THE FUSION THRESHOLD

by Ron Sones

Originally Written 1984, Revised 2009

You may be right, I may be crazy,

But it just may be a lunatic you're looking for.

-Billy Joel

Introduction To The 2009 Revision

If you were misled by the title of this work into thinking that it has something to do with thermonuclear power or weapons, sorry. Instead, I'm using the term *fusion* in its more generic sense, bringing some things together to form something new. The result of this kind of fusion will be much more far-reaching than mere thermonuclear energy.

The something new being dealt with here is a new form of human society, the coming end product of the information processing revolution which began … when? You might mark it when computers were invented, or perhaps when the first printing press was built, or maybe when the first document was set down in writing or the first painting was daubed by a caveman. That doesn't really matter. What does matter is how and when it will end, and what the end result will be.

By the time I wrote the first version of this composition 26 years ago, I, as a computer software developer, had been considering for several years before that point, a great dichotomy. This was the immense disparity between the advances made, over the years since computers were first developed until that time, in computer processing, storage, and transmission capabilities vs. the lack of advance in computer input through keyboards. I wondered, "What would happen if this limitation were overcome? Suppose that instead of entering information into a computer through a keyboard, a mechanism only marginally improved during the century or so since it was invented, what if we could somehow transmit information directly from our minds into computers through some kind of radio frequency link? But then further suppose that many computer users could do the same thing, and that these users were linked together through a large communications network, and that the high speed links between the computers and the users were two-way, rather than just one way?"

As I thought about it, I formulated my own admittedly highly speculative answers to these questions. But these answers were so bizarre and seemingly out of place anywhere except in science fiction, that I felt compelled to get some shred of confirmation that my thought processes were still sane.

Back then I looked around to see if anyone else had considered questions like this. That meant I had to go to a library to do the research. Fortunately, I lived near the US Library of Congress, and I could do my researches there. There was, of course, no Internet back then, so this was the best I could do, given the time and resources at my disposal. They had a computerized card catalog which could be accessed through terminals made available on site to the public. That was very helpful.

I found only one reference that seemed even remotely related, a discussion of the writings of the early 20th Century French theologian Fr. Pierre Teilhard de Chardin. He had many ideas which I felt were very much in harmony with my own. I took encouragement from this and decided to set my thoughts down on paper and try to get the work published. I got permission from my employer to use their new word processing system, after hours, to compose my opus. I completed my manuscript, but I was unsuccessful in getting it published.

I set it aside and went back to the business of the real world. But as time went by, slowly, year by year, I saw developments coming up in technology which convinced me that my speculations were indeed very close to the mark. Eventually, due to various mishaps involving a fire, some disorganized moves, and other circumstances, the manuscript was mislaid. It sat in storage for about 8 years and just recently was recovered.

Now, an Internet search engine query will reveal that many people have been considering the issues I raised in my manuscript. I see that a system has

been developed that allows a computer to monitor EEG inputs and generate written and spoken sentences after some brief processing. A name has even arisen, *Global Brain*, for a concept very similar to what I've envisioned. But, as yet, I haven't found anyone that has followed the line of thinking that I did to come to the conclusions I have about where it all will lead. I figure that the dénouement of the processes I describe are very close at hand, so I'd better say what I have in mind before the things I want to predict have already become history.

Obviously, there have been many technological developments over the past 26 years related to these issues, and I want to include in my new document some analysis of how close or off the mark I've been in foreseeing developments upon which I've speculated. But, that's not the main thrust or point to the exercise. Rather, this all has significance for *you and decisions you might want to make in your life, now. I'm referring here to the most profound kinds of decisions, even perhaps involving life and death.* It's not that I want to be particularly dramatic. I just want to assert that I'm not interested in "trivial pursuits" and despite a few whimsical inclusions in the text, the matters at hand are most serious. Since most of the conclusions I reached when I first wrote this work have not substantially changed, I have left most of the original work unchanged (even at the risk of seeming somewhat quaint with several references to the Soviet Union), as an indication of how visible the conclusions were to me even back then.

