Telling Ripe from Hype in Multimedia: The Ecstasy and the Agony

Anthony G. Oettinger

Program on Information Resources Policy

Harvard University

Center for Information
Policy Research

Cambridge, Massachusetts

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Anthony G. Oettinger
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> John Sculley, then chairman of Apple Computer, Inc., who invited me in behalf of IBM, Microsoft and Toshiba as well as Apple to speak on *New Media in a Digital World — Whence and Whither?* at the Hakone Multimedia and Art Festival held in Hakone, Japan from July 31 to August 1, 1992.

> Dr. Myung Oh, then chairman of the Taejon Exposition Organizing Committee and Dr. Seungtaik Yang, then chairman of the 1993 Asia-Pacific Conference on Communications, which was dedicated to "Integrated Communications for Information Society", who gave me the opportunity to speak on *Information Age Choices: The Ecstasy and the Agony* in Taejon, Korea, on August 25, 1993.

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The many other friends and colleagues who helped set me straight know who they are. All these friends and colleagues and the Program's affiliates are not, however, responsible for or necessarily in agreement with the views expressed herein; nor should they be blamed for any errors of fact or interpretation for which I am solely responsible.

The present text includes some citations and corrections added in June 1994.

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Anthony G. Oettinger[1]

June 1994

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[1]Biography in Appendix A, page 29.

Preface

Just in case the "ecstasy" and the "agony" in the title made you think of a war movie, the coincidence was not wholly intentional. But it wasn't wholly unintentional either.

The assignment my colleague and friend Tony Oettinger gave himself was to provide an overview of the forces and currents at play in the information industries, and some of the sensation of being on the scene. There are, in my view, very few people who could credibly take on this challenge.

What form might such a thing take? Will he lay bare the underlying principles that make it all come clear? Will he throw up his hands and say "you can't make sense of this stuff — come back in twenty years?"

The answer is "neither". The good news is that there are some clearly visible and powerful forces at play. They're explained here. The bad news is that there are lots of them, and each goes its own direction and speed and force. It all adds up to a dynamic, foggy, heady, dangerous business with an ethos and feel unlike any other - in short "ecstasy and agony".

This is the full written form of a speech of which Oettinger presented abbreviated versions in Hakone, Taejon and Beijing as detailed in his *Acknowledgments*. Reading instead of attending a speech deprives the reader of the tones of voice, hand gestures, body language and other devices that add meaning and communicative power to a spoken text - a weakness rendered more acute by a text with the words "ecstasy" and "agony" in its title.

The hazard is that what comes across orally as a portrayal of dynamism and chaos can seem in writing to add up to a kind of lack of structure. No surprise, perhaps, but a potential disappointment.

Let me try to rescue the reader with an observation. Perhaps with the following thoughts as context, you can spare yourself the pain of trying to find a unity which isn't there, and participate instead in the complex flow of this amazing world.

Any clear and orderly structure to a description of today's information industries would *ipso facto* do them an injustice. Yes, there are comprehensible forces at work here, and

organized business companies and official government branches and pre-existing market structures and many other orderly things. In fact we try to smoke them out and describe them here. The trouble is that there are lots of them, and they don't all march in step.

Imagine a kind of super chaos. Imagine a gold rush. Then imagine a military rout superimposed on it. The stakes are high, the forces go in all directions, the pressure is immense, there are clear, fuzzy and non-signals pointing in all directions. There is no leadership. You can't trust anyone. Any choice could have huge upside and downside consequences.

If you're fond of nautical metaphors imagine yourself a captain in a large, closely-matched, eighteenth-century naval engagement. The chance is there for a decisive victory. A rising storm has scattered the formations and is forcing all ships onto a poorly-charted shore. Boats may be flying false colors. The admiral's signal pennant has been shot away. There you've got it! (These military metaphors seem inevitable).

In other words the disorganization in this paper is a deliberate choice. It is trying to reflect what's happening out there, and not weaken the accuracy with a false sense of order. As you read, don't try to superimpose a structure on the description, but let the ecstasy and agony of the swirling currents carry you along. We hope you'll understand — even feel from the inside — what's going on and why it doesn't add up.

Of course if you can pull it all together please tell us. In the words of Tom Lehrer's patter song which sets the chemical elements to Sullivan's music:

> "These are the only ones of which the news has come to Harvard.
> There may be many others, but they haven't been discarvard."

John C. B. LeGates
June 1994

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The ecstasy I refer to in the title is the ecstasy felt by myself and by others who live at the frontiers of the applications of computer and communications technologies. This ecstasy stems from observing that the marvelous cornucopia of smaller, faster and cheaper information hardware devices that electro-optical digital technologies have filled to overflowing in the course of the last half-century or so still keeps brimming over with fresh flowers and fruits or, to switch the figure of speech, this ecstasy stems from a continuing vision of the dawn of a new information age or information society coming just ahead. In practice, indeed, the fact that hardware has gotten so much smaller, faster and cheaper in so few decades often more than compensates for the fact that the software needed for complete systems simultaneously has been getting larger and dearer.

In many realms of application, this has made things better for buyers as well as for sellers by changing an economy of scarcity which stresses efficiency over effectiveness into an economy of plenty which stresses effectiveness over efficiency. We have experienced that kind of transition with pads of paper. In the 17th century, when Newton corresponded with Leibniz, both of them filled up every tiny corner of the paper, front and back, to use that scarce paper efficiently. In contrast to Newton's outlook, think about all the pads of paper each of us owns, all the books on our shelves, all the telephones and all the telephone directories in our offices, all the cars we drive, all of them unused most of the time: once things get convenient enough and cheap enough, the effectiveness of abundance (erstwhile wastefulness) overwhelms the efficiency of high load factor (latter-day miserliness). Commercial airlines, by way of contrast, still live or die in the late 20th century by their load factors, namely by how efficiently they use their expensive capital equipment. In the era of the PC, this transition from stressing efficiency to stressing effectiveness is well under way for computers[2] and, with the spread of optical fiber and LANs (local area networks), it is

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[2]I can illustrate this with a story about the birth of modern computers I heard when I was an undergraduate. In the late 1940s, I spent a couple of summers working at IBM's Watson Laboratory, then in Manhattan down the street from Columbia University. Way up my chain of bosses was a man named John McPherson, who had some responsibility for IBM's engineering. He also happened to be the son-in-law of IBM's founder, Thomas Watson. During that period, my mentor at Harvard was Howard Aiken who had, in 1944, unveiled what he called the Harvard Mark I computer and what IBM called the IBM Automatic Sequence Controlled Calculator. Aiken built his machine with help from IBM, help he had negotiated with Thomas Watson some time after 1937. John McPherson told me he had been present at a meeting where Aiken presented his ideas to Watson. He said that he

beginning to happen to telecommunications. So, if not ecstatic, many buyers are at least satisfied for many of their purposes.

The agony is from the simultaneous observation that the public, myself among them, is usually slower to smell all those flowers or slower to bite all those apples than entrepreneurs and technologists wish they would; that many of the fruits that look so ripe are only hype or, to switch figures of speech again, that it's not a new information age we see dawning, but just the flashing neon signs advertising yet another wave of the "new ages" or "new societies" that seem to churn over us with apparently increasing speed and turmoil, most of them to wash out on some beach where both prospective buyers and the prospect of bankruptcy yawn at them. In less poetic terms, its inventors may love a new system even while the marketplace sees it as merely another gadget, not a better product or service.

What accounts for simultaneous ecstasy and agony? For one thing, just as beauty is in the eye of the beholder, so are ecstasy and agony in the perceptions of each participant in the evolution of technologies and of markets. Buyers and sellers, among other categories of beholders, naturally see things differently: as the saying goes, "where you stand depends on where you sit"[3].

Here, I aim to clarify the root causes of the differing perceptions of buyers, sellers and others — such as referees, policemen or catalysts from governments. In essence, I'll sketch as competently and impartially as I can some fundamental forces and trends that I think underlie all the perceptions. My hope is that this will clarify how each of us, whatever our stakes in the future, might better steer a safer course through those successive swirling, churning information ages. "Interactive Multimedia", for which enthusiasm is so widespread in the early 1990s, will serve as a concrete example.

A word about my credentials for this task. Along with my associate John LeGates, I founded the Harvard Program on Information Resources Policy about 20 years ago to create knowledge, both competent and impartial, on controversial information-related matters. Our

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had counseled his father-in-law against supporting Aiken. I asked him why so. "Because", John told me, "my engineer's soul rebelled against the crazy idea of building a machine 90 per cent of which would be idle 90 per cent of the time".

[3]Appendix D, page 32, illustrates some seats and their standpoints.

idea of success was then and is now that this knowledge would be of high quality and that it would be trusted by any party to a controversy, anyone with stakes in the outcome of the controversy or, for that matter, by any bystander, so that the knowledge would actually be useful to these people in either their personal or their institutional roles.

