CHAPTERS ONE

AN OBVIOUS VISION

THE SENSE OF WONDERFUL DEVELOPMENTS

TWO CULTURES FACE THE FUTURE

A BRIEF HISTORY OF THE XANADU CAPER

AN OBVIOUS VISION

AN OBVIOUS VISION

A computer is essentially a trained squirrel: acting on reflex, thoughtlessly running back and forth and storing away nuts until some other stimulus makes it do something else. A perfectly versatile enactor; by rigmaroles and enchantments we make the computer do our bidding.

But then what things should we have it Enact? How can it improve our lives? This is the important issue. That there is a technological imperative, some way it "has to" be done, is a myth and a fabrication. People get cowed, put in their place, when the technoids start enumerating the world as <u>they</u> see it.

TOMORROW'S WORLD OF SCREENS

Computer viewscreens can bring words and pictures right away. Businesses know it; there are perhaps 4 million computer screens now active in the country in business environments.

Individuals, unfortunately, just don't get it. Most, or "all," of our reading and writing can or will, in this century, be at instant-access screens. The question is not <u>can</u> we do everything on screens, but <u>when</u> will we, <u>how</u> will we, and how <u>can</u> we make it <u>great</u>?

To me this is an article of faith; its simple obviousness defies argument. If you don't get it there is no persuading you; if you get it you don't need to be persuaded.

What I don't understand is the apathy about this in the computer field. There is no sense of urgency; there is no unifying vision of uplift for humanity as soon as <u>every</u> <u>person</u> <u>gets</u> <u>a</u> <u>screen</u>.

LITERARY   1/2   **MACHINES**

TWO HOPES

1. We ought to have our everyday lives made simple and flexible by the computer as a personal information tool.

2. And we ought to be able to read and write on computer screens, with vast libraries easily, instantly and clearly available to us.

The woods are abuzz with supposedly great new computer services that will supposedly be offered to the public. Many computer people are "working in these areas." Yet what they give us time and again is complication, complication, because nobody has taught them how to design simplicity. "Not my job, man." No computer school teaches it. Beneath them, I suppose. Or more likely not imagined by them.

Simplicity does not come in pieces. You can't buy it in sections or add it in parts, on weekends. A thing is unified and clear and simple because it is designed that way, or it is not unified and clear and simple. Making things clear and simple is hard. (Biological unity is another matter-- it takes a long time and millions of mistakes, and does not necessarily act in our perceived interests. Don't pull that analogy.)

The starting point in designing a computer system must be the creation of the conceptual and psychological environment-- the seeming of the system-- what I and my associates call the virtuality. You begin there and work back into the mechanics. You decide how it ought to be, and then make that vision happen; you don't just patch and splice and add and adapt.

The two words that characterize life at computer screens are BINGO and OOPS-- Bingo because things come the instant you call them, and Oops when you did what you didn't intend-- which in bad computer systems, most computer systems, is hard to undo.

Pragmatism and the desire to get along in the world lead people to put up with what should not be put up with. But nothing really stops anyone from creating the good and the elegant except habit, inertia and desuetude-- and the fact that doing right is much harder than not doing right.

As soon as you understand computers, all this should become obvious. Yet most people have not understood computers-- partly because some computer people didn't want them to-- and so the benefits to our lives have been put off and put off.

1/3

Now laymen are getting their personal computers-- Apples and Radio Shacks and so on-- and independently seeing, many of them, how things might and ought to be. (Though the inexpensive computers are being called micro-computers so that newcomers will somehow think they're different from the old ones, and subtly inferior. The word "microcomputer" leads people into thinking that the new dinky computers are in some way not as good. Thus the word is like the word nigger-- suggesting unspoken inferiorities without having to name any.)

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HOPE 1. SIMPLIFYING OUR LIVES

Computers should bring simplification, rather than complication, to our lives: they should handle the minutiae, the snibbety details of day-to-day existence. Computer screens should bring us the everyday data of our lives -- whatever memoranda we use-- effortlessly so we no longer have to deal with myriad scribbles on paper. What you write down for your own use should be always available from a screen, not randomly lost and buried. Birthdays, appointments, possibilities to be kept track of, the blizzard of everyday natter,; the scheduling of our lives

(which is very complicated in principle, and which we blunder through, sometimes with great difficulty); the trivia of bookkeeping (which most people make into a yearly chore in relation to the IRS); the cross-indexing and storage management of the things we keep (conventional wisdom says we should keep less-- actually a reflection, I believe, of the fact that our systems are lousy and therefore very inconvenient).

So we need unified personal systems for a variety of purposes, tying these objectives together. Now, most computer people are under the impression that this implies a vast amount of programming. I say no: what it requires is a lot of good design, and the creation of some very simple building blocks. (As a clue to the sophisticated reader, let me add that exactly two examples of such systems are known to me: they are called Visi-Calc and SDMS, but we have no time to go into them here.)