One of the most surprising aspects I found regarding the ideas expressed here is the resistance I encountered among people with whom I have discussed them. I have had reactions ranging from obvious disinterest to condescending skepticism to outright hostility. Very rarely would I get a sympathetic reaction. I mention this in the narrative regarding antipathy in the common culture, but I was surprised to see how much of this carried over to the individual level. I suppose that doesn't bode well for this work becoming a best-seller, but so be it.

The original manuscript, with editorial updates and corrections, is rendered in this type font. The recent revisions and additions are in this one.

Introduction To The 1984 Manuscript

"Staggering". "Shattering". Those are the words people commonly use these days when they write about the future. It's becoming apparent in this age of emerging computer, robot, and genetic engineering technology that big changes are on the horizon for humanity. But, how big? Just what will be so staggering and shattering? Haven't we already been through cataclysmic changes? Will anything in the future have more dramatic effects than World Wars, atomic energy, satellites and television? Aren't we already shattered; don't we stagger through history as a matter of normal practice?

Even though we've been through so much, we don't succumb to a temptation to say, "Now we've seen it all. Nothing else is possible." (We made that mistake once before when, late in the 19th Century, there were serious proposals to close the US Patent Office, since it was felt that all the possible significant patentable ideas had at that point been developed.) It's too easy for us to visualize sophisticated robots taking our places on the job, and miraculous new medical advances that could radically alter the course of our lives. As much as we have already seen, we instinctively know that it will pale in comparison to what is to come. But, what is to come? Not in terms of specific technological developments, rather in terms of the overall effects on society, what will become of us?

As for myself, those who know me know that I'm not one to get worked up over events and ideas that are all the rage at the moment. I didn't rush out to buy a CB radio when everyone else did. I waited until pocket calculators came down to about $15 before I acquired

one. I still don't own a digital watch. I'm politically conservative and economically frugal (at least I try to be, not always as successfully as I would like). Although I'm imaginative, I'm careful always to bear in mind the difference between what I observe and what I imagine. I'm not an alarmist, although some might think of me that way owing to my propensity to foresee problems with whatever ventures may be set before me (I do that only to pre-empt the problems, not necessarily to discourage the ventures). "Flamboyant" is the last adjective anyone would apply to me. "Extreme" comes in next.

Yet, as I look even at the present, I can see the coming of a state of affairs so different from the way of the world today, so bizarre in relation to the familiar forms of here and now, that words like "flamboyant" and "extreme" would seem to be mere mild understatements of what I suggest. Never in a million years would I dream of even *saying* things such I have set down here, much less commit them to writing, if it were not for the conviction on my part that they are simple, direct logical consequences of events and trends that are *already plainly and obviously in evidence*. Most of the facts I cite have been published in mass circulation media, newspapers and magazines, rather than obscure technical journals. Indeed, by the time you read this, much of what I point to as examples of the leading edge of technology will already be obsolete. Whatever I see as indicative of the state of technology today is no different from what you can see. I will make frequent mention of computers and telecommunications. Whatever I say about them, I am confident you can either verify for yourself, or have someone knowledgeable in the field verify it for you. In that sense, at least, it's all very scientific.

What I have attempted to do, *what most people do not do*, is to connect and coordinate diverse yet clearly discernable trends, and to form logical conclusions as to what the results will be of the interactions of these trends, but not through linear (straight line) extrapolations, rather through non-linear application of analysis and imagination. At the risk of seeming immodest, I consider myself inspired by Albert Einstein. He took the observations of physics down the path of the inexorable logic of mathematics and wound up with the Theories of Relativity. In 1905, it was certainly considered strange to envision a world wherein observers moving at high speeds with respect to each other would not measure time and space to be the same, wherein events perceived simultaneous to one observer would not be so to another. To be sure, I am less fortunate than Einstein, first, in not having intellect anywhere near his, and second, in having to deal with technological and social factors, rather than physical phenomena. His conclusions were, to a substantial extent, immediately and mathematically or even experimentally verifiable; mine must wait to stand the test of time, and, for the present, if taken seriously, might be the object of some controversy.

