

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*

LITERARY 0/1 MACHINES

## 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).

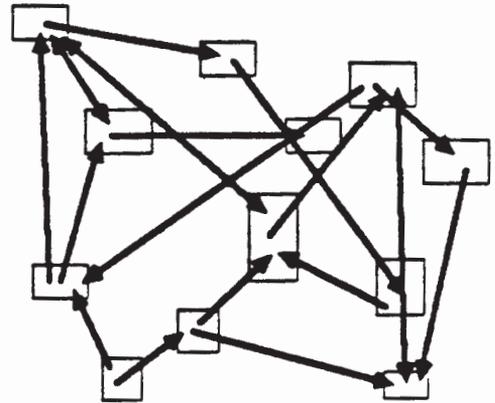
For years I got the impression that no one had heard or read any of this at all. And now, abruptly, it seems that many people did indeed hear, and many have begun to agree. (The first hypertext conference not my own doing is scheduled for November 1987.) The strange thing is that all this took so long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



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\*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.

# LITERARY 0/2 MACHINES

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

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

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 people are assumed to be worthwhile.

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-bandwidth 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.

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\*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

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;

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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).

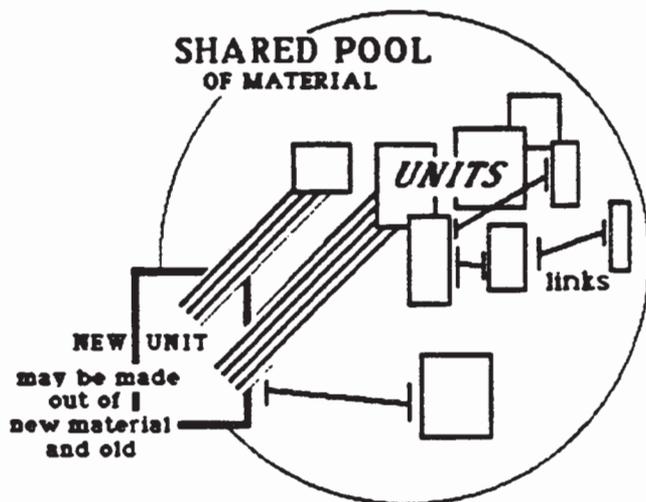
Front-end programs should include our protocol manager, a module which handles sending and receiving in the FEBE(tm) Front End-Back End protocol. It presently compiles to about 30K on the Sun.

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there can be arbitrary links between 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.

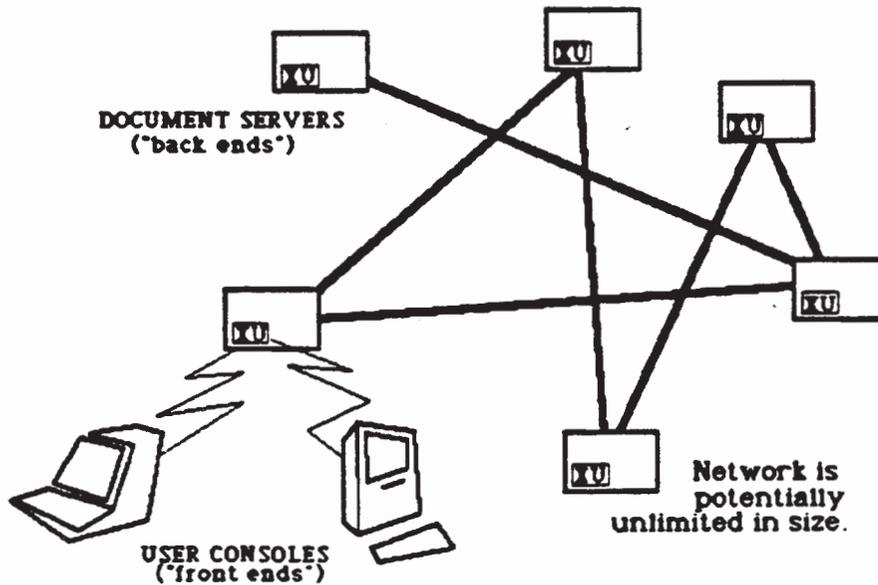
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\*Just as Xerox Corporation created the term "xerography" as a generic term for its new type of copying, we propose this as a generic for our new

conceptual structure of storage. The *particular* way we do xanalogical storage will be discussed in excruciating detail later.

