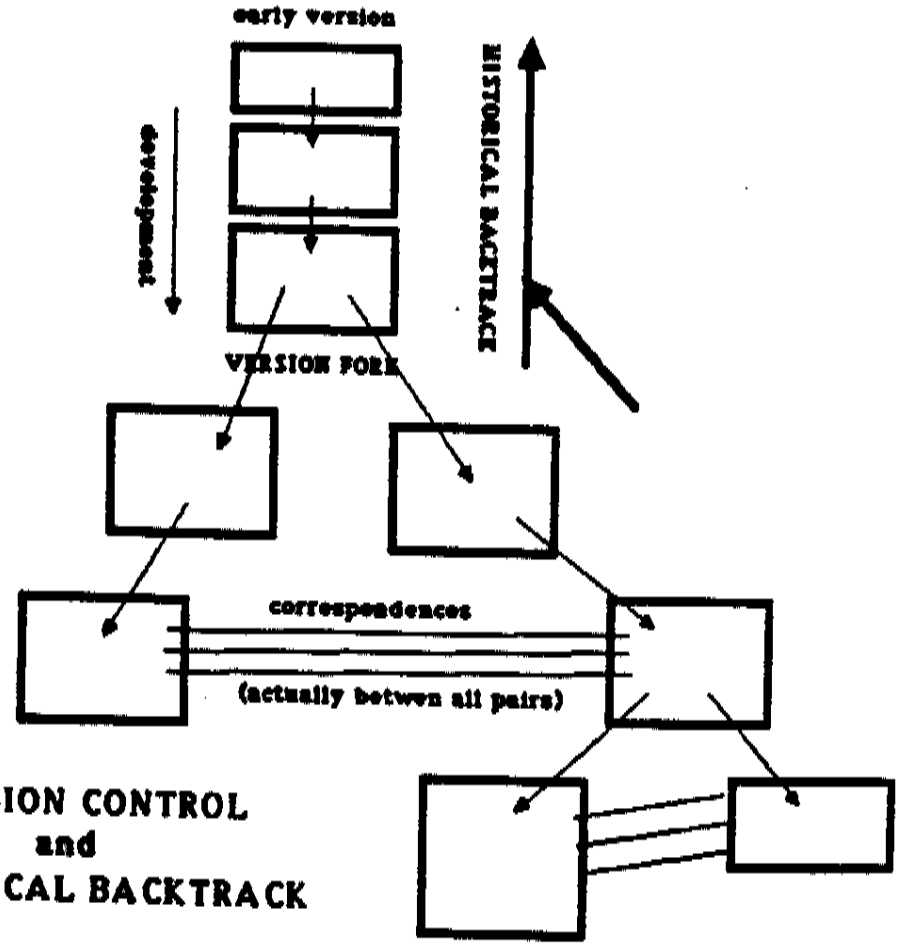
As collections of interconnected materials grow, it also becomes increasingly important to understand them in terms of



what they were, and to keep track of changes in structure.

Being able to go back through changes, and perhaps restore an earlier state, is called the problem of *historical backtrack*. For simple, linear textual documents this can be done by storing lists of changes and undoing them; and indeed several commercial versioning and backtrack systems are now on the market. But it is rather more difficult to do this for hypertext.

Moreover, *highlighting the corresponding parts* is a vital aspect of intercomparison.



VERSION CONTROL
and
HISTORICAL BACKTRACK

HYPERTEXT

Spoken language is a series of words, and so is conventional writing. We are used to sequential writing, and so we come easily to suppose that writing is intrinsically sequential. It need not be and should not be.

There are two outstanding arguments for breaking away from sequential presentation. One is that *it spoils the unity and structure of interconnection*. The other is that *it forces a single sequence for all readers which may be appropriate for none.*

1. *Spoiling the Unity and Structure*

The sequentiality of text is based on the sequentiality of language and the sequentiality of printing and binding. These two simple and everyday facts have led us to thinking that text is intrinsically sequential. This has led to the fallacy that presentation *should* be intrinsically sequential. Marshall McLuhan even put this fallacy at the center of European thought, and perhaps he was right, perhaps it is.

But sequentiality is not necessary. A structure of thought is not itself sequential. It is an interwoven system of ideas (what I like to call a *structangle*). None of the ideas necessarily comes first; and breaking up these ideas into a presentational sequence is an arbitrary and complex process. It is often also a destructive process, since in taking apart the whole system of connection to present it sequentially, we can scarcely avoid breaking-- that is, leaving out-- some of the connections that are a part of the whole.