- One -

It's intimidating to consider all of the classic works that have been written about the future, as I set out to produce one myself. Jules Verne, Plato, Thomas More, Alvin Toffler --they've all had such grand insights. Could I hope to express myself nearly as well as Aldous Huxley? Haven't H. G. Wells and Isaac Asimov already come up with all the really good ideas? Further intimidating to me is the realization that most of these writers were sensible enough to couch their imaginative ideas in works of fiction, so that even if they did believe that what they discussed could actually come to pass, they did not challenge their readers to consider accepting the possibility that any of it could actually become reality. I, on the other hand, will express conclusions that may make Verne and Asimov seem conservative, and yet I firmly believe they represent reality to come. I can only hope that you, dear reader, even if you disagree with my conclusions, can be open minded enough to empathize with how I reached them.

Most of these authors had a particular advantage over me when putting down their ideas about events and conditions of their respective futures. In *An Introduction To General Systems Thinking*, Gerald Weinberg tells us:

> **"We expect the Future to resemble the Past, because in the Past, the Future *did* resemble the Past."**

In accord with that, any of these authors could expect his future, at least the near term future, to look pretty much like his past. If in

1890 H. G. Wells thought about the world of 1910, he could count on things being not very different then from what he knew in his familiar world, and he would have been right. After all, the same monarchies would still be around. The trains might run a bit faster and ships might trim a few days off the Atlantic crossing. Flying contraptions would finally get off the ground, but they didn't really amount to much more than they did while still on the drawing board. Motion pictures would still be an amusing curiosity, and the automobile, electricity, telephone and radio were still far too limited and expensive to be of any wide ranging consequence.

The really important things were still the same. Brittania still ruled the waves and China still was a sleeping giant. Minorities and women still "knew their place", as elitists of the time would say. Oh sure, the Suffragettes would kick up a fuss every so often, but that had been going on for a long time, too. We could still count on disease, wars, and starvation to keep the population stable. Those who were dissatisfied with their lots in life could, for the most part, be relied on to find solace in their Scriptures, rather than in the formation of revolutionary fronts. Most people were unaware of events outside their own neighborhoods, and still suspicious of anyone who looked or spoke differently than they did. Twenty years would not make all that much difference in the world at large.

So it was easy for Jules Verne to imagine a submarine in a navy where the sailors would be punished by flogging and rewarded with grog. And it was only logical for H. G. Wells to predict that the protagonist survivors of the world of thousands of years in the future would be hardly different from his contemporary English neighbors.

If someone in 1850 envisioned the airplane, he might have thought that it would tremendously expedite the slave trade in 1950. “The more things change, the more they remain the same.” For a long time, the Future had always generally looked like the Past. As long as this remained true, one could always expect the future to continue to resemble the past.

Most people who write about the future do just that. They tell us we will traverse the solar system in space ships, but we’ll call our boss on the video phone, and his secretary will answer, just like it’s done today. Or, doctors will perform surgery by inserting tiny tubes into our blood vessels, guided by fiber optics TV systems, but they’ll still be concerned about getting their kids into college, just like today. The writers visualize a technological milieu vastly different from that of today, *only the social landscape, its form and function, looks the same.*

But one of these writers, Alvin Toffler, saw something different. He saw that *the future is beginning no longer to resemble the past*, at least in one major respect. In his landmark work *Future Shock*, surely one of the most insightful works ever written, he tells us how the *ever increasing* effects of technological and social change wrench our minds and bodies even worse than the cultural shocks of going from one society, like America’s, to another, like Japan’s. We can return from Japan to America; we can’t return from the present to the past. And we can’t stay in the present to avoid the shock of ‘progress’, whatever it may be, from the future.