1/4

HOPE 2. ACCESS TO IDEAS

In a day of the "information explosion," with more and more being _printed_, the most up-to-date people use the telephone much more than the library.

The second hope I mentioned earlier was that we could read from and write on screens with new freedom. Those of us who grew up passionately believing in ideals that made our country great, such as liberty and pluralism and the accessibility of ideas, can hardly ignore the hope of such an opening-out. Libertarian ideals of accessibility and excitement that might unseat the video narcosis that now sits on our land like a fog; with alternative explanations so anyone can choose the pathway or approach that suits him; with ideas accessible and interesting to everyone, so that a new richness and freedom can come to the human experience; a rebirth of literacy; etc. All that is what this book is about.

Yet dammit, what's worst is everybody lacking a sense of urgency. This is the eleventh hour of the human race, man. There is a deadly urgency about everything we do.

LET'S DO IT

These two hopes-- the simplification of our lives, the cornucopia of ideas and writings and pictures-- are the focus of my own work. Twenty years ago, in graduate school, the two hopes I have mentioned came to me, as I hope they have come to you one way or another. I have put a lot of time into trying to make these things happen in ways I consider right, which I used to think were obvious to any idiot but apparently aren't.

In future writings I will deal further with the design of simplicity. (Meanwhile my two-part piece, "Interactive Systems and the Design of Virtuality," in the November and December 1980 issues of _Creative Computing_, is A START.

In the current volume, however, I will deal simply with reading and writing from screens, and the universe that I think is out there to create-- and then explore and live in. Vannevar Bush told us about it in 1945 and called it the memex ("As We May Think," _Atlantic Monthly_, July 1945, 101-8), but the idea has been dropped by most people. Too blye-sky. Too _simple_, perhaps.

1/5

This book presents a dream, a wild
surmise that perhaps many have had but
most have kicked under the bed as unfit
for daytime contemplation. I have
tried to capture it, a ludicrous
butterfly-hunter scampering through un-
known territory.

Okay, maybe it will turn out to
be impossible. But if not the details,
if not our valiant try, perhaps the
vision may endure-- and perhaps also
some readers may achieve an expanded
realization of what it means to make
simplicity happen.

I think this whole dream is pos-
sible. I may be wrong but I've given
it my best shot, and here you are.
This book describes it so that the rea-
der-- anyway, the technical non-timorous
reader-- can decide if it's something

he wants. If not goodbye. If so, well
-- join the club. We can be reached.

1/6

THE SENSE OF WONDERFUL DEVELOPMENTS

No alert person, drubbed by popular magazines and TV news, can fail to have heard that we are on the threshold of some sort of new era in the user of information. Soon, we hear, we will be able to get at the Library of Congress stored on a disk, or movies in a pinky ring, and information that we want vaguely may come at us without our even having to ask.

A hundred jarring systems are confuting. Many media moguls-- "smart money"-- think they have it all worked out; although in different directions. Corporations are being formed. The hearts of investors are palpitating. Foundations and federal agencies are continuing to put out money for breakthrough showcase projects. Yet, in my estimation, we have not a state of progress but a state of confusion. Never before have so many accepted the unrefined technical fantasies of the few. Never before has so much been spent for what has been so little understood or thought out.

Unfortunately, the public has no simple comprehension of the varieties of possibilities, the vast range of options. They will believe anything they are told except the whole picture, which nobody tells them. Laymen have no longer the slightest idea of what is going on. The gap widens continually.

This sort of thing happens easily in any field. Technical people create catchphrases, and people from outside, eager to be up-to-date, seize on the catchphrases as received wisdom, ideas that seem to span and comprehend all the possibilities. Those outsiders now spread the gospel to their own corners of the world, never quite sensing what an arbitrary selection has been made for them; failing to ask pointed questions, they in turn become opinion leaders for other outsiders who are even more afraid to ask. To mix parables, it is as if the blind men, after evaluating the elephant, then lead the other blind men in their several directions.

LITERARY

MACHINES

A variety of people are proposing arrangements by which other people, meaning we the public, should handle information in th future; and accordingly the public ought not submit with docility to just whatever may result spottily by chance. A phrase often heard is, "anything you want, instantly." On closer investigation, however, it turns out that there is much disagreement as to what you want, as well as considerable disagreement as to what instantly means.

(In my book Computer Lib I endeavored to sort out for laymen the differences between the fifty or so most important systems for retrieving and presenting information. That book has done rather well, but mainly among readers who already knew the subject.)

THE CABLE BABEL

Videocable operators think the public is ripe for about anything they offer. (Indeed, in England, France and other countries so-called "videotex" and "teletext" systems are already in operation, offering a variety of specialized information to the TV user, and their enthusiasts think it could revolutionize the world.)

THE OFFICE OF THE FUTURE

Souped-up "workstation" computers on one big cable, the Ethernet: that's the Xerox vision, supported by DEC and Intel-- mighty computer corporations.