Combining competence and impartiality is not all that easy. The Harvard Program on Information Resources Policy follows what still seems to be a unique process, with many ingredients, for addressing this problem. One of the essential ingredients of that process is research support that comes both in small doses and from the widest variety of sources whom we can convince to contribute their money to our work; we aim to be owned by everybody so as to be owned by nobody: no single sponsor can kill us just by withdrawing their support[4].

So, whence spring whose ecstasy and whose agony today, in our own *fin de siècle* of the late twentieth century?

The effects of smaller, faster and cheaper electro-optical digital technologies already are extensive after fifty years of evolution. Fundamentally, smaller, faster and cheaper electro-optical digital technologies have already vastly increased the range of alternative information products and services that sellers can dream up, develop and bring to market and that buyers of information products and services can choose among. Where once a few large sellers plus a very few large buyers were in control, the buyers in control have grown ever larger in numbers and ever smaller in size. No sphere of human endeavor has remained untouched by evolving electro-optical digital technologies[5]. In many endeavors, like airline, bank and even retail operations, normal functioning is no longer conceivable without computers and communications. In many other endeavors, like most manufacturing, operations would seriously degrade at the very least.

There's ecstasy in the early 1990s among the sellers of information products and services because huge markets have developed that didn't exist fifty, ten, or even 5 years ago and some even less than that. There is agony in the early 1990s among these same sellers because,

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[4]The list in Appendix B, page 30, gives a snapshot of where the money came from in July of 1993.

[5]My associate Martin Ernst has identified the information activities most profoundly affected to date as: correct-integrate, link-find, examine, analyze, interpret, sense. Ernst, Martin L. *Computers and Literacy: Redefining Each Other*. Research draft, Cambridge, MA: Harvard University, Program on Information Resources Policy, 1993. Table 4-3 "Computer-aided Capabilities to Support Improved Use of Information".

as their markets have become huge, they have also tended to become both highly competitive and increasingly fragmented[6]. Nowadays the buyer is in the saddle, controlling the markets and eroding the sellers' margins in increasingly competitive declining cost markets not just in such perennially dog-eat-dog precincts of the information businesses as the consumer electronics industry, but even in such genteel-for-a-while information businesses as the newspaper, broadcasting, computer and telecommunications industries where monopoly, near monopoly, and monopoly margins had become the comfortable norm of the previous few decades and had conveniently quenched memories of the dog-eat-dog beginnings of those businesses.

The agonies of "old line" computer companies like IBM are highly visible in the early 1990s. The divestiture of American Telephone and Telegraph Company (AT&T) in the United States in 1984 and the worldwide and ongoing re-regulations, privatizations and restructurings of telephone monopolies in the early 1990s are widely appreciated at least among cognoscenti. Simultaneous but less visible and less widely appreciated is the fundamental restructuring from the bottom up implied by unregulated marketplace phenomena like the rapid growth of personal computers and of local area networks (LANs) in the early 1990s. In spite of efforts by some traditional managers and government regulators, especially in telecommunications, to hold on to traditional ways all information businesses, those engaging in telecommunications

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[6]Classical telecommunications voice transmission products and services have been fragmented on economic and political grounds through elaborate systems of differential costing and pricing, as detailed in Weinhaus, Carol L. and Anthony G. Oettinger. *Behind the Telephone Debates*. Norwood, NJ: Ablex, 1988. From the standpoint of customers, as from a scientific or technological standpoint, telephony took sound from mouths and conveyed it to distant ears. These functional traits of the service made it as stable and as homogeneous a commodity as they come, given that the statistical distribution of mouth and ear characteristics is genetically determined hence very stable (and, after a century of study, extremely well understood, at least for transmission purposes) and that the evolution of the arbitrary conventions of human vernaculars is slowed by the very fact that languages must have some stability to remain effective as tools of communication. By contrast, end-user data applications are highly idiosyncratic, inherently fragmented by occupations, therefore presenting niche markets with clear commonalities only at very high levels of abstraction corresponding at the highest levels to commodities such as transport of uninterpreted bits. Even the statistical characteristics of bit streams are unstable and not well known at the turn of the 1990s. Unity or fragmentation of markets, however, is not causally linked to unified or fragmented industry structure, as Derrick Huang shows in his March 1994 computer science doctoral thesis at Harvard University *A Bang or a Whimper: Key Issues and Implications of Alternative Telecommunications*, in his *Up in the Air: New Wireless Communications*, Cambridge, MA: Harvard University, Program on Information Resources Policy, 1992, and in his *Managing the Spectrum: Win, Lose, or Share* Cambridge, MA: Harvard University, Program on Information Resources Policy, 1993.

functions prominently among them, are looking more and more like the consumer electronics, book publishing and apparel industries and less and less like PTTs.[7]

There's ecstasy in the early 1990s among the buyers of information products and services because of the continually widening range of choices that buyers are offered by increasing numbers of competitors among more or less better information products and services with which to fulfill their institutional and their personal responsibilities or desires. There is agony in the early 1990s among these same buyers because, as the range of their choices has become huge, that very abundance of choices — often where no choice at all existed before — has also become the source of indigestions (oh, so unreliable; oh, what lack of integrity of records, etc.) and frustrations (what is "better"? oh, that uninstalled software; oh, those "the computers are down" blues; oh, those claims of actually decreased productivity after computerization[8]; and oh, what terrible things TV and video arcades are doing to the young[9], etc.,etc.) and, I think most significant of all, the source of renewed and profound instability in the cycle of learning and experimentation that binds information skills and tools together into the bundles that we call literacy, numeracy, and artistic sensibility, bundles which make up a controlling element of the information infrastructure at least as critical as any information distribution systems. Distribution systems — old fashioned, or information superhighways to the field of dreams, or anywhere in between — are necessary for leading the water to the horse. But they are not sufficient to make the animal drink.

I think that the best and the worst are yet to come. The most exquisite of ecstasies and agonies still lie ahead. The mainstream killer applications of electro-optical digital technologies to date have done in a more efficient way the mental tasks which humanity has

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[7]The manufacturers of "switches" used in LANs and similar network growing out of the computer industry (Appendix C, page 31) compete with such well-known "classical" switch manufacturers as AT&T, Ericsson, Fujitsu, NEC, Northern Telecom and Siemens; in early 1993, many of the newcomers were growing at rates well exceeding 100% per year.

[8]The implication is that computers and communications are making the economy worse off. Sorin A. Bodea reviews the literature on this so-called "productivity paradox" in his March 1994 Harvard doctoral thesis in information systems and business management, *Key Success Factors in Efficient and Effective Transfer of Hardware, Software and Management Know-how to the Former Socialist Countries of Central and Eastern Europe*, especially in Chapter 2, "The impact of information technology and systems on business performance: the productivity paradox".

[9]An account more sympathetic than the usual jeremiads is given by Provenzo, Eugene F., Jr., *Video Kids: Making Sense of Nintendo*, Cambridge, MA: Harvard University Press, 1991.

done from the beginning of literacy, numeracy and art, and mostly the menial tasks at that. The full potential is yet to be realized.

An historical parallel is the transition at the start of the twentieth century from horse-drawn carriages to horseless carriages that had buggy whips and running boards mounted on them. Still ahead lay the automobile, the suburbs and the shopping malls that blossomed from the 1950s on. In the institutional mainframe world, the equivalent of using horseless carriages has been automating and globalizing the routine tasks of business and government — airline reservations, financial transactions, moon-trip and missile Newtonian ballistics, and so on. In the individual PC world this has meant writing (word processors), mathematics (math packages), accounting (spreadsheets, tax preparation and review programs), keeping track (data bases), and representing (graphics). Especially in the world of individuals by the millions (contrasted with the world of institutions by the thousands) there is still growth ahead in these buggy-whip-and-running-board applications, such as linking them, making them portable, making them easier to use, cheaper, more capacious and the like.

Fundamental change is beginning to happen in earnest in the early 1990s, as it has happened at only a few previous milestones of recorded history. Our exploiting the fruits of faster, smaller, cheaper electro-optical digital technologies — whether packaged as computers, as telecommunications systems, as music synthesizers, as fuel injection controllers, as video-arcade games or as brilliant weapons guidance systems — is having two major catalytic effects of central concern here:

> First, we are dissolving away the cords that tie together the traditional bundles of information conventions and skills we call literacy, numeracy and artistic sensibility, bundles we had come to live by in their present forms only since about the middle of the 19th century when they began to be born of the necessities and the possibilities of steam-driven technologies and societies[10]. This is divergence, not the convergence that seems to be fashionable in the early 1990s[11].