This is engendered, he explains, by what he calls the *Accelerative Thrust*, the increasing pace of change in technology and society:

> **"In 1836 a machine was invented that mowed, threshed, tied straw into sheaves and poured grain into sacks. This machine was itself based on technology at least twenty years old at the time. Yet it was not until a century later, in the 1930's, that such a combine was actually marketed. The first English patent for a typewriter was issued in 1714. But a century and a half elapsed before typewriters became commercially available. A full century passed between the time Nicholas Appert discovered how to can food and the time canning became important in the food industry.**
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> **"Today such delays between idea and application are almost unthinkable. It is not that we are more eager or less lazy than our ancestors, but we have, with the passage of time, invented all sorts of social devices to hasten the process. Thus we find that the time between the ... idea and application has been cut radically.**
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> **"(Robert B.) Young found that for a group of appliances introduced in the United States before 1920--including the vacuum cleaner, the electric range, and the refrigerator--the average span between introduction and peak production was thirty-four years. But for a group that appeared in the 1939-1959 period--including the electric frying pan, television, and washer-dryer combination--the span was only eight years. The lag had shrunk by more than 76 percent. 'The post-war group,'**

Young declared, 'demonstrated vividly the rapidly accelerating nature of the modern cycle.'

"The stepped-up pace of invention, exploitation, and diffusion, in turn, accelerates the whole cycle still further. For new machines or techniques are not merely a product, but a source, of fresh creative ideas.

"Each new machine or technique, in a sense, changes all existing machines and techniques, by permitting us to put them together into new combinations. The number of possible combinations rises exponentially as the number of new machines or techniques rises arithmetically. Indeed, each new combination may, itself, be regarded as a new super-machine.

"...It is vital to understand, moreover, that *technological innovation does not merely combine and recombine machines and techniques. Important new machines do more than suggest or compel changes in other machines--they suggest novel solutions to social, philosophical, even personal problems. They alter man's total intellectual environment--the way he thinks and looks at the world.* (emphasis added)"

This, then, is the fundamental fact of life of our civilization and society, that technology *and society* are changing, and with each passing day, the rate of change increases.

It used to be that the road ahead of us curved gently, that by carefully looking ahead, we could discern the size and shape of the

vehicles and landmarks before us. We could speed up, slow down, change lanes as needed to avoid collisions. But now, with every year that passes, the curvature of the road becomes tighter. It seems harder and harder to see much ahead at all. If we were driving a car, we would slow down to keep control. Alas, we're not driving a car, rather time is driving us. It refuses to slow down, and the increasing curvature makes our motion into the future happen that much faster. Very nerve-wracking.

Where will we be taken? Most people who consider the future look at the direction we are going and say, "if we continue in this direction, we will come to..." We will come to work over the telephone line via computer terminals rather than in our cars. We will come to have greater democracy through two way television communication with our legislators. We will come to face greater danger of mass annihilation through proliferation of inconceivably powerful weaponry. We will pollute ourselves to death. We will engineer microbes to clean up pollution. We will build factories in space, then send robots up to work in them. We will develop cures for cancer and the Japanese will sell them less expensively. We will have more to teach our children and they will have less to say to us. We won't use money to buy things anymore, and whatever we buy we will quickly discard anyway. Our favorite TV shows will be cancelled even faster.

Yes, if we continue in this direction, all these things will come to pass, but we aren't going to continue in this direction. Not only is the curve in the road becoming tighter, but the hill we are climbing is becoming steeper. Changes which used to take centuries to accomplish now take years, or even months. *Most predictions you find*

about the future take current trends, and trace them by 'straight line' extensions. They tell us we will work at home via computer terminal. What else will we do at home via such terminals? How will the nature of work itself be affected? How, in turn, will this affect society in general? How will all this, then, affect the computer terminal itself? The task I am undertaking here is an attempt to go outside straight-line extensions, to apply *non-linear* thinking. I thereby want to avoid the trap that would have lead that 1850 visionary to think that the airplane would merely speed up the 1950 slave trade. I want to attempt to visualize the radical changes to come in society, effected by radical changes in technology.

- Two -

The Information Explosion -- that's one of the great clichés of our time. Clichés become clichés, though, because they usually have some element of truth attached to them. In this case, it's a frighteningly accurate characterization of our current situation. Think about an explosion. The flame on the fuse reaches the gunpowder. The first grains of the powder ignite, producing heat and pressure causing neighboring grains to ignite, further reproducing the cycle. Finally, within a small fraction of a second, the pressure of the released hot gases exceeds the strength of the container, which then bursts. The hot gases quickly expand to take up as much space as necessary to relieve the pressure, and carry along with them anything not sufficiently braced down. Whereas the original device occupied a very small space, the explosion itself influences a much larger space, and does so in a very short amount of time. Information has been very much like that, *except that in this case, the explosion does not die down once pressure has been released, rather, the expansion continues without any end in sight*.