Of course, we do this kind of simplifying sequential breakdown all the time, but that doesn't mean we *should*, it just means we *have to*.

(Some thinkers, of course, really *do* believe that certain of their ideas are primary and that the rest follow from them, and that's fine. I criticize merely the presumption that all systems of thought have an intrinsic sequence, or should be made to.)

2. *Forcing Simple Sequence Inappropriate for All Readers*

People have different backgrounds and styles (as I said of the Noids and Fluffies in Chapter 1.3). Yet sequential text, to which we are funneled by tradition and technology, forces us to write the same sequences for everyone, which may be appropriate for some readers and leave others out in the cold, or which may be appropriate for nobody. (This book, too, is hardly everybody's cup of tea, since there is not very much *choice* among its sequences.)

Thus it would be greatly preferable if we could easily create different pathways for different readers, based upon background, taste and probably understanding. Now, in normal circumstances this is handled by writing different articles (and books) about the same subject, and publishing them in different places (or ways) for different audiences. This will give readers many choices in approaching the same work.

In the computer world this will change, especially if-- as I foresee-- there will be one great repository, and everything will be equally accessible. This means that "different" articles and books will more likely be *different versions of the same work*, and *different pathways through it for different readers*.

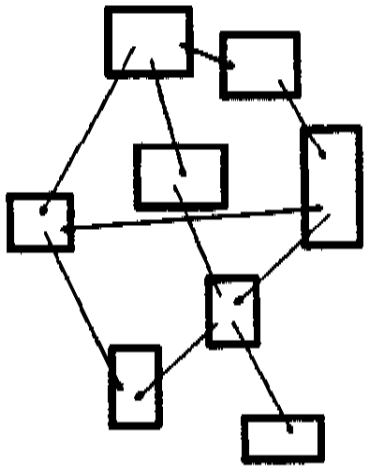
THE ALTERNATIVE: NONSEQUENCE

Nonsequential writing on paper can be all sorts of things-- magazine layouts, funny arrangements of poetry, pieces of writing connected by lines, or many other things.

As we go in this century from paper to the computer screen-- and tomorrow's computer screens will have the richness and resolution of paper-- all these nonsequential forms, and more, are possible. And we must discover and invent them.

Some are obvious. The most obvious is that which simply connects chunks of text by alternative choices-- we may call these *links*, of which more later-- presented to the user. I call this simply *chunk style hypertext*. The user, or reader, moves through it by reading one chunk, then choosing the next.*

CHUNK STYLE HYPERTEXT



Another form of text that is becoming increasingly important is *compound text*, where materials are viewed and combined with others. (This term too has recently become common.) A good way of visualizing this is as a set of windows to original materials from the compound texts themselves. Thus I prefer to call this *windowing* text.

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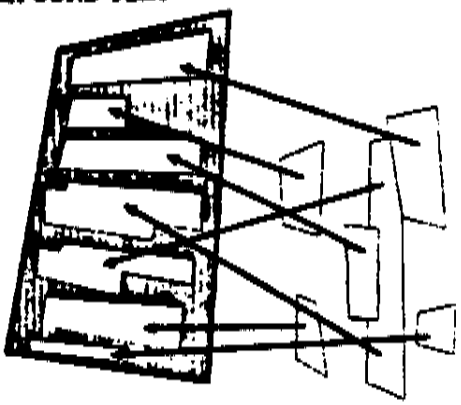
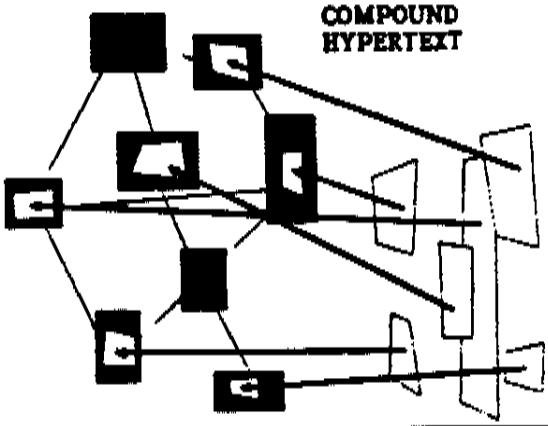
*Note that if the connections to be followed are given different types, we may call these *colored links*. (This is the mathematical usage, where connections are called "colored" if they are of different types.)