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[10]How the bundles were tied in the first place is detailed for England by Clanchy, Michael T. *From Memory to Written Record, England 1066-1307*, 2nd ed. Oxford, U.K.; Cambridge, Mass.: Blackwell, 1993, and by Altick, Richard D. *The English Common Reader*: A Social History of the Mass Reading Public 1800-1900. Chicago: Univ. of Chicago Press, 1957; and for the United States by Boorstin, Daniel J. *The Americans, vol. 3*: The Democratic Experience. New York: Random House, 1973.

[11]The only clear-cut convergence is the convergence of the science and the technology of all information devices and systems into the science and the technology of electro-optical digital devices and systems, as I've noted in Oettinger, Anthony G. "Compunications in the National Decision-Making Process," in *Computers,*

Second, we are embarking on a voyage of trials and errors of unpredictable length and unknowable destination. By fashioning new tools that exploit interactivity, virtuality, and multiple information modes (words, music, pictures, etc.) on a scale unprecedented in human history because they rely intimately on the necessities and on the possibilities of electro-optical digital technologies, we are discovering possibilities for entirely new information conventions and skills. These new conventions and skills encompass traditional 19th century-born literacy, numeracy and artistic sensibility but they also go beyond them in ways and extents as yet only barely fathomed, although we'll sample some of them up ahead (page 16). Whether there's convergence or divergence in the marketplace remains to be seen. On the seller side, in any case, much mutual fear and loathing was evident in the early 1990s, as for instance between Hollywood and Silicon Valley working folks, whatever alliances their board rooms might have contrived.

The new information conventions and skills then in their turn enable us to imagine new tools with which to apply the conventions and exercise the skills more efficiently and, mostly, more effectively. This puts new demands on the existing tools and stimulates imagining and building newer tools yet. Eventually the newest tools once again loosen the ties that bound the very bundles of information conventions and skills that shaped the demand for those newest tools. This triggers yet another evolutionary cycle, and so on. Meanwhile, several generations of information conventions and skills coexist in uneasy anarchy, dominated at the start by the traditional information conventions and skills but increasingly disordered by the waxing and the waning of numerous alternatives undergoing trial-and-error[12].

There is interactivity not only between the user and the tool at any instant, but both are redefining each other as they go. Although user skills and tools redefining one another is a process with numerous historical antecedents[13], there are three new elements here:

Communications and the Public Interest, M. Greenberger (ed.), Johns Hopkins University Press, Baltimore, Maryland, 1971, (with discussion by Ithiel Pool, Alain Enthoven, David Packard). This has no <u>necessary</u> consequences for industry structure, politics, markets or any other dimension of the evolution of information products or services.

[12]These processes are exemplified both in the design of any one spreadsheet system and by the evolution of spreadsheets since the original Visicalc; they are detailed in Ernst op.cit. Note 5 and in the following earlier publications: Ernst, Martin, *Users and Personal Computers: Languages and Literacy, Costs and Benefits*, Cambridge, MA: Harvard University, Program on Information Resources Policy, 1993; Ernst, Martin L., *The Personal Computer: Growth Patterns, Limits, and New Frontiers*, Cambridge, MA: Harvard University, Program on Information Resources Policy, 1991; Ernst, Martin L., *Electronic-Print Competition: Determinants of the Potential for Major Change*, Cambridge, MA: Harvard University, Program on Information Resources Policy, 1989.

[13]Various facets of the diffusion of new technologies are described by Cowan, Ruth Schwartz, *More Work for Mother: The Ironies of Household Technology from the Open Hearth to the Microwave*, New York: Basic Books, 1983; Basalla, George, *The Evolution of Technology*, New York: Cambridge University Press, 1989; Petroski, Henry, *The Pencil: A History of Design and Circumstances*, New York: Knopf, 1990 and *The Evolution of Useful*

- the tools in question are tools for mental, not physical work or play;
- the duration and the rapid pace of redefinition are unprecedented because of the unprecedented and enormous malleability and speed of computers;
- and the process is endless in principle because there is no end to complexity.

No matter how complex a process, just repeating it makes another process that's more complex — and that pattern is just a most elementary example. Increasing complexity would be self defeating, were it not that complexity under the hood, so to speak, can make the tool look and feel simple to the driver. Just as the self-starter, when it replaced the hand crank, made automobiles safe for men's arms and jaws and usable by women unassisted, so software packages of ever increasing under-the-hood complexity can make it look easier to the "driver" at the keyboard, mouse and screen. We don't care about the "inefficiency" if the resulting product or service is both more useful and cheaper than alternatives. This is one of the key ways in which faster, smaller, cheaper electro-optical digital technologies can make products or services better in a relatively clear-cut sense, although what this really means for workers and workplaces is a question addressed mainly by ongoing trial-and-error in businesses and other organizations to the accompaniment of a Greek chorus of falsehoods from economists and platitudes from business schools[14].

This anarchic, apparently tail-chasing, yet evolutionary process, when as rapid as it has been in the 1980s and as it promises to be through the 1990s, helps to account in substantial part for both the ecstasies and the agonies. The heroic and dedicated early adopters who dwell at the frontier outposts of innovation combine new tools, new information conventions and new skills to create apparent wonders. The entrepreneurial imaginations fired up by the wonders of the early adopters promise those wonders to the prosaic, fickle old-time dwellers of the comfortable hinterlands as a wealth of new applications that never could have existed within the old confines. Hence the ecstasy. But some products and services will be ripe, others only hype. Some products and services will be ripe but unwanted. Others will be seen as too complex; still others as too simple. And the ones successful at the expense of someone

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Things New York: Knopf, 1992.

[14]Sorin Bodea analyses some of the trials, errors, successes, falsehoods and platitudes are analyzed in his doctoral thesis (op. cit. note 7, 8).

else's market often enrage the losers into political action that changes the rules of the marketplace[15]. Hence the agony.

"What is ripe?" in any given period is therefore a key question for would be sellers and would be buyers alike to ask. But alas, the answer is usually forthcoming only from hindsight and not beforehand, so the question is one to which only a soothsayer would claim a valid answer with which to solidify the entrepreneur's or the early adopter's necessary faith.

Fortunately, "What is ripening" and "By what process is it ripening?" are questions that can be addressed with some hope for realistic and useful illumination of the choices available to buyers and to sellers and to the referees, the policemen and the catalysts of the marketplaces as they make their decisions.[16]

In the myths of the ancient Greeks, the goddess Athena sprang instantly and full-grown from the brow of the supergod Zeus. In the real world, true innovations usually reach big markets only after lengthy gestation involving considerable trial-and-error among a few early adopters, unless the innovation happened to plug right in, so to speak, to fulfill an already familiar function in a familiar environment in about the same familiar way.

Some apparent counter examples, like the rapid emergence of facsimile in the 1980s are just that: apparent counter examples. The following lament sounds contemporary:

> "The probable simplification of the facsimile [sic] system of Caselli, by which an exact copy of anything that can be drawn or written may be instantaneously made to appear at a distance of hundreds of miles from the original; and the countless other applications of electricity to the transmission of intelligence yet to be made, — must sooner or later interfere most seriously with the transportation of letters by the slower means of post."

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[15]The loser in marketplace competition often asks government or other political processes to "make a level playing field" for competition. Hence increasing competition is often accompanied not by "deregulation" but by increasing and more complex formal regulation or other forms of government/political intervention.

[16]Appendix D, page 32, further details the various standpoints from which ripeness is judged. For both ideas and their expression in this and neighboring paragraphs I am indebted to my associates Martin Ernst (as author of the works listed in Note 5) and John C. B. LeGates (in many ways but especially as constructive critic of Ernst's draft).

Its source, however, is the *Annual Report of the Postmaster-General of the United States* for 1872.[17] The poor man scared himself half to death at least 100 years too soon. All the necessary ingredients got ripe enough in the eyes of all the relevant beholders only at the turn of the 1980s when personal fax machines began to take off, much to the chagrin of the Federal Express company which had just bet on a market for facsimile offices from which mechanical delivery by courier or post would fan out to the ultimate destinations.

Other apparent counter examples illustrate that gestation and trial-and-error can take place in just a few years if there are entrepreneurs and early adopters willing to defy the conventional wisdom <u>and</u> the innovation can be useful standing alone rather than embedded in an environment many aspects of which must evolve to simultaneous ripeness. A story vouched to me to be true has it that IBM once commissioned a consultant study of the market for dry copying which concluded that carbon paper would more than adequately meet all foreseeable market needs. IBM consequently lost interest in the fledgling company then called Haloid Xerox. However, familiar copying in a familiar enough way (with the complexity of the new-fangled technology hidden under the hood, so to speak) vastly expanded because of the significantly greater net ease of doing so with the new products.

The continuing complaints of the older set about the difficulties of using TV remote controllers and the continuing evolution of that gadget illustrate an intermediate case.