In *Future Shock*, Toffler tells us,

> **"Prior to 1500 ... it would take a full century to produce a library of 100,000 titles. By 1950, four and a half centuries later, the rate had accelerated so sharply that Europe was producing 120,000 titles a year. What once took a century now took only ten months... And, by the mid-sixties, the output of books on a world scale, Europe included, approached the prodigious figure of 1000 titles per day."**

And that doesn't include magazines, corporate reports, TV and motion picture scripts, government reports, advertisements, propaganda, or credit card bills.

It's not hard to understand why an information explosion exists in the first place. Start with another explosion, the population explosion. All other things being equal, increasing population causes an increase in the numbers of people producing and consuming information. But even without the population explosion, the world's overall literacy rate is slowly rising, owing to improvements in communication, among other things. This means that independent of the population explosion, the numbers of producers and consumers of information is still rising. Since both the population explosion and overall rising literacy complement each other, both growth rates contribute to a compounded growth of the world's body of information. Now, both of these effects are further compounded by the fact that, particularly in technologically advanced societies, the share of the work force employed in information oriented occupations, as opposed to manual labor, is increasing. As if all these factors weren't enough, the explosion of information is further compounded by the increasing availability of machinery, such as word-processing systems, micro-computers, and computer terminals, which increase any given individual's information generation productivity. And, of course, to top it all off, all the foregoing effects are even further compounded by ever-increasing efficiency and capacity intrinsic to inter-nodal communication within these systems of information processing machinery (i.e., the computers are getting faster, and the communication links between are also getting faster). The result is

that although the world's population doubles now about every decade, the world's supply of information increases at a *far faster rate*, perhaps doubling every two to three years.

In the early 21st Century, the population explosion has substantially slowed, however the other factors, if anything, have increased.

Granted, at any given time, most of us are not concerned with most of the information available. But, as the total volume of information expands, *so too does the particular subset of information that interests us*, and at an increasing rate, so that as time goes on, it becomes harder for us to keep up even with our own interests, however narrow they may be.

This points up another side to the information explosion. Not only does the supply of information explode in our faces, but the demand for it jumps as well. Ordinarily we don't expect enlightenment from TV commercials, but Federal Express once ran one that was refreshingly high in that regard. In it, we are first shown a scene, captioned as being set in the 18th Century, in which an executive, appropriately attired for that period, tells a colleague, while sealing a letter with wax, "I absolutely positively must have that package by next year". The scene shifts to the 19th Century in which the executive tells a telegrapher, "I absolutely positively must have that package within three months". Next, in the early 20th Century, the executive, on an old style phone, says, "I absolutely positively must have that package by next week". Finally, the contemporary executive, on his Touch Tone phone, says, "I absolutely positively must have that package by tomorrow morning". The point is, we now

tolerate much less in the way of delay for our needs to be satisfied, including our need for information. How long are you willing to wait for your balance when you call the bank now (or when you place an inquiry at the local automatic teller machine)? How long were you willing to wait ten or twenty, years ago?

So, not only does the overall supply of information grow so fast that it's increasingly difficult to keep up with it, but the *need to find individual items of information quickly* increases just as fast. What do we do? Ironically, the very thing responsible for creating much of the information explosion, the computer, is also the thing that can (but not always does) help us deal with it. There are computer systems now that can store millions of pages of information in a space the size of your shoe, and then retrieve any and all of the documents you choose by specifying a word or combinations of words within about a second. There are now companies whose sole business is either to provide vast bases of data for others to search, or even to perform such searches for others through computerized or non-computerized sources of information. Well over a thousand on-line data bases are currently available publicly. New ones come up almost daily.

The problem is not completely solved by any means. When you ask for information now, chances are you will get the information you ask for along with a lot of other information you didn't realize was available along the same lines as whatever you needed. Some of this extra output may also be of interest, but most of it will not be. When you are planning your lawn and you ask for information about Kentucky

Blue Grass, along with what you want, you may well get reports on Camouflage Dying of Marijuana in Louisville.