HELLO CENTRAL, GIVE ME HEAVEN

Another view is held by companies that are selling office interconnect systems built around the telephone-- such as Rolm and Datapoint.

TEXT SYSTEMS

Computerized text communities are springing up. Offices find they can tie their "word processors" together, speeding information between executives. Time-sharing systems offer "electronic mail," which has the advantage of not interrupting the recipient (as does the telephone), but still getting a lot communicated fast.

A crucial development, the Arpanet connects university and military computers all over the country. It turns out that its main use, though, is sending messages among its users.

1/8

All this has led the post office to jump into "electronic mail" with both feet; its new ECOM service will begin next year.

Computer Bulletin Boards, "Community Information Systems," teleconferencing systems, all are creating new communities that share text via computers. The armed forces, too, have complex text systems (where commanders can read all messages of those below them, but not vice versa).

ELECTRONIC PUBLISHING

Electronic publishing is coming, this much all agree on. Just what it will be is not so clear.

For some five hundred years the educated public has been reading from books and magazines of paper.

Now all of that may change.

As screens become more and more available, there is less and less reason for printing on paper. The costs of wood pulp and gasoline, the long lead times of paper editorship and production, the increasing divergence of specialized interests, the lowering cost of computers with screens, of disk storage and digital communications, all suggest this.

Beginning thinkers in this area often suppose that what will be offered to the screen reader will be merely individual stored documents, available on line quickly, but based somehow on conventional documents enstling in conventional computer files.

Our point of view is different.

Many approaches to electronic publishing are very complicated. But that can't work on a broad scale; "publishing" suggests use by the public. Meaning simplicity.

1/9

WHITHER?

All these approaches are differ-
ent. They _seem_ to be converging, but
are they? They do not combine well;
hooking them together creates some-
thing like the New York subway system.

The point of view I would like
to suggest is that we need unified de-
sign. It has to be simple. It has to
be powerful. It doesn't have to be
complicated. In fact, _can't_ be compli-
cated. And perhaps it can be built
from the "document" as we have long
known it, the "author" as we have long
known him, and an extended form of
"writing" as we have long done it and
read it, rather than what some people,
such as McLuhan and the video freaks
and the CAI folk, have been telling us
would be anonymous, colle-tive, scram-
bled, psychometric, and/or Boolean.
I believe there exists a clean, com-
plete and thorough solution.

1/10

TWO CULTURES FACE THE FUTURE

C.P. Snow pointed out long ago that there are two educated cultures, the culture of technology and the culture of the humanities, and they don't talk to each other. That was twenty years ago, but it's still true.

Not only is it still true, but the two cultures have united on a _false_, _agreed-upon_ _definition_ _of_ _what_ _computers_ _are_. In this polite conspiracy the members of the two cultures, technical and literary-- who rarely talk to each other -- have it all figured out.

Their false notion of computers is that they are Inhuman, Oppressive, Cold, Relentless; and that the somehow Reduce Everything to Mathematics.

One camp says "yessir, and I run 'em," and the other camp says, "I want no part of it."

Never mind wat computers _really_ are. This view, in its two variations, is a strange fact of our culture and psychology. But it has virtually nothing to do with computers.

To throw things in a sharper light, let me refer to those with technical training as the _Technoids_ (or Noids for short), and I will refer to those with a humanistic background, in literature, history, the arts, etc., as the _Fluffies_.

LITERARY

1/11

MACHINES

THE NOIDS

The technoics have an exaggerated and caricatured notion of what constitutes clear-minded thinking, and never miss a chance to denounce other cognitive styles as "illogical." Or to denounce people who have difficulty learning the complicated systems they, the technoids, dream up.

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. But that's not the myth. For some reason a rigid and punitive notion of "logic" is important to such people.

NOIDS' OUTLOOK

The technoids are usually hired guns, interested in the next complex problem they can get into. They generally have an obsession with favorite methods, and a negligible concern for history, art, literature or human freedom. Indeed, some of them like to oppress (and some of this type get to head computer centers eventually).

In a famous experiment, psychologist Stanley Milgram, wearing a white coat, instructed unsuspecting subjects, who thought they were merely paid assistants, to push buttons that would inflict terrible pain on others. To Milgram's chagrin, nearly everyone followed instructions without a qualm.

This in a way characterizes the Technoid mentality. If the government solicits bids on a Deterrent Weapons System that will selectively barbecue only the small children of an Aggressor Nation, the technoid will probably say Yes Sir, Can Do, What Color Do You Want the Corpses? While the Fluffy who has read Sophocles and/or Tocqueville may be slightly more likely to say, Wait a Minute...

1/12

THE FLUFFIES

The Fluffy cognitive style leans toward vagueness and the reduction of issues to vague idealistic terms (they being unused to specifics except for Metaphors and Object Correlatives.) Their disposition is always to get away from specifics as being mundane and/or Sociological.