Although no one is quite sure what anyone else means specifically when they talk of interactive multimedia in the early 1990s, the common generic element in usage of the term seems to cover expression using, more or less simultaneously, spoken, written, pictorial, musical or any other form of human expression about real or virtual or imaginary worlds.

Interactivity is hardly new. All of us, and our ancestors back beyond the dawn of history have had what we might call "innate interactivity" thanks to the speech format, the most ancient human information format we know of. Although highly interactive, speech lacked durability: once said, gone with the wind, except for what remained in the heads of speakers and listeners for their brief time in the sun. That is because until Edison invented the

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[17]*Annual Report of the Postmaster-General of the United States* for 1872. The Fiscal Year Ended June 30, 1872. Washington: Government Printing Office. 1872. The historian Jonathan Coopersmith gives a more thorough account of facsimile's tortuous road to universality in his "Facsimile's false starts," *IEEE Spectrum*, February 1993, pp.46-49.

phonograph in the last century, speech relied entirely on formats born inside our heads, issuing out of our mouths, going through the air to the ears of anyone within earshot and hence to their brains. Although fixed by physics and evolutionary biology, this format has always lent itself to very real, albeit space-and-time limited possibilities of what we nowadays refer to as creating open-ended structures as you go along and interacting with and controlling information. That's where languages as we know them were born and keep evolving.

By providing not only durability which frees the speech format from limitations of time and space but also unprecedented means for speech synthesis (relatively easy) and for speech analysis (from merely difficult to impossible, depending on what's asked for), electro-optical digital technologies have made ancient speech a modern glamour format of the early 1990s, with plenty of ecstasy at the renewed interest in speech's capacity for creating open-ended structures as you go along and interacting with and controlling information but also increasing agony as the realities of multiple perceptions of ripeness along multiple dimensions once again take their toll and markets expand by meandering inches rather than by leaps and bounds.

Digitally synthesized or at least digitally controlled speech, for instance, is nowadays routinely heard in airport announcements, in instructions for credit card phone calls, and in voice mail systems. Speech analysis has produced devices that enable handicapped people to operate computers with spoken instructions rather than by hand, although the process is still too cumbersome and expensive for routine common use. But the availability of voice-actuated and voice-responding tools in the workplace holds out the opportunity or the threat — depending on the beholder — of spoken "literacy" reclaiming not the exclusive hold it had before the upstarts writing and print came along, but at least some greater share than it holds now of the workaday human communications load. Whatever their intentions, advocates of universal literacy like Barbara Bush and Hillary Rodham Clinton seem unaware that they are helping the continuing enshrining of the 19th century in schooling investments without a forward glance to what the 21st might want[18]. The access to contemporary technology

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[18]The question of ripeness needs asking repeatedly, to reduce the odds of going unawares from the premature scare of the postmaster general to the belated recognition of the value of dry electrostatic copying (page 9). In following the question in this realm over several decades, I've found negative answers until now, but the tools are getting better! My prior assessments are in Oettinger, Anthony G. *Proceedings of a Symposium on Digital Computers and Their Applications*, Annals of the Computation Laboratory of Harvard University, Vol. 31, Cambridge, MA; Harvard University Press, 1962, (general editor, and contributor of the "The Geometry of Symbols"); "The Uses of Computers in Science," *Scientific American*, Vol. 215, No. 3, September 1966, pp. 160-172; in *Run, Computer, Run: The Mythology of Educational Innovation*, Cambridge, MA: Harvard University

envisaged by proponents of a "national information infrastructure", "information superhighway", "infobahn", or the like[19] is a beginning, but only a beginning for reasons that I develop further ahead on page 22.

The invention of writing brought us <u>practical</u> durability throughout an age reckoned in mere thousands of years. But writing also diminished interactivity, relative to the innate interactivity of speech, since handwriting formats in the West were initially manipulated only by the servants of the elites. Only later did writing become a job-related necessity for the elites themselves and for the masses when the so-called Industrial Revolution sparked a need for clerical skills that outran the world's supply of noble second sons and favored serfs, formerly the menial custodians of a menial skill. As writing gained in dominance, we conveniently forgot the upstart character of writing that had one of Plato's protagonists look down his nose at it, just the way the literary snobs of the late 20th century look down their noses at speech, video games and PCs:

Socrates But there remains the question of propriety and impropriety in writing, that is to say the conditions which make it proper or improper. Isn't that so.?

Phaedrus Yes.

...

Press, 1969; and in "The Semantic Wall", in E. E. David, Jr., and Peter B. Denes (eds.) *Human Communication: A Unified View*, New York: McGraw Hill, 1972.

[19]As, for instance, in the following abstract of a presentation by Ed Fitzsimmons, Special Assistant for Education and Training, Office of Science and Technology Policy, Executive Office of the President at George Mason University, on October 27, 1993: "The vision of the Office of Science and Technology Policy, a vision that is likely to be shared by the National Science and Technology Council, is to ensure every American access to excellence in education and training regardless of location, background, or personal situation. We believe that this vision can be realized only through the infusion of information technology, which makes inexpensively and widely accessible both the content and interactions of high quality instruction. To achieve this end, we expect to capitalize on the obvious and inexorable incursion of information technology that is occurring in all aspects of daily life. Our goal is to develop policies that accelerate the infusion of technology into education and training, create a broader market for learning technologies, foster development of open systems standards, and motivate cooperative enterprises between private and public sectors, thereby both increasing the equality of learning technology and making it more widely accessible and affordable. Building on the rapidly emerging national information infrastructure, we hope to provide access to learning environments tailored to each individual's needs and interests, encourage students and parents to reach for educational opportunities in and beyond the classroom, and ensure that high quality, affordable training is available to all workers and employers who heed to invest in skills and knowledge".

Socrates ... when it came to writing Theuth said 'Here, O king, is a branch of learning that will make the people of Egypt wiser and improve their memories: my discovery provides a recipe for memory and wisdom'. But the king answered and said 'O man full of arts, to one is it given to create the things of art, and to another to judge what measure of harm and of profit they have for those that shall employ them. And so it is that you, by reason of your tender regard for the writing that is your offspring, have declared the very opposite of its true effect. If men learn this, it will implant forgetfulness in their souls: they will cease to exercise memory because they rely on that which is written, calling things to remembrance no longer from within themselves, but by means of external marks; what you have discovered is a recipe not for memory, but for reminder. And it is no true wisdom that you offer your disciples, but only its semblance; for by telling them of many things without teaching them you will make them seem to know much, while for the most part they know nothing; and as men filled, not with wisdom, but with the conceit of wisdom, they will be a burden to their fellows'.[20]

As the king points out, writing is not an interactive format, but essentially a static format, what we would call a ROM (read-only memory) in the early 1990s, though obviously not a CD-ROM. Once committed to paper, writing stays put ever after, namely until the paper disintegrates. Anyone who remembers using an eraser, even on pencil marks, knows how poorly reusable paper is, or even a slate or a blackboard. Of great merit for books of accounts and for archives, this property of the paper format precluded our using it to create open-ended structures as you go along and interacting with and controlling information except by a laborious process of manual drafting and redrafting which was convenient relative to working in stone but which, by the early 1990s, had been almost totally displaced among the upscale younger generation by the PC or laptop word-processing software. Still, with the advent of the universal prepaid post, the writing format, as letters, became a major mode of delayed-interactive (in contrast to instantaneous-interactive) communication for the world's people until supplanted in the industrialized nations by the telephone within the last decade or two. Whether the massive investment nations make in teaching handwriting in the schools remains a sensible one is an urgent question for the mid 1990s. The zenith of handwriting lives on in the novels of Charles Dickens, but its sun may be setting in the real industrialized world of keyboards, mice, and rudimentary speech recognition[21]. On the other hand, the continuing

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[20]Hackforth, Richard (translator). *Plato's Phaedrus*. Cambridge, UK: University Press, 1952. p.156.

[21]A presentation I made in this vein on July 18, 1981 to a meeting of the Business-Higher Education Forum at the Harvard Faculty Club in Cambridge, MA met with total disbelief on the part of the assembled industrialists and academics. Judging contemporary ripeness is left to the reader. The history of prior transitions is recounted in Altick, in Boorstin and in Clanchy, Note 10. That ripeness of this idea **may** have increased is evidenced by the publication in 1993 of Aufderheide, Patricia (rapporteur) *Media literacy: a report of the National Leadership Conference on Media Literacy*, Washington DC: The Aspen Institute, 1993, but - alas - the media literacy

popularity of greeting cards and the birth of email and voice mail suggest that people often prefer delayed-interactive communication over instantaneous-interactive communication.