WINDOWING OR COMPOUND TEXT



Extending the notion slightly, we get *windowing hypertext*-- where nonsequential writings-- hypertexts-- window to other stored materials.

COMPOUND HYPERTEXT



It is this notion, then, of windowing or compound hypertext-- which we foresee as the vital and basic new information system of the future-- that has charged and inspired the present work.

Unfortunately, for thousands of years the idea of sequence has been too much with us,* because nothing else has been practical; and indeed, creating a system subtle and profound enough to meet our real needs has proven to be an extensive task indeed.

The structure of ideas is never sequential; and indeed, our thought processes are not very sequential either. True, only a few thoughts at a time pass across the central screen of the mind; but as you consider a thing, your thoughts crisscross it constantly, reviewing first one connection, then another. Each new idea is compared with many parts of the whole picture, or with some mental visualization of the whole picture itself.

It is the representation of whole structures of ideas, and placing them on the page for others to understand, that we call *writing*. Writing is the representation and the presentation of thought.

(So are pictures and diagrams; but they are intrinsically nonsequential, and so not relevant to the present argument.)

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*Except for the Talmud. This is an extraordinary hypertext, a body of accumulated comment and controversy, mostly on the Torah (the Hebrew Old Testament) and on life in general, by Jewish scholars of old. It has been accreted over centuries with commentaries on commentaries. This hypertext is a fundamental document of Jewish religion and culture, and the Talmudic scholar is one who knows many of its pathways.

HYPERTEXT DEFINED

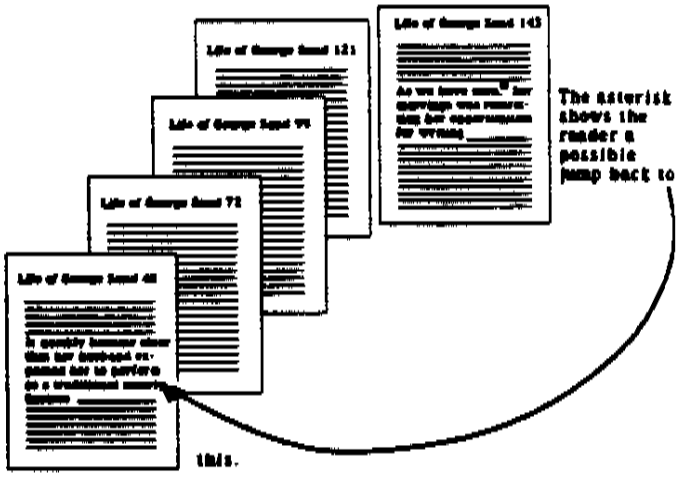
By hypertext I simply mean non-sequential writing. A magazine layout, with sequential text and inset illustrations and boxes, is thus hypertext. So is the front page of a newspaper, and so are various programmed books now seen on the drugstore stands (where you make a choice at the end of a page, and are directed to other specific pages).

Computers are not intrinsically involved with the hypertext concept. But computers *will* be involved with hypertext in every way, and in systems of every style. (Ideally, you the reader shall be free to choose the next thing to look at-- though repressive forms of hypertext do turn up.)

Many people consider these forms of writing to be new and drastic and threatening. However, I would like to take the position that hypertext is fundamentally traditional and in the mainstream of literature.

Customary writing chooses one expository sequence from among the possible myriad; hypertext allows many, all available to the reader.

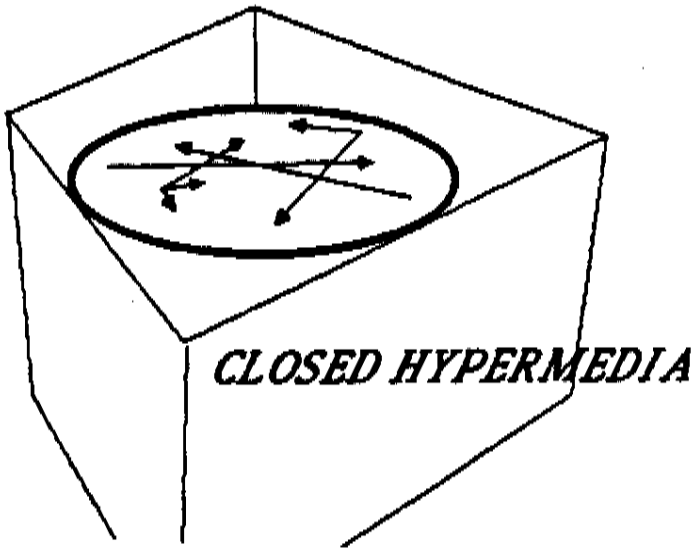
In fact, however, we constantly depart from sequence, citing things ahead and behind in the text. Phrases like "as we have already said" and "as we will see" are really implicit pointers to contents elsewhere in the sequence.