And they do not like computers or the idea of screens. "I love books," "I hate computers," "It sounds so cold," "I can't take it on the train (in bed, in a hammock, into the woods)" etc. "I can't see cuddling up with a CRT in bed." They have no conception of the importance inad immediacy of creating an electronic literature that reflects their own values.

I have experienced many levels of Fluffy negativism to computer ideas, which I call (simply as a measuring-stick), Fluffy-Indifferent, Fluffy-Resistive, Fluffy-Hostile and Fluffy-Aggressive. WE NEED NOT GET FURTHER INTO THIS AT THE PRESENT TIME.

LITTLE CORNERS

About the only thing the groups have in common is their shared view of computers. Their views of each other are mutually derogatory, roughly on the level of "Youre the one who eats weird food, not me!"

But one interesting aspect of the two cultures is their view of each other in the world. Each sees the other group as "those people in their little corner, unaware of the big wide world."

To the Fluffies this real world is history, art, literature, and the little corner is "technical things." To the Technoids the real world is that of Technical Questions and Ideas, and the little corner is the artsy-craftsy nook of bygone concerns.

1/13

SYSTEMS HUMANISTS

As you may have suspected, I
see another point of view. As far
as I am concerned both the Technoids
and the Fluffies are in their own
little corners. In the broader view,
the goals are the long ones of civ-
ilization-- education, understanding,
the preservation of human values--
but we must use today's technologies.
I call this view systems humanism.

Civilization as we now know it
is based in part on running water.
That system had to be thought out.
Similarly, somebody's gotta design
waterworks for the mind. But it
should be someone who understands the
fluidity of thought.

1/14

A BRIEF HISTORY OF THE XANADU CAPER

Eagles don't flock.
You have to find them one by one.

H. Ross Perot

Expeditions and projects do not end in the spirit they began in. This thing began with long walks in Cambridge and has become different sorts of ordeal for many people.

Complicated ideas evolve slowly. People who do not work with ideas a great deal may not always realize the many steps, guesses, postulations, reconsideration and general mucking about such things entail.

In retrospect it is baffling. I know now that there was no reason to expect to find technical secrets-- they just happened to be where no one else was looking; there was no reason to expect a collection of eccentric geniuses devotedly to work the thing through without salary, but they did; there was no reason to expect we could advance to this point while retaining the majority ownership that assures it will be done right. But we have. Strange forces are at work, and we will try to stay tuned.

Of course, anyone else would have found the same things, if only he had looked in all the right places. But from the literature it does not seem anyone has.

Through all of it we applied a relentless pressure for consistency and simplicity, and the thing cooked down remarkably. The amazing fact was that it has worked, that the hard technicalities could be pushed to fit soft ideals. But only by intricate search. This could not have been done with schedules and deadlines. When a project requires both exhaustive exploration and unusual inspiration, it is going to take however long it takes.

LITERARY   1/15   **MACHINES**

OBLIGATORY "ON THE SHOULDERS OF GIANTS" PARAGRAPH

I far prefer to work alone on complex ideas, without other people's diversionary, obtrusive and irrelevant suggestions. It would never have occurred to me that I would have ended up assembling and shepherding a group of people smarter than I who would actually get the thing done, and get it done right, from time to time overruling my own ideas.

The project has from the first been carried out in a conspiratorial atmosphere on the assumption that I (later we) understood something others did not understand, and reached for ideals others were not yet ready to comprehend.

It would have been nice to get advice from Jefferson and DaVinci and some other heavies. (Just a "nice going" now and then would have helped a lot.) Unfortunately they weren't around, so we had to wing it. And the scholars and "humanists" who consider themselves the anointed heirs and guardians of their tradition weren't available for comment. So we have been thrown on our own resources.

WE WANT IT, YOU SEE

This thing has been created because I and later my collaborators, wanted to use it. I have been sharpening a very big pencil for twenty years, and hope to live long enough to finish the other writing I have been accumulating so long in note form.

It may be of interest that we who made it want to be ordinary users of the system. The group is not, as a rule, particularly modest or retiring; the fact that we have created a system on which we desire no more than to be ordinary users should be taken to indicate, not that our wants are modest, which they are not, but rather that we want to put an emperor's resources at the fingertips of all users, especially children and scientists and poets. ("At last I can live like a human being!"-- Nero, on completion of his palace; "There need be no titles of nobility since there will be no higher honor than to be called Citizen."-- Constitution or Federalist papers someplace.)

1/16

ALONE

I hated school all my life, from first grade through high school, unrelentingly and every minute. I have never known anyone who hated school as much as I did, although my assumption is that other dropouts do.

I dropped out of school in the seventh grade after one altercation too many with a certain teacher; sent from the room I kept on going. That was the basic dividing-line of my life. The sense of defiance, of finality, of burning my bridges, of contempt for the sheep who put up with it all, are with me yet. Cajoled back after a year out, I found nothing had improved.

My real education took place in bookstores-- to which I would sneak when avoiding the hated sports; in movie theaters (I lived where you could see a lot of English movies), from conversations with my grandparents and great-grandparents. And from magazines.