Print, like writing, is essentially a non-interactive, static format of good durability which brought pre-electro-optical but digital formats and processes into ascendancy in all industrialized nations. The analog formats of speech, music and pictures became the province of the fine arts, while literature and business built on the digital formats. In any case, the print formats, like writing before and concurrently, were static ROMs unsuited for creating open-ended structures as you go along and interacting with and controlling information, except to a limited extent by elites called authors tied in to businesses called publishers. The era in the West that followed immediately after Gutenberg's development of the movable type press did not differ all that markedly from the preceding manuscript copying era: reading remained an elite skill. Only in the mid 19th century when the steam era and the resulting migrations from the countryside to the "dark satanic mills" created a need for widespread readin', writin', and 'rithmetic skills in the new industrial work force did print become democratized and today's conventional literacy enshrined as a state sanctioned and state financed bundle of skills[22]. Since the economic and political conditions that brought forth conventional literacy, numeracy and artistic sensibility have long since been overtaken by new realities, it seems timely to reconsider the merits of the conventions rather than merely attempt to recast them into the mold of new technologies.

As digital print was reaching its zenith in the West, analog pictures came on the scene first as movies and later as TV. Although a mode of personal expression for their producers, until the 1980s the high price of production technology for movies and TV meant that most watching was bound to be as passive as the term "couch potato" evokes. The summit of ecstasy in classical movie/video marketing at the turn of the 1990s was the prospect of choosing which from among 500 or more movies to watch. But movies mark the birth of dynamic virtuality. Traditional paintings and sculptures epitomize static virtuality. They are

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movement seems to take current television as its main image of "media" and interprets literacy as the ability to tell TV lies and propaganda from truth, a stance useful perhaps if not mere political smoke, but limited in its scope in any case.

[22]Details of this evolution in England are in Altick, in Boorstin and in Clanchy, all in Note 10. The fact that some religious sects in the United States insisted that all their members should be able to read happened to get the U.S. off to a head start in the "literacy race."

virtually real, they represent reality, in a way that words are not and do not, even though words strung together do denote reality[23]. But paintings and sculptures stand still, while reality moves.

Movies captured moving reality for the first time in history, hence dynamic virtuality. But a traditional movie, bound up on its film or its analog videotape is not easily malleable in the way that computers have already accustomed us to smithing words and numbers with great ease and great speed and low cost. However, faster, smaller, cheaper electro-optical digital technologies are enabling computers to give pictures and music the same malleability, the same simultaneous interactivity as words, and those faster, smaller, cheaper electro-optical digital technologies are putting that power within reach of not only the Steven Spielbergs, the Walt Disneys, the research hospitals and the military of the world but, increasingly, within reach of the small business and, eventually, of the individual.

This possibility is entirely unprecedented; even the video arcade fan of the early 1990s does not yet personally control the palette, so to speak, that the Spielbergs and so on have at their disposal today. And what would he or she do with it? While Henry David Thoreau ultimately proved to be wrong in his sarcastic assessment of the value of Maine linking up telegraphically with Texas ("What does Maine have to say to Texas?"), it did take a while to get there. Hence while ecstasy over the possibilities runs highest in this realm of image multimedia, so does the agony over the barriers on the way to realizing dreams[24]. The agony is not entirely technological and commercial. The cultures of words, pictures and music have evolved in large measure apart from one another, so it is unlikely that shaking them all up with a computer will produce instant Nirvana except among some of the avant-garde.

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[23]Much of this is still difficult to express, even for professional art historians and philosophers of art. The gaps in our understanding of the fundamentals of non-alphabetic representations may be discerned from such philosophical works as Putnam, Hilary. *Representation and reality*. Cambridge, MA: MIT Press, 1988; Gombrich, E. H. *Art and illusion: a study in the psychology of pictorial representation*, First Princeton/Bollingen paperback edition, Princeton, NJ: Princeton University Press, 1969; and Goodman, Nelson, *Languages of Art: An Approach to a Theory of Symbols*, Indianapolis: Hackett Publishing Company, Inc., 1976.

[24]Examples of trial-and-error by creators in this realm are in the July 1993 issue of the professional journal *Communications of the ACM* under the headline "Computer Augmented Environments: Back to the Real World"; and in Gelernter, David Hillel, *Mirror worlds, or, The day software puts the universe in a shoebox— : how it will happen and what it will mean*. New York: Oxford University Press, 1991. *Scientific American* carried my earlier version of such dreams nearly three decades ago (Note 18); much of the latter has since been realized.

But seedlings of the interactive multimedia future abound in the outposts of the computer mainframe world, even as that world transforms itself into a world of parallelism and other approaches to supercomputing. For instance, they are visible — or at least easily visualizable — from the areas where pictorial experimentation is rife, sometimes in TV advertising and in other forms of non-interactive advertising, but especially with supercomputer and interactive high resolution pictorial facilities as, for example, in medical imaging systems — such as ultra-sound, magnetic resonance imaging (MRI), computerized axial tomography scanning (CAT scans), and X-rays — sometimes coupled with telecommunications as in teleradiology and telepathology, which involve the transmission of radiological images and pathology slides, respectively, to remote sites, and in military applications such as aerial reconnaissance, defense map displays, cockpit displays, simulators and large-screen displays for command centers.[25]

In the mid-1990s, the seedlings of the interactive multimedia future also grew increasingly visible not only in video arcades but on home game-playing devices and PCs. Professional industrial design, Hollywood blockbuster movie animation, and musical synthesizer instruments appear to be in transition from upscale institutional buyers to upscale personal buyers.

Both the firm rooting of interactive multimedia in the past and the potential for growth into the future are evident in the following scenario taken from a study of the High-Definition-Television (HDTV) fever of the turn of the 1990s by my associate Robert Tirman:

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[25]The examples and the scenario that follows are drawn from Appendix H of: Tirman, W. Robert. *The Elephant and the Blind Men: The Phenomenon of HDTV and Its Would-be Stakeholders.* P-91-3, Cambridge, MA: Harvard Program on Information Resources Policy, 1991.

SCENARIO EVENTS

MY INTERPRETATION OF PORTENTOUS EVENTS

"On Monday morning, Jane Smith rises and prepares for her work day. While she and her eighteen-year-old daughter, Jackie, eat their wheat toast and oat bran cereal with strawberries, they watch the "Today Show" coverage of the latest pictures of Neptune sent to Earth from the *Voyager* spacecraft. After they part at the door of their town house, Jackie walks down the street and takes the number 3 bus to her high school, noticing the advertisement on the side of the bus for the latest style of "Guess" jeans. Jane stops at a newsstand to pick up the copy of *Time Magazine* celebrating the 200th Anniversary of the French Revolution before taking a taxi to the airport to meet an out-of-town client. At the airport, Jane scans the large screen display for the latest flight information on her client's arrival and pauses to watch the commercial for the new Lancia Dedra before heading to Gate 12.

watching synthetic "real reality" is opening up into watching real "synthesized reality"

Back at her office, while her client meets the rest of her staff, Jane sits at her computer workstation putting the finishing touches on the multimedia presentation she has prepared. In addition to the overview of her company with the usual graphs and financial data, Jane adds a video "walk-through" of one of the buildings she has just designed and decorated and goes off to make the presentation. At Millard Fillmore High School, Jackie is researching the life and works of Monet from the video encyclopedia on the personal computer in the school library in preparation for the class trip to the Fine Arts Museum that afternoon. She then attends her lunchtime meeting of the Young Physicians' Club where she, and 30 other pre-med hopefuls with strong stomachs, view a videotape of a heart by-pass procedure while munching their sandwiches.

"working within structures" is opening up into "creating open-ended structures as you go along"

"receiving information" is opening up into "interacting with and controlling information"

After her presentation and a quick lunch at the hot dog stand on the corner, Jane takes the subway across town to meet with one of her fabric suppliers. Hurrying from the subway entrance, she ruefully eyes the Pepto-Bismol advertisement on the billboard across the street. Inside the conference room of her supplier, Jane previews the color and weave of some new fabrics — by videoconference — with the supplier's manufacturer in Singapore. After placing an order in anticipation of concluding a deal with today's client, Jane stops at the clinic to get the results of the blood test she had taken yesterday. The receptionist tells her that her doctor finished reviewing the blood sample with the pathologist — each in their respective offices — that morning and the results

"exchanging information" is opening up into "taking informed action"

"time proportional to distance" is opening up into "time independent of distance"

were negative. With that good news, Jane returns to her office to finish her afternoon's work.

Meanwhile, Jackie and her classmates are comparing the live exhibit of Monet's works at the Fine Arts Museum with <u>a televised exhibit of Renoir's paintings</u> currently on display in another city. The director of the museum points out the minute differences in the brush strokes and the subtle color values of the respective Impressionist painters. On its way out of the museum, the class stops to watch a computer artist create a <u>full-motion 3-D rendering of a futuristic automobile</u> for the museum's coming exhibit on commercial art.