LITERARY 1/17 MACHINES

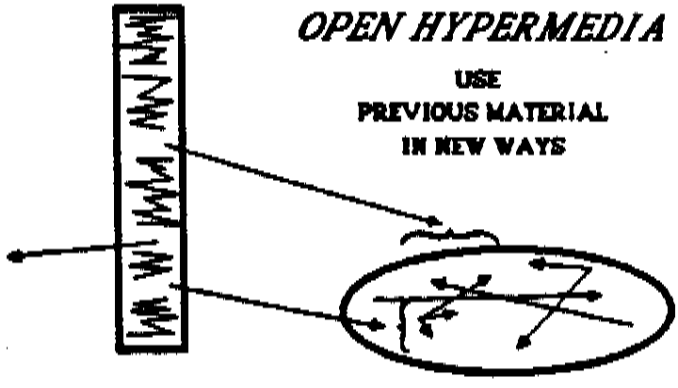
CLOSED CONTEXTS AND OPEN MEDIA

Just as it is important to be able to work only with a closed context of material, it is vital to be able to *open* a closed context. This is especially important with today's new media, where designers are able to imprison users as never before. You could always turn the page of a book, or slam it shut. Not so today: in computer-assisted instruction, in the proposed interactive disks (CDI), and in many other forms of interactive media, designers can make it impossible for you to move on, to follow a pathway of your own choosing. To say nothing of leaving a comment for the next guy.



This must change; and so we need a master indexing scheme that will *embrace other hypermedia*, and allow the leaving of comments, and the creation of alternative pathways amongst pre-canned materials, by others.

In open hypermedia, others can add to any production or re-use its parts as they see fit. Anyone can do new things with the same material, freely.



It is a balance of rights: the first author and publisher have a right to show you something *their* way; but users have a right to employ these things as *they* choose. Under freedom it can be no other way. As long as the original's context is preserved, ongoing new ones must be allowed.

Thus the Xanadu system is designed as a *universal open hypermedia environment.* The originating author or publisher may create a closed environment; then another

author may anthologize, or otherwise re-use, parts of the same document in a *new* closed environment; but the inquiring user must be able to step from closed environment to closed environment, intercomparing the parts, with complete freedom.

ADDING THESE ASPECTS LATER

In the "all we need" approach, with which most hypertext projects are begun, all these problems tend to be swept aside, with good reason. *They're hard to do.* But then, later in the life of a hypertext project, the developers start *adding* features of this type. Unfortunately, trying to add such things later is very different from designing them in at the start. And so it is hard to build much of this into the hypertext systems now existent.

You now hear people say things like, "We don't need anything as complicated as Xanadu." This is wrong on two levels. First, the Xanadu system can be arbitrarily simple at the user level; and second, that as soon as you start *adding* features like networking and link types and historical backtrack and framing, it becomes a complex morass, and what you really need is a system designed from the start to have all these features.

TOWARD A SUBCULTURE OF INTELLECT

Intellectualism is not a specific body of knowledge or a subculture, but a questioning, observing, hypothesizing outlook.

There are no intellectual subjects. For someone used to learning, to grabbing vocabulary and ideas, the elements of a new subject can come quickly. The more diagrams you have seen, the more words you know, the more theories you have heard, the more easily you can grasp the next one and assimilate it to the snowball of ideas already rolling around in your head.

In an era of school-induced stupor, punch-and-judy news and video narcosis, we hope the Xanadu System will encourage depth and a never-ending procession of new insights.

But it will be important to build a central constituency--a subculture to form a nucleus at the center of this new world.