When I was twelve, my heroes were Bucky Fuller, Bertrand Russell and H.L. Mencken, as I recall. Also Walt Disney, of course, and Orson Welles.

A big moment in my life was when my grandfather took me to an exhibit of DaVinci's inventions. It was in the IBM building on 57th Street. I thought, "Wow!" What a great company IBM must be, to back a guy like this!" I was young; perhaps my expectations of IBM from that experience were too high. I always had a low threshold of indignation.

College turned out to be not like "school" at all. At last-- people were interested in ideas, in talking.

I did Philosophy, the gentleman's major, and explored things. Doing things from scratch, ignoring the way things had previously been done-- that was my thing; trying to start from first principles with unclouded vision. (There is a moral issue here. It is as wrong to do things because others don't do them as it is wrong to do things because others do. What should be done cannot be ascertained from watching other people.) I got out of college expecting to find new things to be done that others hadn't. I was proud of my own powers of abstraction and conjecture.

1/17

COMPUTERS

My second year in graduate school, fall 1960, I took a course in computer programming. The instructor, Arthur S. Couch, was an easy-going and reasonably well-informed guy. One of the things he told us right off the bat was that integrated circuits would make computers small and cheap very soon, even though the only computer at Harvard was the 7090 up at the Smithsonian Observatory-- a big machine indeed.

I will always be grateful that the course did not cover Fortran, and that instead we got into machine language and assembler-- the Real Stuff that let you see what really happened in the machine.

I announced as my term project a writing system for the 7090: the idea was to store your manuscripts in the computer, change them with various editorial operations, and print them out. (When this became commercialized years later, it was called "word processing." I called it, at the time, "text handling," which still seems to me the more appropriate term: you do not <u>process</u> words, you simply put them away and get them back out.)

My specs for the term project went much farther, however; the obvious notion of being able to revise text seemed to me obvious and inconsequential; the really <u>important</u> features would have to do with the organizing of the text for the user's benefit. So I designed in the additional features of alternative versions, historical backtrack, and revision by outline. (I'm not sure presently whether "links" were in the first specs or not.)

It seemed so simple and clear to me then. It still does. But like many beginning computerists, I mistook a clear view for a short distance.

While it was obvious that <u>interactive</u> computers-- "one person, one computer"-- would be along in a year or so, tat system had to be configured around input commands punched on IBM cards. I had a dumb little input language worked out.

The long and the short of it is that I wrote thousands of lines of 7090 assembler code-- I think in the range of 40,000, but I'm not sure.

The project was not finished. I got an incomplete. Since Couch was such a good fellow, I suppose I might've found some way to make up the course, but I never did, which is one reason I only got a master's.

1/18

CAI

There was a lot of talk around Cambridge then about Computer-Assisted Instruction, for which there was a lot of money. I was originally all for it. After talking with CAI people, though, and rather soon after getting into the subject, my original editing ideas were expanded, and became what I first called the "thousand theories program"-- an explorable CAI "program" that would let you learn many different theories on many different subjects, at your choice. This rather quickly swung into what I would eventually call "hypertext"-- non-sequential forms of writing involving links. This was essentially my second design.

My other studies meant nothing to me now. I wanted to be in Computers-- but at that time there prevailed the silly notion that computers were "mathematical," and being a mathematical incompetent I was unable to get a job in the field.

THE PORPOISE WORKS

I did manage to find other interesting work, however, and went down to Miami for a year at John Lilly's dolphin lab. There I fed and petted the dolphins, got splashed by the notorious Elvar, and did photography and movie editing for Lilly's enterprise.

Lilly had a computer-- one of the original classic LINC computers developed by Wes Clark-- but that was somebody else's department, and I got no chance to use it, though it would have been ideal for what I wanted to do.

Still looking for a way to break into computers, and convinced that this revolution was right around the corner, but mystified at everybody's general obtuseness as to where it was going, I took a job teaching sociology at Vassar-- partly because I now had a family.

Now I was thinking about a third system, combining the old text editing and idea-management stuff with non-sequential writing. So a third system gradually became clear at Vassar. My notion was that of having sequences which could be linked together sideways; zippered lists, I called them.

The Vassar job provided time to start writing articles. And, to my amazement, I found it easy to get articles published.

1/19

PUBLISHING ARTICLES

My first paper was accepted by the ACM national conference, 1965. It was in Cleveland, but even so, I was thrilled. The audience was some 800 strong, and they really liked my presentation. (Little did I know it would be downhill from there.) I was briefly lionized in the field. I got invited to a VIP-researcher wingding at Lincoln Labs.

Then people lost interest. I was talking about the structure of ideas, and thus how to set computers up to hold them. Nobody got it. Everybody was listening for something else. Some people didn't want to see what I was saying, calling it "blue-sky" and "arm-waving"-- in other words, they basically lacked the capacity to visualize. If I had understood years ago how little capacity most people have for visualizing things, I'm sure I would have gone about matters rather differently-- though I can't quite see how.