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## A SINGLE PROGRAM, RUNNING THROUGHOUT A NETWORK

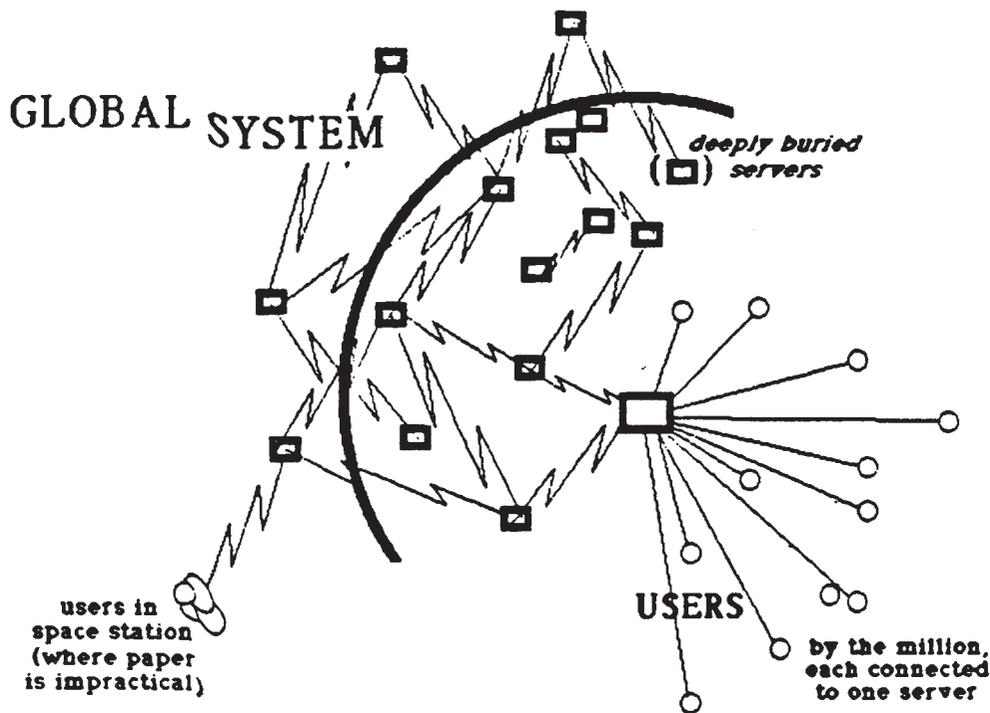


### THE SMALL IMPORTANT USES

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.

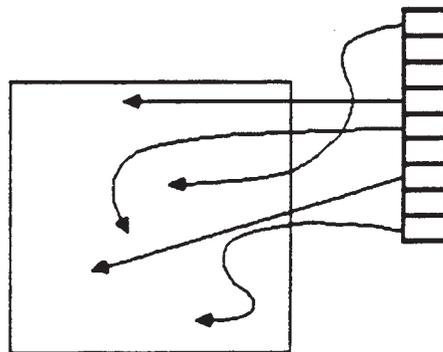
Because the system is based upon one pool of storage which can be shared and organized in many ways, materials can be reorganized constantly without losing their *previous* organization.

# LITERARY 0/7 MACHINES



This means that all materials--whether they are bodies of writing, 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 *disorder* easily becomes cumulative.