The realm of intellect has had long connections to the establishment, and has been hoary and stuffy since the Middle Ages. A nice allegory of this is Hermann Hesse's heavy novel *Magister Ludi*, which is about a future subculture of generalists who look for resemblances and connections across all knowledge. But they have an elaborate competitive hierarchy like chess masters--establishment nexocrats contributing to no one else.

In our time, a comparable organization is Mensa, a group of elitist establishment test-takers. (Founded, interestingly, by Cyril Burt, now discredited for his apparently fraudulent researches on intelligence.) But this is an exclusive club, not an open arrangement for the general benefit.

We propose to give momentum to our system by the creation of a new subculture which provides an alternative to the stuffiness of the rest of the intellectual world. This will be wide open to everyone, especially whoop-te-do enthusiasts who enjoy sharing their sophistications.

There are presently two different intellectual subcultures in America. I distinguish them because they are more or less out of touch with one another:

One is the academic and traditional intellectual culture--of the universities, of grand English, of *Harper's* and *The New Yorker*.

A second is the new generalist subculture--a populist movement that unites science-fiction and popular science. *Omni* magazine is its beginner's dream book, the popular science magazines are its outposts; and *Whole Earth Review* is its pinnacle.

I think these two subcultures can and should be brought together, and that the

Xanadu Hypertext System is the way to do this.

We think we can build a new subculture of intellect, intellect in a new and enthusiastic style--more like the science fiction subculture than Academia.

Here is a bunch of people who are paid to sit around and make things interesting for you. A national corps of peripatetic smarties plus the local bright kids are the Xanadu Conductors. The locals, kids of all ages, run the stand; the national Xanadu Hypercorps™ move around, share insights and explorations, do demos constantly for each other and for the local kids at a given stand, showing them what's new and what they've recently discovered in different subject realms on the system.

The Xanadu Hypercorps is expected to be an unusual and elite group. They will circulate among Xanadu stations transmitting skills and outlook. They will not be people who can program or repair a computer; rather, like the stewards and stewardesses of the airlines, they will know how to make users comfortable. Also how to help them be productive and enjoy themselves within their intended budget. Like good librarians the Hypercorps will have an understanding of what materials are available, but they will know how to deal with an avalanche, rather than a trickle, of ideas and information. Like good teachers they will have a sense of how to convey ideas. Like good woodsmen they will have a sense of the trails and byways of the territory to be explored. And like academics they will have a personal love for one or more topics that they will watch and study in their free time on the system.

The customers who hang around the stands will become an active subculture--including the bright, the verbal, and those interested in everything. Just as in music circles it is customary to know about symphonies and in sports circles it is customary to know about scores, in Xanadu circles it is customary to know about everything: to exchange interesting anecdotes, remarkable facts, extraordinary interconnections--and hold conversations with a Xanadu screen near at hand for reference. They'll be a subculture of generalists who act more like trivia freaks or D&D players.

There'll be festivals and events: Hypercons, Kublacons and Front-End Functions, Footnote Festivals and Intertwingularity Expos. There'll probably be an argot; perhaps Porlock and Rosebud codes, something like the ten-codes of CB radio. It's a fast lane for Zips, a picture-book for Bozos, and for night people as well as day.

A CULT?

Yes, call it a cult if that makes the idea clearer; but a secular cult of fascination with ideas and their uses, ready to wrap itself around the new or the old.

Cults do not just happen. They are constructed. If they become successful, it is through careful planning and insight about what works.

WHAT WORKS?

This cult offers a social system with its own status ladder (highest are the travelling generalists), a promise of "education" to reassure parents with--it's better than pinball, right? And cheaper per hour.

FREEDOM IN OUR TIME AND BEYOND

Freedom is indivisible.

Rumpole of the Bailey

Eternal vigilance is the price of freedom.

John Philpot Curran,
as popularly misquoted

Freedom is not a simple experience. And as technology becomes more sophisticated, living in freedom--which means living with constant, changing choice--will only become more complex.

Emily Prager

Tomorrow's hypertext networks have immense political ramifications, and there are many struggles to come. Many vested interests may turn out to be opposed to freedom.

It is important to see *why* the issues of freedom hinge so tightly on what many laymen would consider to be obscure technical issues.