Flushed with the excitement and success of their day, Jackie and Jane decide to treat themselves to dinner and a movie that evening. They make reservations at the new Video Theater, where they enjoy a meal while watching <u>*Indiana Jones and the Last Crusade*</u> on the 23-foot screen. On their way out, Jane makes reservations for the following Saturday to see the <u>Rolling Stones concert to be broadcast live to the theater</u>. Mother and daughter then return home, turn on the TV, yawn, and promptly fall asleep on the couch. Another typical Monday comes to an end."

What the portentous events in the scenario have in common, of course, is a newly felt influence of maturing faster, smaller, cheaper electro-optical digital technologies: *the capacity for individuals to interact instantaneously and at their own volition either with themselves or with other individuals by transparent means, namely means that do not significantly interfere with the desired functions of the interactions.*

The independence of time from distance has, of course, been experienced by people of all ages and in all ages but to significantly lesser degrees than today and tomorrow. Every child is conscious of his or her ability to shout to someone out there to go after a ball about to get lost down the hill and therefore to get the ball retrieved a lot faster, if at all, than by running after it themselves. We've had that capacity as long as there have been people. The telegraph in the middle of the last century gave global reach, but without instantaneity (although the speed-up was near-miraculous by the perceptions of those times) and with considerable interposition by intermediaries who could both snoop on and garble the messages. And message transfer was about as far as capabilities went.

By the yardstick of the telegraph, the telephone was a miracle of instantaneity (at least once you got connected) and of directness and privacy of communication, at least once you

could be sure you were connected without the operator or the secret police listening in. But you were limited to what you could *say* or *sing*, with no chance to draw, except in the dreams of Caselli and the nightmares of the postmaster general. In the mid 1990s, as far as the electro-optical digital science and the electro-optical digital technology of it are concerned and except for touching and feeling, everything you can do by way of communicating with people in a room with you can do as instantaneously and, in principle, as privately[26] with people anywhere on earth or in modest orbits around it.

Of course not all the capabilities are ripe today! Sorting what you think is ripe from the hype even in the limited domain of telecommunications needs doing along all the following dimensions that sellers see: scientific, technological, economic, political, legal and marketplaces (customers). And then there are the dimensions the buyers see: price and effectiveness. What we do at the Harvard Program on Information Resources Policy is, indeed, to look at all these dimensions. But there's no time here to say more than "ripeness is very different along all these dimensions for different products and services".

Taking informed action instead of merely exchanging information with the aid of tools built from new-fangled electro-optical digital technologies by now has a long history as histories go in this young realm, reaching back all the way to the use of radar in World War II. The steady ripening among early institutional adopters is evident in many realms, as for example in currency trading and other high-value, high volume financial transactions and military intelligence, command and control. Even here, however, the ripening is uneven and often not very far advanced; some of the failures mixed in with the successes of the U.S. military in the 1991 Persian Gulf War attest to that, often in areas where the interface of electro-optical media deviated from the customary print-on-paper look-and-feel to take advantage of new capabilities[27]. There's a price to pay for eliminating the buggy-whip holder

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[26]The technologies to guarantee communications privacy through cryptography and other precautions exist. In most countries, however, what is to be kept private from the government (and also within the government) is the subject of continuing controversies. Some of the issues are outlined in Knauf, Daniel J. *The Family Jewels: Corporate Policy on the Protection of Information Resources.* Cambridge, MA: Harvard University, Program on Information Resources Policy, 1991.

[27]Additional details are given in: Coakley, Thomas P. *Command and Control for War and Peace.* Washington D.C.: National Defense Univ. Press/Superintendent of Documents, U. S. Government Printing Office, 1992; and in Guest Presentations, *Seminar on Intelligence, Command and Control: Guest Presentations. Nine volumes from Spring 1980 through Spring 1991 (the seminar was not held during 1983).*, Cambridge, MA: Harvard University, Program on Information Resources Policy, 19XX. By 1994 a vast and still growing literature had become available detailing the events of the 1991 war in the Persian Gulf, often tagged as the first "information war".

and the running board too soon. But the scenario illustrates hopes for diffusing the capacity to take informed actions into much broader markets, like purchasing agents — not even speaking, yet, of the general public.

Watching real "synthesized reality" begins to take advantage of the results of the wholly unprecedented processing capabilities of electro-optical digital technologies. But those results are mostly presented in a familiar format. A picture of Neptune synthesized by computer from signals sent to Earth by the onboard sensors of the *Voyager* spacecraft is tolerated even with its synthetic colors. Who on earth, after all, has seen Neptune with their own eyeballs? However, accepting synthetic pictures of Earth itself in synthetic colors is something still done mostly by professionals like astronomers, weather forecasters and pilots. The general public sees the skies as blue, has seen them that way on the occasional TV shots beamed down from Earth orbits, and gets them that way in all the synthesized products exhibited on the nightly TV weather forecast and even in the Hollywood adventure, cartoon and horror productions created on mainframes. Even those high points of current more widespread synthesized realities, the icons and cellular L-shapes used in PC menus and in spreadsheets stick very closely to the familiar born of the older information technologies.

It is the acts of creating open-ended structures as you go along and interacting with and controlling information that lie at today's frontiers with only the half-forgotten lessons of spoken interactivity to guide us in the exploitation of entirely novel capabilities. "Interactivity" is the mostly unprecedented capability that contemporary faster, smaller, cheaper, electro-optical digital technologies are, for the first time in human history, moving from the rarefied reaches of the institutional early adopters to the earthy and wide-open spaces of the (hopefully) mass markets of individual purchasers. What ecstasy!

But where interactivity is concerned, ripeness is in question in all dimensions but the scientific. The technological, economic, political, legal, marketplaces and customers dimensions are all still problematical. What agony¡ The moves in the advanced industrialized nations exemplified in the United States by Vice President Gore's long-time advocacy for getting the electronic superhighways of the future from pipe dreams to paid-for glass pipes exemplify one dimension of the ecstatic hopes and the agonizing frustrations in the early

1990s. The electronic highways in place are practically global for speech and for writing. They are as yet but cowpaths for interactive digital pictures so the question is who will pay how fast for the field of dreams[28].

Indeed, the symptoms of ecstasy and agony, exhibited only privately among friends in the early days of the cresting interactive multimedia wave of the early 1990s, had gone shamelessly public by the mid 1990s. "MEDIA MANIA", headlined *Business Week* on July 12, 1993. *Digital. Interactive. Multimedia. The rush is on. Warning: not everyone will win.*, the subhead specified. On July 14, 1993, the *Wall Street Journal* brought interactive multimedia out of the closet in its lead article under the headline *Vague New World* with subheads *Digital Media Business Takes Form as a Battle of Complex Alliances* and *Partnerships Across Industries Coalesce in Chaotic Race to Establish a Market* and with the following headline-supporting quotes from industry leaders:

> People know what the skeleton looks like, but they don't know what the muscles look like," says Frank Biondi, chief executive of cable operator Viacom Inc. Intel Corp. Chief Executive Andrew Grove says that when speculating about what will be a hit, "I don't know what the hell I'm talking about, really. . . . We'll know the truth when we get there.[29]

Judging ripeness is indeed no easy task. In what remains, I offer some fundamentals for use in judging ripeness in the hope of leaving you with a considerably sharper image than when you came in, as well as with tools for better understanding of the present and for at least improving our odds as we forge ahead in our own enterprises, commercial, political, or scholarly.

Where there is interactivity, ripeness is a moving target. Why is ripeness a moving target? Because, except for the heroes among us, we buyers only rarely perceive effectiveness (an essential aspect of ripeness along with price) absent transparency: it's too much trouble to use a tool if that tool is not transparent but instead interferes with performing the desired

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[28]An overview of the global context of global ripeness issues is given in Ganley, Oswald H. *Communications and Information in the Post Cold War Era* Incidental Paper, Cambridge, MA: Harvard University, Program on Information Resources Policy, 1993. A survey of more mundane issues to be addressed is in Martin C. Libicki, *Information Technology Standards: Quest for the Common Byte* (Newton, Mass.: Butterworth–Heinemann, in press).

[29]A wider range of similar opinions is expressed by, among others, Microsoft's Bill Gates, in an article on information technology in *Fortune*'s April 18, 1994 issue beginning on page 99.

functions. And transparency requires familiarity, which comes from stability — or at least the stability of enough familiar elements perceptible to the user. To the extent that it makes unfamiliar processes perceptible to us, gives us control over them, and leads us to the unexpected — which, after all, is the point of interactivity — interactivity breeds unfamiliarity. Facing the unfamiliar or unexpected, we are forced to keep learning continually, and that can be a source of discomfort for most of us in most workaday situations, even though it is pleasurable in games. This is why mere access to technology ia only a beginning, as I suggest on page 12.