## REORGANIZATION IN PLACE



# 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.

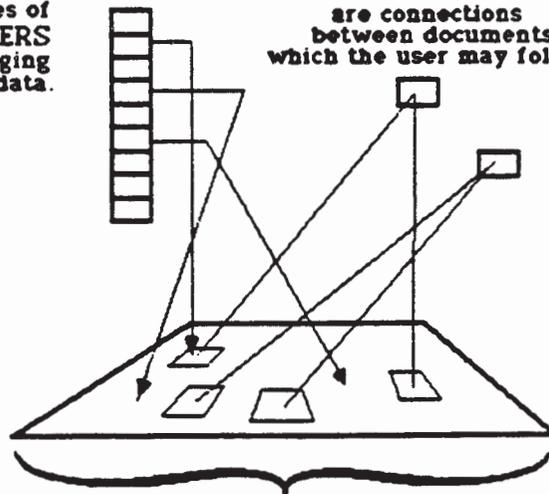
## THE STRUCTURE EXPLAINED

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

**DOCUMENTS**  
are series of  
**POINTERS**  
into the changing  
web of data.

**LINKS**  
are connections  
between documents  
which the user may follow.



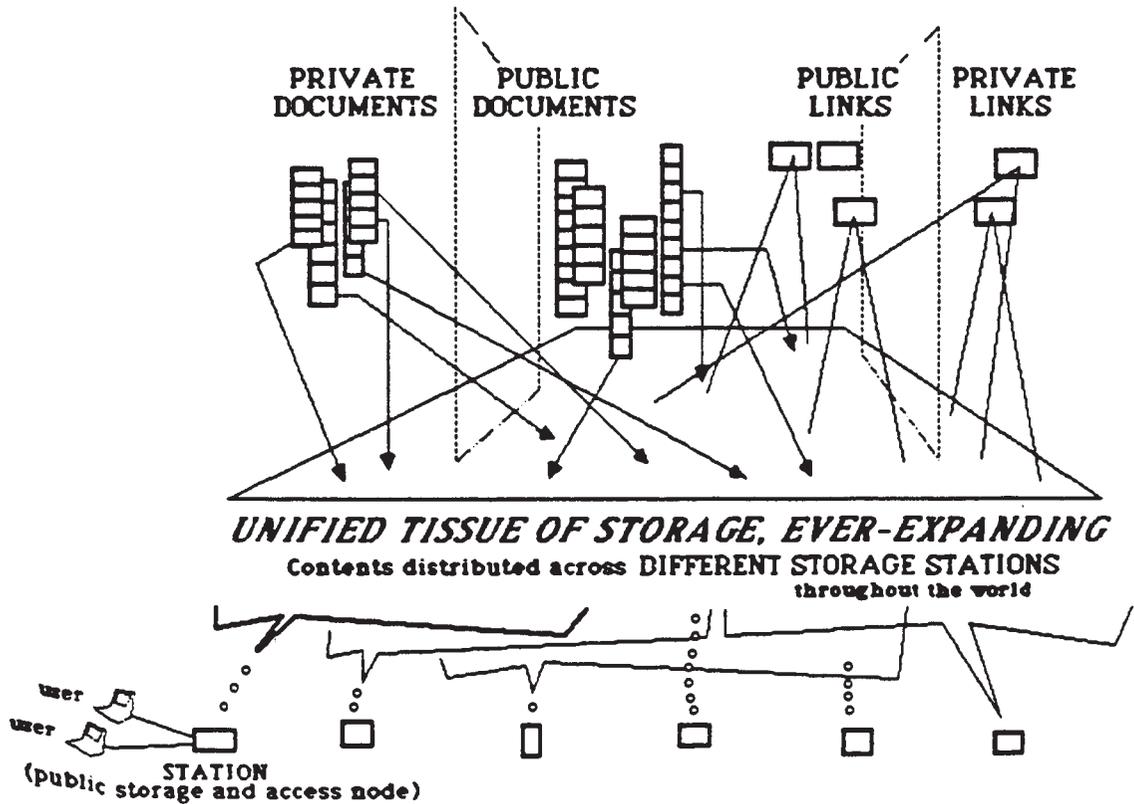
Expanding Tissue of Text, Data and Graphics

# LITERARY 0/9 MACHINES

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 civilization 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.

# LITERARY 0/11 MACHINES

## 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 systems, 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

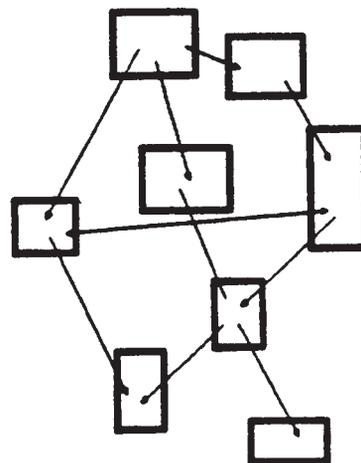
Nonsequential writing on paper can be all sorts of things-- magazine layouts, funny arrangements of poetry, pieces of writing connected by lines, or many other things.

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



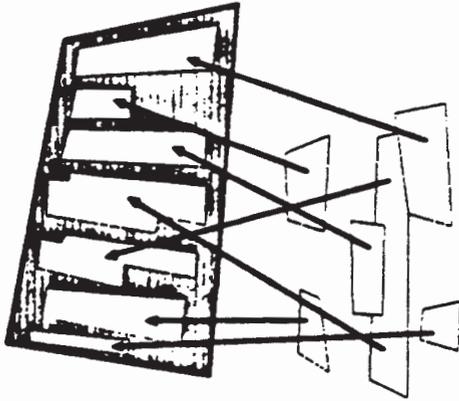
Another form of text that is becoming increasingly important is *compound text*, where materials are viewed and combined with others. (This term too has recently become common.) A good way of visualizing this is as a set of windows to original materials from the compound texts themselves. Thus I prefer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