On-line text systems may or may not become universal or replace much of paper publishing. Whichever view you take, the questions are *what these systems are to be like*; what things are to be available, and to whom, and under what circumstances; and who may put things in, and who is responsible for their contents, and who may censor them, and who may protest the contents, and what gets thrown away on whose decision; and what is to be their relation to the archiving of our heritage, and how accessible they are to be, and how reliably and accessibly the personal, national and human heritages are to be preserved. For rolled into such designs and prospects is the whole future of humanity, and, indeed, the future of the past and the future of the future--meaning the *kinds* of future that become forbidden, or possible.

These problems have been waiting.

The Xanadu group did not create them. The problems will be the same whether our system is adopted generally, or somebody else's, or no system at all--meaning a mess that is less for everybody.

Senator Robert Packwood (D-OR) has called for a "bill of information rights" that will serve us in the age of digital media and transmission. But this concern seems to have reached few others in the political arena.

NEW FORMS OF IMPRISONMENT

New forms of restriction and imprisonment involving computer screens are turning up, some with the best intentions.

The reader of a book can close it or skip to the ending. In some new environments, such as Computer-Assisted Instruction, it is possible to trap the user fully, giving him or her no options whatever except what the planner intended, with no overview and no way to step out of it. I submit that this can be highly oppressive, and is not our free tradition.

In a related development, some advocates of Artificial Intelligence would have computers decide what the reader shall see. As a filtering service this may be just what you want--but the danger is its evolving into a circumscription of your rights, where the choice is no longer yours.

A whole new set of rules is about to be generated. You may be supposing you have freedoms that aren't there anymore.

Consider wiretapping. Time was when a wiretapper sat in the basement with earphones under his fedora. No more. Your phone now can be tapped by a person thousands of miles away who simply gives the proper commands, as beeps, to your ESS switching station. Or so I am told by my telephone-knowledgeable friends, and I believe them.

So in principle, if we ever get the Wrong Sort of Government, they can study your life from your telephone use like an open book. So that particular form of freedom may have slipped away quietly.

What, then, about your computer transmissions? (Computer transmissions will be a basic form of communication for individuals soon.)

An ominous situation has already arisen. The U.S. government has given its approval to a system of encoding that you can buy on a chip. This system is called DES, Data Encryption Standard. Since you can prime it with a secret 56-bit "key," it is thought that running your transmissions through it acts like an electronic shredder, hopelessly garbling your transmissions except to the other party, who presumably knows the key you are transmitting with.

There is only one problem. The DES system stands impeached. Researchers on both coasts have accused this method of being easily breakable by the National Security Agency, the government's decoding

arm; many believe it a fraud perpetrated by the U.S. government to make all "encoded" transmissions readable by intelligence agencies.

Another system of codes has been proposed that supposedly can't be broken by *any* extant computer in less than millions of years. This is the RSA code, originally proposed by Hellmann and Diffie of Stanford, and developed by Rivest, Shamir and Adelman of MIT. It has several remarkable properties, among them being the ability to exchange unbreakable messages between strangers who have not had a chance to swap code keys; the ability to co-sign electronic documents that anyone can read and know you signed; and more. And the U.S. government tried to suppress it.

This may seem faroff to the average reader--perhaps as faroff as television seemed in the nineteen-thirties. Then consider the following:

If you are not careful, some government may be able to read your private computer documents in the future at any time.

THE MINISTRY OF TRUTH

In Orwell's *1984* the Ministry of Truth told lies and changed history. This was done by judicious snipping, disposal and replacement of paper.

As documents go electronic, however, no longer need paper be involved. A reference article, say, in an encyclopedia can be changed simply by storing another one in its place--and poof! history is changed.

There is no typography or watermark to check. Characters sent on the wire are all alike. But the right sort of *encoding*--what is called an *authentication* code--may help us know when documents have been fraudulently replaced. Authentication codes, too, the government is trying to suppress. When you're looking at the what purports to be the Mona Lisa on your screen fifty years from now, and she has a mustache, don't say I didn't warn you.

THE THOUGHT POLICE

Freedom of the press has been challenged by tyrants and scoundrels since Gutenberg. The problem now has new forms.

The Thought Police in *1984* couldn't really read your mind, but they knew enough psychology to have good suspicions.

Tomorrow's real-life Thought Police will have detailed access to a huge number of incidental records about your life, from banks and auto registration and so on--instantly investigable.

But will they also keep track of, and punish, *who says what* on text networks? For if we may be easily punished for the words we let slip, it will be as if freedom of speech and the press had been obliterated all at once.

And suppose you keep silent. Will they be able to find out what you *read*?