I've also learned that most people are afraid of (and/or angered by) new words. Unless a thing comes on just the right silver platter, people don't want to think about it.

Since that time, always thinking it would help, I have wasted an unconscionable amount of time writing articles and giving speeches. I have come to learn that people's viewpoints are so entrenched, and their abilities to listen generally so negligible, that it is just not worth it. And most people aren't interested in ideas.

PUBLISHING HOUSE

My next job was at a large book firm. I wrote to its head; he was somewhat taken with my ideas and hired me; I reported directly to him. I have found then and since that the people at the top listen and understand better. This man was the brighest I have ever met.

He almost backed the Xanadu project-- it would have been at an opening budget of a qurter of a million-- but then they decided to go into CAI instead. I demurred, expressing my views of CAI, and we parted company.

This is when my designs got the name "Xanadu," it being a traditional name for a magic place of literary memory.

At that time my main design took the form in my mind of a sort of super Executive's Console, self-contained. But the idea of communicating between such devices was beginning to get through to me.

1/20

STRETCHTEXT

One of the hypertext designs I work-
ed on at that time I called "Stretchtext."
It was a stretchable form of text with a
pyramidal structure. As you explored it
got longer and shorter.

It was designed for the writing (and ex-
ploring) of history. It was actually de-
signed around a Tektronix display, which
is pretty hard to zoom on. (Zooming i-
deas have recently become popular, espe-
cially with the SDMS work of the Archi-
tecture Machine Group.)

SPOOKS

A government Intelligence Agency
contacted me. I was so flattered at
first, and so sure they must be very
smart to have gotten in touch with me,
that it took a long time to realize what
chowderheads they actually were. They
led me on, wasted my time, and had me
form a corporation on promise of big con-
tracts. No dice. However, some of the
ideas I presented to them finally got
through, as is evident from a recent book
about their new system.

RING BUFFERS

In the 1968-70 era my concern was the
organization of streams of data babbling
through core memory, especially for use
with "calligraphic" displays. I did cle-
ver stuff but it later turned out not to
be the heart of the problem.

I spent about a year working on mili-
tary text systems for a big lab. No i-
deas resulted.

A CERTAIN UNIVERSITY

About that time I wasted thousands of
hours and thousands of dollars of my own
money commuting to work with a group at a
well-known university, but it turned out
not to have been worth it.

They wanted to create a hot text sys-
tem. My attempts to communicate the
sorts of non-trivial structure I though
were necessary for that system were dis-
missed as "raving" and "flaming." That
there was a more sweeping outlook in my
ideas beyond what they were choosing to
implement was not considered by them as a
possibility. They took rather the posi-
tion that they had extracted the small
gleaming insight in a morass of absurd-
ity.

1/21

I emphasized to the system's developers that the word hypertext, as I had already defined it in print, properly referred to non-sequential writing, and that the interactive system itself should not be referred to as "hypertext."

To no avail: they consistently muddied up the terminology and referred to the damned thing as "Hypertext," with a capital H, to the galling effect that it has been referred to widely, since, as "IBM's Hypertext," with the capital H. Having been released through the IBM program library, it is available through IBM, but hypertext it certainly isn't.

I broke off relations with them not long after being required to sign a groveling paper saying that the "ideas" in the system were half theirs. I suspect the system has been widely influential in the development of "word processing," but who cares.

THE XANADOERS

By this time an individual named Jonathan Fagin invested some money in what I was doing. This brought a sense of movement; I recruited two others who moved the work on considerably. These were John Ridgway, then a sophomore at Swarthmore, and Cal Daniels, who then worked at Minicomputer Systems, Inc., and who had written their cassette tape operating system.

JOHN RIDGWAY

A clever second-generation Swarthmore student with hair down to his shoulderblades,-- incidentally, the first second-generation programmer I ever met, they were rare in those days, John Ridgway was an 1130 Fortran and folk-dancing whiz. And a very enjoyable guy. Naturally we implemented in 1130 Fortran.

CAL DANIELS

Soft-spoken, warmhearted, quietly clever. He lived in a section of Queens that looked like Old English houses, but the bachelor's interior of his own was startling in orange and tiger upholstery.

Cal was black, so-called, which does or does not deserve mention. The neighborhood kids teemed in and out of his livingroom to play chess.

Good meals, long evenings of discussion. I would explain something and Cal would stroke his chin and bob his head and say "Mmm..." And it turned out he saw problems far past where I was looking.

Cal's death in 1978 was a sorrow to all of us.

1/22

DISCOVERY OF THE ENFILADE

So the years 1971 and 1972 were essentially devoted to the problem of disk management and editing-- which turned out to mean Data Structure and fast editing methods that would always be up to date.

Gas was cheap then. I zoomed a lot between my Manhattan apartment, driving back and forth and back among Ridgway at Swarthmore, Daniels on Long Island and the R.E.S.I.S.T.O.R.S. kids' computer club in Princeton, talking the system, hashing details.