- Three -

What we really need is a system that will continuously monitor all of the information available in the world at large and deliver to us in a timely fashion, without our asking for it, all the information that would *at that time* be of interest to us, and not more than that. Such a system would be so valuable that the right people would be willing to pay huge sums of money to subscribe to it.

So thought the founders of IRIS, the International Reporting Information System. As reported in the Washington Post in April, 1983:

> **"You, a government official, banker or corporate chieftain, walk into your office, sit down at your video terminal and punch a few buttons. The screen lights up and the last 24 hours' 'take' of significant political and economic information affecting your interests flashes in front of you.**
>
> **"It already is carefully sorted and professionally analyzed. No more complicated searching of data bases; no more extraneous material, for this is information in an area you have specifically selected, and it reaches you automatically.**
>
> **"... IRIS was officially launched in November 1981. Fifteen months later it collapsed. During its short life it became more than a dream but something less than reality; IRIS existed but it never went anywhere.**

> **"... The basic concept of IRIS was to gather, sort and analyze the vast amount of information floating around the world -- thereby greatly increasing its value -- and deliver it electronically to subscribers. The individual components of the service -- news reporting and analysis, business consultancy and electronic publishing -- were not new. Successfully combining them, and delivering the service to customers according to their prescribed needs, would have been a breakthrough.**
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> **"IRIS computers, though they were large, were not unusual. What was special was the software, particularly the 'syntactical algorithms,' the brain of the software that enables the computer to 'read' material and make key distinctions, say, between oil (petroleum) and cooking oil, or between Venetian blinds and blind Venetians. The software would sort the mass of information flowing hourly into the computer and direct it to IRIS clients on the basis of their specific needs built into the computer's programming. The key to the IRIS system was that, instead of you searching for the information, the information would be searching for you."**

Unfortunately, despite backing from some large international financial institutions and from several high profile political figures, such as former British Prime Minister Edward Heath and former U.S. Defense Secretary and World Bank head Robert McNamara, management errors and marketing miscalculations proved the undoing of the venture. With annual subscription fees of $100,000 to

$500,000, they never succeeded in signing up a single client, and the pump priming money simply ran out.

The most significant lesson to learn from the failure of IRIS was that business problems, rather than technical problems, prevented the success of the project. Undoubtedly, the entrepreneurs just lacked the right information at the right time! The concept itself was eminently technically feasible.

Had IRIS succeeded, it would have provided a valuable first step in alleviating a good deal of the world's information access problems, but it still would have been only a first step. After all, it was directed only at well-heeled governments and large corporations, and apparently was intended only to deal with politically and economically oriented information.

If a system like this could be made available to as wide an audience as could practically use it, and if it could cover a much broader spectrum of information, huge strides could be made toward solving the ills that beset humanity. Information is more merely a commodity, although it is surely that. It is also power itself to achieve any objective.

By the early 21st Century, much of the capability of IRIS has become commonplace. With the World Wide Web, Internet search engines, and "search agent" software applications, automated specialized information searches have become eminently practical. And note well, at how much less cost!

Consider this modest goal: the prevention of nuclear war. Imagine that through some miracle, all of the world's leaders would adopt the following plan: At some mutually agreeable time and date, all of the world's governments totally dispense with their counter-espionage activities, and allow any and all intelligence gathering agents from all other governments to have free and unlimited access to all information possessed by them, including all military, economic, and political information in their possession., All records would be opened to the visiting intelligence gatherers, including the identities of all of that government's agents abroad. All government officials would be available for debriefing interviews by the agents. All information about other governments would be made available. Everything would be made public except perhaps for stories of embarrassing personal peccadilloes.

The agents would be at liberty to transmit all information they gather back to their home governments as soon as they gather it, and they would be allowed to continue their activities indefinitely at their own discretion.