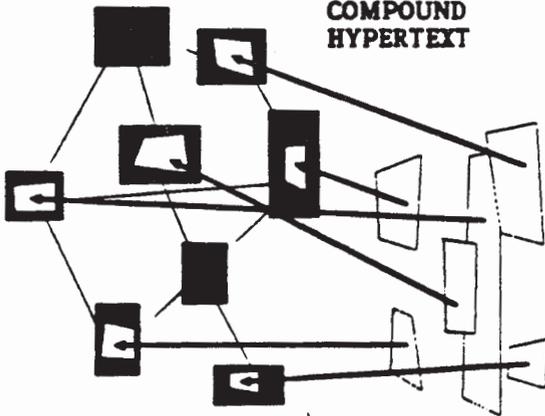
(This is the mathematical usage, where connections are called "colored" if they are of different types.)

## WINDOWING OR COMPOUND TEXT



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

## COMPOUND HYPERTEXT



\*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

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.)

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.

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## HYPERTEXT DEFINED

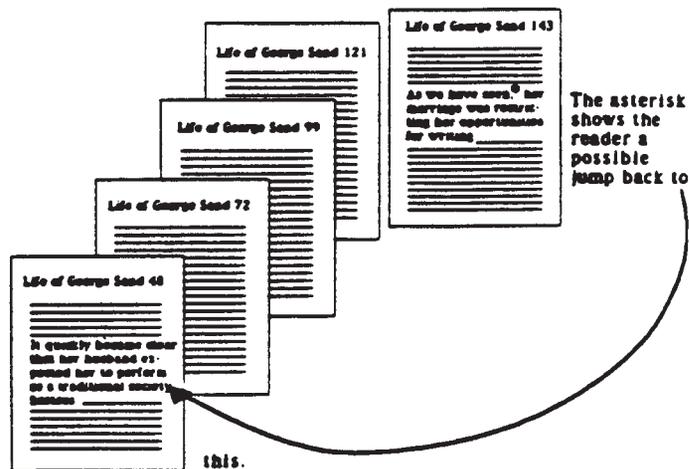
By hypertext I simply mean non-sequential writing. A magazine layout, with sequential text and inset illustrations and boxes, is thus hypertext. So is the front page of a newspaper, and so are various programmed books now seen on the drugstore stands (where you make a choice at the end of a page, and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

## 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 Structure*

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.

# LITERARY 1/18 MACHINES

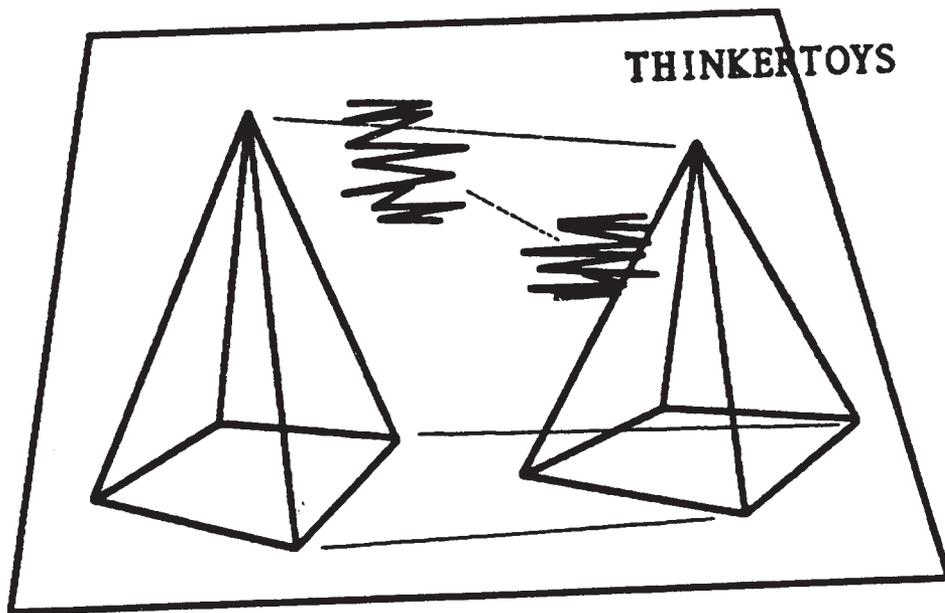
## THE IMPROVED REPRESENTATION OF THOUGHT

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.



# LITERARY 1/19 MACHINES