In his paper *Computers and Literacy: Redefining Each Other*[30] my associate Martin Ernst sketches the basis for that observation as follows:

"The computer industry, tumultuous even in its calmest times, showed signs in the early 1990s of being at an evolutionary watershed. The symptoms of structural death and structural birth seemed to be swirling in a melée of stark contrasts... ."

"... the primary source of the turmoil has been a major transition that only recently got underway and is moving us in new directions for the sources of future growth and toward new paradigms for the future roles of PCs. In the process, the transition will redefine not just computing but also the nature of future literacy — and what it will mean to be, and take to become, literate in a meaningful way."

"Computers have already redefined themselves many times, and, as they did, they redefined many of the ways people work with information and even work in general... ."

Except for a handful of pioneers, the general public has stayed in the buggy whip holder and running board era of computer applications. In the early 1990s, even the tools to help collective work, and the means to find and use information more effectively, as by means of programs that can help search for, filter, prioritize and link materials, and the means for integrating multiple types of media in a single computer product for work, education, or pleasure remain traditionalist, with icons, screen buttons, whizzing spacecraft and projectiles, stylized heroes and villains and the like at the outer limits. So far, in brief, the ways people work with information and even work in general have, throughout the turmoil and at considerable collective effort and cost in training and retraining, remained the readin', writin' and 'rithmetic of the 19th century, with a bit of doodling and pointing thrown in but with the basic investment in schooling intact. That already keeps taking considerable learning, almost

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[30]Op. cit. Note 5.

like learning a new language a month. The learning entailed in traveling into the altogether uncharted territory of simultaneous interactivity with moving visual material still lies ahead.

The potential widespread availability of faster, smaller, cheaper, means for creating open-ended structures as you go along and interacting with and controlling information puts in question all prior investment in literacy, numeracy and artistic sensibility. If the investment stays as it is, the buggy-whip holders and running boards will be with us as long as it takes for the postmaster general's fax nightmare to come to pass — which could be a long time given that the post offices of the world are still alive and mostly well, thank you. If the investment is shifted too soon, we may be lost in limbo. If the investment is shifted too late, those who happen to find themselves first and faster than you can say "Xerox" in an information world better than the one we're accustomed to will have an advantage.

What is it that's so all fired fundamental about faster, smaller, cheaper, means for

- ☻ creating open-ended structures as you go along; and
- ☻ interacting with and controlling information?

In old fashioned terms, creating open-ended structures as you go along means nothing less ambitious than making up your own languages as you go along or. as we go along, making up even more general means of expression than languages as we now pretend to use them[31]. The already evident explosion of PC applications programs is ample testimony to the enormous potential this unleashes for both convenience and confusion, power and impotence, ecstasy and agony.

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[31]We pay lip service to "correct" grammar, diction and spelling, but all of us have our little pet words at home and collectively do pretty well at inventing local and professional jargons, slang raps, acronyms and so on. Only the French formalize their hypocrisy with the insistence of the Académie Française on keeping the language "pure". Evolution and cross-fertilization, not fossilization, are the observed conditions of all living languages. Not even de Gaulle could stop "franglais" from its incursions into French, though he tried, even as the Balladur government kept on trying in 1994, to pass laws prohibiting the use of English at scientific meetings in France. The late Léon Dostert, who was Eisenhower's interpreter in World War II, told me the following story of a meeting between Eisenhower and de Gaulle, who pretended not to understand English and refused to speak it on political grounds. When de Gaulle requested permission to use his Free French troops instead of Americans in operations in Eastern France, Eisenhower turned to Dostert and said: "Tell the son of a bitch he can't do it." Dostert turned to de Gaulle and rendered this in polite and unemphatic language, whereupon de Gaulle retorted to Dostert: "Monsieur, vous adoucissez!" (Sir, you are softening it!)

The last time a similar opportunity is said to have occurred, it is said to have had the following consequences, probably because someone aspired to have their operating system become the world's standard[32]:

> Now the whole world had one language and a common speech. [2] As men moved eastward, they found a plain in Shinar and settled there.
>
> [3]They said to each other, "Come, let's make bricks and bake them thoroughly." They used brick instead of stone, and tar for mortar. [4]Then they said, "Come, let us build ourselves a city, with a tower that reaches to the heavens, so that we may make a name for ourselves and not be scattered over the face of the whole earth."
>
> [5]But the Lord came down to see the city and the tower that the men were building. [6]The Lord said, "If as one people speaking the same language they have begun to do this, then nothing they plan to do will be impossible for them. [7]Come, let us go down and confuse their language so they will not understand each other."
>
> [8]So the Lord scattered them from there over all the earth, and they stopped building the city. [9]That is why it was called Babel — because there the Lord confused the language of the whole world. From there the Lord scattered them over the face of the whole earth.

A more contemporary and thoroughly practical assessment is Mitchell Kapor's observation that "there are only two problems with computers: they're impossible to program and impossible to use"[33]. More ecstasy and more agony.

In old fashioned terms, interacting with and controlling information means mostly nothing outside the realm of speech: mostly our past is that of passive couch potatoes, taking it all in from the outside — or at least reading and watching only what we want to hear — but with little going back out, at least in writing or in pictures. About the only agents we could interact with and control were our own minds and maybe those of a relative or a friend or two. Now, even in print — but dynamic interactive print — we communicate with people and with computers around the world with new means like electronic bulletin boards and with new usage patterns, as with email in the mushrooming electro-optical digital networks (like the Internet) for which there are no evident precedents and to which aficionados refer as cyberspace. The earlier advent of other "retail" information technologies (like VCRs) has

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[32]*The Tower of Babel; Genesis 11:1.*

[33]Mitchell Kapor. Personal communication.

already vastly changed the reach of individuals, with truly global political as well as economic consequences already evident[34].

More important, perhaps, but far less widely understood let alone appreciated, is the fact that when we use computers we still communicate mostly with ourselves, but in ways that we can tailor at will to our own predilections. The tensions between efficiency and effectiveness for such solitary purposes, which point toward idiosyncratic choices of linguistic and other expressive information conventions and efficiency and effectiveness for collective purposes, which point toward universal compatibility if not standardization, set up a dynamic which infuses intense contemporary relevance into the ancient story of the Tower of Babel[35].

What it all boils down to is that faster, smaller, cheaper electro-optical digital technologies have put in our hands enormously powerful and varied yet increasingly practical and economical means for information processing means that stimulate us to reexamine everything we do to information and with information and then choose to do nothing, to reinforce the old ways, to modify them, or to abandon them altogether in favor of altogether new ways. Enthusiasm for corporate reengineering is one early '90s reaction to this stimulus in one particular realm with a long history of earlier buggy-whip-holder-and-running-board imitations[36] But fundamentally, throughout the realm of information itself, the stimulus is for reexamining of what we mean by literacy, numeracy and artistic sensibility.

To reexamine effectively, we need concepts expressive enough to say what we want to say without being tied to the past and without mortgaging our ideas to futures that may not materialize. Substance, format and process are the immutable conceptual pillars of information products and services. Substance is the subject matter, the stuff of interest to the ultimate

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[34]Examples are treated extensively in the following: Ganley, Gladys D., *Mikhail and the Multiplying Media.* Publication P-94-3, Cambridge, MA: Harvard University, Program on Information Resources Policy, 1994. Ganley, Gladys D., *The Exploding Political Power of Personal Media*, Norwood, NJ: Ablex Publishing Corporation, 1992. Ganley, Oswald H., and Gladys D. Ganley, *To Inform or To Control?: The New Communications Networks, Second Edition*, Norwood, NJ: Ablex Publishing Corp., 1989. Ganley, Gladys D., and Oswald H. Ganley, *Global Political Fallout: The VCR's First Decade*, Norwood, NJ: Ablex Publishing Corp., 1987.

[35]More details on ecstasies and agonies in achieving compatibility by standardization or other means are given in Libicki, Martin C. op. cit. Note 28.

[36]An example of the genre is: Champy, James and Michael Hammer, *Reengineering the Corporation: A Manifesto for Business*: New York : HarperBusiness, 1993.

user. Format is the embodiment of the substance, as in voice in the air, ink on paper, pixels on a screen, bits and bytes traveling on a glass fiber or stored in a computer's memory. Process is what happens to substance-embodied-in-format as it wends its way from producer to consumer. While substance, format and process are distinct concepts, they are intimately linked in practice in the specification of information products and services as bundles of substance, process and format[37].

To illustrate the significance of the linkages, the introduction of printing made it possible to produce books with consistent pagination; before then, the substance (or contents) of individual pages (for the same total document substance) differed from one scribe or copy to another, making pagination relatively futile. With effective pagination, tables of contents, indices, references, cross references, and other positional information could be used, changing the nature of legal practice as well as of scholarship and aiding books in the competition with scroll formats. All that is relatively easy to see with hindsight[38].