At the moment this plan took effect, war of any kind would become impossible. [We are painfully aware in the early 21st Century that this applies only to countries. There are non-country armed groups, usually characterized as "terrorists", for whom this analysis would not apply.] In order for a country to make war, its attack planning and preparation must be conducted in secret. Otherwise, obviously, the enemy could take steps to counter the attack and neutralize, or at least reduce, its effectiveness. *If there is no secrecy among governments, there can be*

no war. "You shall know the truth, and the truth shall set you free." Not only, that, but it will keep you alive and secure.

Why don't the governments of the world do this? After all, it is so obviously to the benefit of everyone. Well, until now, it simply hasn't been possible to do it, even if all concerned wanted to. Without computers, satellites, and data networks, the field agents couldn't transmit the information fast enough to be useful, and even if they could, those who receive it couldn't process it fast enough for it to help. But now, the state of technology in communications and computers is such that it is technically feasible to implement this plan. Systems are now in place such that the field agents can transmit their findings back to the home offices as quickly as if they were in the next room. So why don't we adopt the plan? Is it because too many of the world's leaders would find that without the power to make war, running their governments would be no fun at all? Maybe, but, of course, the true reason, as always, is lack of trust. *We can never be sure we know what's going on inside the other fellow's head*, and if we lay all our cards out on the table for him to see, how can we be sure he is not holding out some ace up his sleeve?

The serious point not to be overlooked in this fanciful scenario is that if the plan were implemented, it would indeed work. We know this is true because, except for the cooperation suggested in the plan, the maximal exchange of information about opposing powers is exactly what the CIA and KGB are all about! Oh, of course, there is no intent to *exchange* information, but that is, after all, the net effect of their activities. The more successful these organizations are in their information gathering endeavors, the more all concerned are assured

that there won't be any surprise attacks from the other side, and the more peace is assured, so long as each side is roughly as effective as the other. The cooperative aspects of my scenario would only serve to improve the level information flow, and make our intelligence agencies' jobs easier. (No, I'm not advocating that you should turn classified information in your possession over to intelligence agents of foreign countries. Cooperative exchange of information must originate at the top.)

It's heartening to note that when push comes to shove, our national leaders can come to see the value of cooperation in information exchange. For over twenty years there has existed a *Hot Line* between the US and Soviet governments, intended for use during times of unusual international tension or crisis. It is not, as popularly portrayed in films such as *Failsafe* and *Dr. Strangelove*, a telephone connection, but rather a teletype link. Both sides prefer this, since it is felt that direct voice communication could lead to more hasty decisions and actions than either side would desire. But there are proposals afoot now, according to *Computerworld*, to upgrade the hot line to include 'high-speed facsimile capability', that is, wire photo or Fax. Not only that, but there is serious consideration of a data communications link to be included in the hot line. The purpose of all this, as stated in the 1983 Defense Authorization bill, is to 'develop measures for building confidence between the U.S. and the Soviet Union for improved crisis stability and arms control.'

The implication is clear. The more information that can be put at our disposal, the more likely we can handle the problems facing us,

including prevention of blundering into war. And the more of us in that situation, the more problems can be handled at the same time, the more solutions can be formulated, the better all our lives become.

But, what is *Information* in the first place? Many say that we're now in the *Information Age*, so it must be important, whatever it is. There are precise mathematical definitions for what constitutes information and what does not, but, for practical purposes, we can say that it's the things that allow one intelligent being to learn about the mental or psychological processes of another intelligent being, or about the nature of the world around about them. So, newspapers convey information, and so do television and radio and books. But music is also information by this broad definition, and so are art and gossip and the cooing of your partner during romance. Whatever you learn about plants from looking at a blade of grass is information, and the expression on your child's face when he sees a lion at a zoo is also information. We have to be careful here: the term *information explosion* is usually referring to those forms of information that are recorded and/or intended for communication among individuals or groups of people. Part of the information explosion comes about because we are now able to capture and record forms of information that couldn't be recorded before, maybe couldn't even be perceived before, such as one's brain wave activity.