Anyhow, somehow we discovered the system we now call the first enfilade-- the Model T-- the data structure that manages huge agglomerates of text and their arrangement in and out of core, and which with its attendant routines edits fast and clean. Still secret, unfortunately, it is the granddaddy of the other enfilades which constitute our system.

Records of the discovery are spotty. However, it is clear that the Model T enfilade was fully formed by 6 March 1972, according to my design notes of that date.

Anyway, appropriate credit will be apportioned later when we can all sit down and figure out what really happened. Certainly it is the case that the help and advice from the Resistors (especially Nat Kuhn and Glen Babecki), and the detailed analyses of John and Cal, meant a great deal. I also vaguely recall jumping up and down and whooping with John Ridgway (in Parrish 22 at Swarthmore College) when we had discovered something incredible and codified it on the blackboard, but on combing hundreds of pages of notes that moment does not jump out at me.

In July 1972 the "Calgol" version was completed-- Cal Daniels' version of enfilade editing written in Algol-- but we had given the Nova back and had no chance to try to run it. (Too bad, because we could've had a fine, cheap word processor easily.)

Meanwhile John Ridgway continued with an interpretive version in 1130 Fortran. It eventually ran-- and actually drew a picture using its interpretive screen-language (which we called DINGO)-- on a Calcomp, in September 1973.

CIRCLE CAMPUS

In '73 they brought me to the University of Illinois in Chicago. A few weeks there made it clear I woudln't fit in with their computer establishment, so I contrived to write Computer Lib. I published the book myself in, I believe, August of 1974. It was an instantaneous success. Hundreds of orders came in. (At this writing some 40,000 have been sold.) It didn't make a lot of money-- clumsy business arrangements-- but its hidden invitations were to bring in the guys who would finally finish the work.

1/23

BILL BARUS

At about this time William F. Barus, whom I had known long before as a kid, took an interest in the Xanadu work.

Bill Barus was a graduate student in philosophy, brilliant, famously incomprehensible, with the unworldly kindness and deep moralism of a Li'l Abner.

It took Bill perhaps six months in the mid-seventies to work through with me the design of the system up to that date, since he was not satisfied merely to understand it; he needed to understand the theory behind each decision, the frame of mind, and the possible alternatives that might have been overlooked.

Then he thought about it for another six months, and tried out many conceptual alternatives. (We were sure, though, that we were going to create the system in PDP-11 machine language, using 16-bit codes for everything.)

My precious system up to that point was good on text storage but bad on links. Bill announced a solution that would fix that. His new method would allow linkages to keep up with all changes. It was instaneous and permanent and could grow indefinitely. All changes, once made, left the file in canonical order, which was an internal rule of the system.

I did not understand Bill's solution for a long time. Like many others who have encountered his remarkable mind, I sometimes had great difficulty in following his ideas; so understanding it took another six months.

Until Barus' remarkable discovery, what we could do was essentially what anybody could do-- fast lookup that did not degrade too badly for large files. But Barus's work, which we refer to jocundly as "the eye in the pyramid," made possible an efficiently ever-linkable enfilade, a whole universe of poly-enfiladic structures. While his particular designs have been superseded, his stunning insights opened the way to the world of unlimited linkages we believe we have found.

By now the personal computer field had opened up, and Barus and I tried several business ventures "to support the Xanadu work." But as in most cases of doing B to support A, A quickly got swept aside as we got swamped.

On an off chance I got a brief teaching appointment at Swarthmore, a chance to teach my own stuff. It didn't work out well. It proved more difficult to teach my own stuff, not easier. But trying to say certain things clearly for the first time did help my thinking quite a bit.

1/24

THE FINAL IMPLEMENTATION SQUAD

During 1978 a group of accomplices finally coalesced for the final assault; pledging lives, fortunes and sacred honor, and mostly a whole lot of time.

We are devoted capitalists all-- I from hatred of committees, blunted creativity and the dilution of thought; they from desire for their own space shuttle. Virtually all of us had awful school experiences; the fire that has driven this had to do with hopes for real change and liberation of the mind. Not your everyday people. Bright guys who had a rotten time in school. Spacers, two of us, anxious to get off the planet immediately. And propelled by knowing we were onto something.

MARK MILLER

Mark Miller, at that time a Yale undergraduate and fan of <u>Computer Lib</u>, lived in Philadelphia. We talked virtuality for a while, then the Xanadu system. A superb programmer and remarkable theoretician with an infections smile and ingratiating waddle, he makes everybody happy; this despite his constant complaints about ther being too much gravity, and continual demand for the immediate abolition of all governments.

STUART GREENE

Stuart Greene had taken both my courses at Swarthmore, but went on to get a film degree at NYU. Devastatingly clever and probingly elfin, Stuart was teaching holography while he was in highschool and frequently goes on Buddhist retreats. In all things requiring manual coordination he is astounding, supposedly due to Zen meditation.