With mere foresight at their disposal and no omniscience, Messrs. Biondi and Grove are realistically vague. Whatever the degree of their control over the dimensions of ripeness that sellers see, their degree of control (or anyone's) over the dimensions of ripeness near and dear to buyers is far less because buyers are engaged in the intensive and recurrent bouts of learning I described above (page 22). Hence the realistic tone of their blank predictions of the future marketplace. Very few as yet know much about the dynamics set in motion by the new possibilities for creating, outside of speech, open-ended structures as you go along and for interacting with and controlling information.

There's ecstasy in contemplating the many attractive new and open roads ahead. There's agony in choosing among them. In organizations accustomed to planning with a high probability of being on mark in not so long ago stable and controllable environments, the notion of gambling on the future takes getting used to for managements, boards, legislatures,

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[37]Details on these concepts and their practical applications are given in: McLaughlin, John F., with Anne Louise Antonoff. *Mapping the Information Business.* Cambridge, MA: Harvard University, Program on Information Resources Policy, 1986 and in Ernst, Martin L., Ed. *Mastering the Changing Information World.* Norwood, N.J.: Ablex Publishing Corp., 1993, especially Chapter 2 (Oettinger, Anthony G. "Building Blocks and Bursting Bundles") and Chapter 5 (Rubin, Jerome S., and Janet Wikler. "Publishing as a Creature of Technology").

[38]Adapted from Ernst, Martin *Computers and Literacy: Redefining each other* op.cit. Note 5.

financiers and referees alike. Deep pockets are an asset only if they aren't mortgaged to the past. It's often their big anchors to the past that allow big enterprises to be overtaken by upstarts. But placing bets is the best we can do. I believe, however, that it helps to be smart and I believe that knowing a little bit more is better, on the average, than knowing a little bit less because it can help you to improve the odds in your favor. You also need to be lucky. I wish you all luck.

Appendix A.

ANTHONY G. OETTINGER
Chairman, Program on Information Resources Policy
Chairman, Center for Information Policy Research

Anthony G. Oettinger is Gordon McKay Professor of Applied Mathematics, Professor of Information Resources Policy, and a member of the Faculty of Government at Harvard University. He is on the Board of Visitors of the Joint Military Intelligence College, belongs to the Council on Foreign Relations, and he is a Trustee of the Charles Babbage Foundation and a panel member of the Naval Studies Board of the National Academy of Sciences/National Research Council.

He founded the Harvard Program on Information Resources Policy in 1972 to create useful knowledge, both competent and impartial, on controversial information matters. Toward this aim. the Program follows what still seems to be a unique process, with many ingredients. Among the essential ingredients is research support that comes both in small doses and from the widest variety of sources the Program can convince to contribute their money to its work; the idea is to be owned by everybody so as to be owned by nobody: no single sponsor can kill the Program just by withdrawing support.

In the White House, Professor Oettinger was a consultant to the President's Foreign Intelligence Advisory Board (1981-90), the National Security Council (1975-81) and the Office of Science and Technology (1961-73). He chaired the Massachusetts Cable Television Commission (1975-79) under Democratic governor Michael Dukakis, having been on it from its start in 1972 under Republican governor Francis Sargent. He founded the Computer Science and Engineering Board of the National Academy of Sciences and chaired it from 1967 to 1973. He was also on the Research Advisory Board of The Committee for Economic Development (1975-79) and a consultant to Arthur D. Little, Inc. (1956-80), as well as on the Scientific Advisory Group of the Defense Communications Agency (1979-90; now DISA, the Defense Information Systems Agency) and on the Command, Control, Communications and Intelligence Panel of the Naval Research Advisory Committee (1978-82).

He is a Fellow of the American Academy of Arts and Sciences, the American Association for the Advancement of Science, and the Institute of Electrical and Electronic Engineers. From 1966 to 1968 he was president of the Association for Computing Machinery.

Professor Oettinger wrote, with Martin Ernst and others, *Mastering the Changing Information World*. Ablex, 1993; with Carol Weinhaus, *Behind the Telephone Debates*, Ablex, 1988; and, with Paul Berman and William Read, *High and Low Politics: Information Resources for the '80s*, Ballinger, 1977. He is also the author of *Automatic Language Translation: Lexical and Technical Aspects*, of *Run Computer Run: The Mythology of Educational Innovation* and of numerous papers on the uses of information technologies. His former students follow not only academic but also business, military, legal and other careers.

Appendix B.

HARVARD UNIVERSITY
PROGRAM ON INFORMATION RESOURCES POLICY

Affiliates — June 1994

American Telephone & Telegraph Co.
Apple Computer, Inc.
Applied Telecommunications Technologies, Inc.
Arthur D. Little, Inc.
Australian & Overseas Telecommunications
  Corp.
BellSouth Corporation
Braxton Associates
Commission of the European Communities
Computer & Communications Industry Assoc.
DACOM (Korea)
Deloitte & Touche
Dialog Information Services, Inc.
DRI/McGraw Hill
Educational Testing Service
EG&G Inc.
ESL Inc.—a TRW company
ETRI (Korea)
European Parliament
France Telecom
Gartner Group, Inc.
GTE Corporation
Hitachi Research Institute (Japan)
IBM Corp.
International Data Corp.
International Resource Development, Inc.
International Telecommunications Satellite
  Organization (INTELSAT)
Korea Telecom
Lee Enterprises, Inc.
Lincoln Laboratory, MIT
Martin Marietta Corp.
John and Mary R. Markle Foundation
McCaw Cellular Communications, Inc.
MeesPierson (U.K.)
Mead Data Central
MITRE Corp.
National Telephone Cooperative Assoc.
NEC Corp. (Japan)
The New York Times Co.

Nippon Telegraph & Telephone Corp. (Japan)
North Communications
Northern Telecom
NYNEX
Pacific Bell
Pacific Bell Directory
Pacific Telesis Group
Puerto Rico Telephone Co.
Research Institute of Telecommunications
  and Economics (Japan)
Revista Nacional de Telematica (Brazil)
Samara Associates
Scaife Family Charitable Trusts
Siemens Corp.
Southam Inc. (Canada)
Southern California Edison Co.
Southern New England Telecommunications
  Corp.
Sprint Communications Company L.P.
State of California Public Utilities
  Commission
Strategy Assistance Services
The College Board
Thomson Professional Publishing
Times Mirror Co.
United States Government:
  Department of Commerce
    National Telecommunications and
    Information Administration
  Department of Defense
    National Defense University
  Department of Health and Human Services
    National Library of Medicine
  Federal Communications Commission
  National Security Agency
  U.S. General Accounting Office
U.S. Media Group
Viacom Broadcasting
VideoSoft Solutions, Inc.
VISA International

Appendix C.

PARTIAL LIST OF LAN CONTROL EQUIPMENT MANUFACTURERS
1993

ADC Telecommunications	Minneapolis, MN
Banyan	Westborough, MA
Bytex	Westborough, MA
Cabletron	Rochester, NH
Chipcom	Southboro, MA
Cisco Systems	Menlo Park, CA
Coral Network Corp	Marlboro, MA
CrossComm	Marlboro, MA
General Datacomm Co	Middlebury CT
Hewlett Packard	Palo Alto, CA
Informix	Menlo Park, CA
Lannet	Tel Aviv,Israel
Microcom, Inc.	Norwood, MA
Motorola	Schaumburg, IL
Network Systems	Brooklyn Pk, MN
Network General	Menlo Park, CA
NetWorth	Irving, TX
Novell	Provo, UT
Optical Data Systems	Hardson, TX
Oracle	Redwood City,CA
Proteon, Inc.	Westborough, MA
Retix	Santa Monica,CA
Standard Microsystems	Hauppauge, NY
Sybase	Emeryville, CA
Synoptics Communications	Santa Clara, CA
ThreeCom (3Com)	Santa Clara, CA
Wellfleet Communications	Billerica, MA

Appendix D.

OUTLOOKS ON RIPENESS

Functional Stage	Seller	User	Payor
Imagined	Mainframes	Early adopter	User's
Trial-and-error	PCs	Compelled user	institution
Regular	Publishers	Voluntary user	User
Practice	Telcos	Casual user	Others:
etc.	LANs	etc.	Private
	Systems		Public
	software		etc.
	Applications		
	Software		
	Consumer		
	electronics		
	etc.		

Governments as:
Many of the above roles plus:
referee
    courts
    administrative agencies
    etc.
policeman
    U.S. antitrust laws
    trade sanctions
    etc.
catalyst
    political platform
    tax money
    preferential treatments
    etc.