This is one of the most serious problems of the present moment. We thought it was further off, but in the fall of 1986 certain government figures announced that henceforth we the public would be limited as to what on-line information we could get, and we were further informed that they would be watching who reads what.

This particular threat was overcome, but plainly the forces of evil stand ready to take over any second.*

THE NEAR BATTLE

It may be easy to tell whether the battle for hope in our time is lost or won; simply ask whether there is instantaneous access to the many voices of science; of politics, the proposals and the arguments, wherever they may come from; the many facts and asserted facts which implicitly support or undercut various points of view--without their being censored, stifled, drowned out, smeared and scribbled over by those who want only their views heard, tainted by fraud and forgery, obliterated by bomb or threat or mysterious disappearance. These are the freedoms we have called "freedom of speech" and "freedom of the press." But digital storage will be the new microphone and printing press, and so access to it will be the battleground of freedom in the future. Knowing what kind of new printing press is possible should help you understand the freedoms that are truly yours--if you fight for them.

THINK FAST

These problems are real and present, and have been here waiting for us all along. Far on the horizon as they may now appear, soon they will be on us like a tornado. The way to approach these issues, I believe, is not to sit in a corner and tremble, like a rabbit in a tiger cage hoping it won't be eaten, but to run between the legs of the beast before it fully wakes up.

Electronic freedoms will be at the center of the whirlwind of the coming years. Either we will fight for them, or they will be taken from us like candy from a child.

The future will go on for a long time. And it will be a protracted war between those who wish to have access to information--the first need of a free people--and those who wish to suppress that access. This war will last as long as humanity endures.

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*See T. Nelson, *Computer Lib*, second edition, "Great Issues," for further discussion of this topic.

THE INDEXING OF MOVIES AND VIDEODISCS

There as yet exists no sensible means by which motion pictures may be annotated by different commentators in a common bank of writings. Similarly, there exist no good film-editing systems that support the intercomparison of complex alternatives.

Tomorrow's nonsequential movie media--hypermovies and "interactive videodiscs"--require new depths of access by users. Though interactive videodiscs have begun to proliferate, it is only as closed systems to which others may not add or make variations. This is unacceptable in the long term.

Xanadu indexing is needed for films and video, from raw footage through editing to archive, and for on-line interactive presentations of every kind.

MUSIC: AN EXAMPLE

A key form of data is *music*. While conventional musical staff notation has been adapted to computer storage, and many computer-based *performance* systems are being constructed, the overall problems of musical archiving, cataloging, annotation and scholarship have not had a unified software base from which they may proceed rationally; let alone from which they may be correlated with performance.

What we propose goes far beyond the storage of notes (which will of course allow front-end performance); but will allow for the cataloguing, annotation and charting of interconnections amongst the whole corpus of musical scores and recordings.

From a given Mozart piece, say, it will be possible to get to every document which mentions or comments on that piece; every musical composition which quotes from that piece; and every recording of that piece or its derivatives.

Students, scholars and listeners should all deeply benefit.

CIVILIZATION AND ITS DISK-CONTENTS:
THE ARCHIVING PROBLEM

"The future isn't what it used to be," as they say. But then, neither is the past. Books disappear. Knowledge of the past is lost. Libraries *burn*, and each time, we are diminished.

The loss of the library at Alexandria in ancient times is still one of the greatest losses in human history. But such things continue. A major library with hundreds of thousands of manuscripts from American history burnt earlier in this century. The Jewish Museum library in New York burnt in 1970, with the loss of manuscripts centuries old. And in popular movies (such as "Chinatown" and "Defense of the Realm"), we see heroes ripping things out of library books with a polite cough.

This attrition of the heritage can in principle be stopped.

Only digital archives give us long-term hope for preserving our heritage--not just writings, but text, paintings (stored as detailed photographs), sculpture, architecture, whatever.

There are many bombs and fires to come. The system this book proposes is a generalized and self-networking structure that can eventually be put in deep rock and deep space--Iron Mountain or the asteroid belt. In the long run, only a digital system of the kind described in this book can provide security for the human heritage of literature, art and science.

But who is to control and safeguard these systems becomes the next question. And it is well to remember Ray Bradbury's book *Fahrenheit 451*--in which different individuals accepted the task of preserving individual books by memory. This allegory may take on new meanings in a world whose future rulers would like to alter the past--a common conceit in such occupations.

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