ROGER GREGORY

Roger Gregory defies description. Roger Gregory defies everything. Knowledgeable adn rancorously opinionated on all subjects, he defies you to argue by expressing himself as fiercely as possible. Miraculously, most people like him a lot, perhaps because he wastes no energy in hypocrisy. Some, however, would find him unkempt.

I first met Roger at some science-fiction convention in Chicago. He has gradually taken over day-to-day supervision of the project, cajoling, snarling, and demanding hotter spices.

1/25

ERIC HILL

While it was alleged that at fifteen he was involved in misdeeds involving a government computer over the phone, Eric was chortled out of juvenile court by an amused judge. In high school he was active in DECMUG (Digital Equipment Corporation MisUsers Group). He knows Systems. He is also more suave and worldly than the rest of us now that he is out of highschool.

ROLAND KING

Incredibly gaunt and thin, gentle and soft-spoken, Roland was a graduate student in formal linguistics when he joined us. The vanDyke beard suggests a Robin Hood, but underneath burns perhaps a fiercer Libertarian than all the rest of us. With his soft Southern accent, ever-present cigarette, faraway look and incredible graciousness, he is that member of the group on whom the term gentleman would sit most comfortably.

THE AUTHOR

Oh yeah, and myself, glib, eager, sloppy, impatient, always behind. For 1980, during much of the group's work, I edited Creative Computing, which was the wrong way to spend the time but an interesting experience. It also permitted a little spreading of the word.

TWO YEARS BEFORE THE VAST

In the summer of 1979 the group rented an idyllic tree-shaded house and we designed. No premature coders we. Ever probing and reformulating, the group redesigned Barus's linking enfilade system, designed the historical trace enfilade, formulated the general theory of envilades (that the work of Miller and Greene) and by the end of the summer got into actual programming. The language, of course, is Bell Labs' C.* Despite a constant lack of funds, we muddled through.

It was a very special time: dolce far niente design sessions on the porch with blackboards, long evenings talking design while Stuart, with his back to us, conquered Apple Breakout with one ball over and over. A special experience was a number of afternoons we spent with the very wonderful John Mauchly, listening to his reminiscences.

The group has fiercely and relentlessly pushed for generality. Several of my pet ideas went out the window, though they hung onto the sill for a time. One of those was the "literary link" formulation, expounded in various of my articles since about 1975, which is too tricky to go into at the present time.

* Lifeboat Associates' BDS C under CP/M was God's gift to us-- well, actually, the gift of its creator, Leor Zolman. It's terrific.

1/26

(I wanted to restrict the link-types in the interest of simplicity. No, they wanted complete generality, and they were right.) Another was my notion of a separate Thinkertoy system. Everything got pushed into the front end, so that our system gradually became only the back-end feeder system of the present design.

A Xanadu joke. How many Xanadu people does it take to change a light bulb? "None, that's a front end function."

Roger kept up the momentum when the group disbanded in the fall. He got a job programming reactors in Pascal and rented a house in the Valley Forge area-- Xanadu House-- while the fluctuating group continued its work.

Summer 1980 saw the final assault. With the help of Steve Eberbach in Ann Arbor we bought an Onyx computer on time; it has worked well and sped development. Different enfilade structures sprang to life, fell back, were born again.

The group removed to Ann Arbor in January and moved in with Eberbach. And a demonstrable version of rearranges was announced by Roger on 21 April 1981, as this book was being put together. A single-CPU system is a short distance away; and we believe we know how to do the rest.

* In the world of enfilades there are a few dark clouds. One is the Primal Grinch, a curious phenomenon whereby if you make an insertion, deletion or rearrangement which is a prime number of bytes, you may be subjected to a significant random delay. We think we know how to get rid of this, but it is not our first priority.

1/27

FATE ACCOMPLI

This is a Caper story-- a beckoning
dream at the far edge of possibility that
has been too good to let go of, and just
too far away to reach, for half my life.
The intrepid little group-- my comedy
burglar team-- has gotten far closer to
this dream than any sane person could
have thought possible.

Though everything has seemd to block
our way, on balance the Fates have been
very much with us: laying down a trail of
crumbs, as it were, through a very strange
forest to a very unusual place. We pro-
pose to build a palace here and let you
all inside.

Whether the ground will hold, what
beasts and trolls may assail us here, all
remain to be ascertained. We have done
our best and will continue to do so.

We bring banners. We have held to
ideals created long ago, in different
times and places, the very best ideals we
could find. We have carried these ban-
ners unstained to this new place, we now
plant them and hope to see them floating
in the wind. But it is dark and quiet
and lonely here, and not yet dawn.

Now it is for you the reader to exam-
ine this place and say where, if anywhere,
you would rather be. We hope you share
our sense of urgency and of history. The
choices are fewer than you might have
thought, and perhaps they need to be made
quickly. Good luck to you, and to us all.

1/28