Again, though, we're concerned with getting just the information we need, and not more. Management analysts have long been familiar with the *information overload* effect. That means that the time it takes you to reach a decision is a strange function of how much information is at your disposal. If you have only a little information

or none at all, it takes a long time to reach a decision, because you must take time to consider all contingencies and possibilities. As you gain more information, your decision making time decreases, because with the given additional information, you are able more quickly to dismiss irrelevant contingencies and evaluate appropriate choices.

But, you eventually reach a point where you have so much information that in order to properly digest and evaluate it, you must take so much time that your decision making process slows down again (although, presumably, the quality of the decisions still improves). This is much more than a trivial embarrassment of riches. It adds another facet to the information explosion--not only do we have a problem of extracting interesting information from the total world's base of information, but we also have a problem of separating more useful information from less useful information, compounded by the routine possibility that the less useful information may indeed *appear* more interesting. To get out of this box, we *must* find creative ways of utilizing our information processing resources.

The most promising answer to this dilemma comes out of the emergent field of *Artificial Intelligence*. If you ask ten experts in this field for a definition of what artificial intelligence is, you will probably get about twelve answers. In general, it has to do with getting computer systems to perform tasks that would usually be associated with thinking, whatever that is, were they to be done by humans. At one point, a system that could play a respectable game of chess was regarded as an example of an artificially intelligent system. Nowadays, since such systems are available in department stores for a couple hundred dollars, we look to more sophisticated

applications as candidates for artificial intelligence. A system that could select winning football plays, under actual game conditions, is one possibility currently under development at Yale. Very advanced A.I. systems will exhibit behavior that we would characterize as creativity. This creativity could be applied to having systems monitor information as it becomes available and, through knowledge of preferences of members of the audience, having the systems direct pertinent information to these people according to those preferences. This was the idea behind IRIS. With the right distribution and marketing, I believe it could be an overwhelming success.

So, our weapon against information supply overload and demand under-satisfaction is the computer -- not just the computer, but the computer linked to communications networks, so that the information can be moved where needed, when needed. Actually, the distinction between computer equipment and communications equipment is becoming less and less clear as time goes on. Computer systems now routinely communicate, and communication systems routinely compute. This has been recognized for quite a while now, but the significance of this trend is lost on most people. I believe that it is one of the central factors making our road to the future bend as sharply as it does. Every telephone in the world is, in technical fact, barring politically motivated disruption, connected to every other telephone in the world. As we connect more and more computers to those telephone links, we create an information handling potential that grows with each connection. 'Potential', I say, because the full capability has yet to be realized, not only due to political considerations, but some technical ones as well, such as rampant lack of standardization throughout the computer/communication industry.

But, as time goes on, these problems are being overcome. Standardization is improving, connections are proliferating. The potential is beginning to be realized, and as this continues, our power to solve problems or otherwise assert our will continuously increases. (The vision here, of course, has largely come to fruition through the Internet.)

It should be noted that the computer, without regard to data communication networks, is, in itself, a communications device. Most people don't realize this, and that's why there has traditionally been a great deal of dissatisfaction with computers on the part of end-users. The computer is, in fact, a medium of communication between those who put information into the computer, especially in the form of instructions, or programs, and those who get information out of it. The programmer usually thinks in terms of giving sequences of instructions to the machine so that if certain inputs are entered into the system, certain outputs will be generated by the system. In fact, he is doing much more than that when programming a computer. The program entered into the machine carries direct implications (that is, information) to the end-user that in order to operate a given application, he, the end-user, must specify such-and-such information in this-or-that way in order for the whole thing to work. If these 'implications' are not clear to the end-user, he won't be able to operate the program properly, and that is poor communication on the part of the programmer! Unfortunately, this happens all too routinely. Historically, these implications have been supposedly clarified in documentation in the form of user manuals. The quality of these manuals is as varied as the personalities of the programmers that produce them. Lately, we see more and more of this

documentation in the form of on-line ‘help’ commands, built into computer applications. The usability of programs is a direct function of the quality of this documentation. Again, communication of information is at the heart of getting things done.

Ultimately, two factors influence the effectiveness of computer/ communications networks. One is network availability. As time passes, network availability is rapidly increasing. Publicly available communication networks, such as Tymnet, Telenet, and several microwave based systems, are proliferating at a prodigious pace. Of course they are -- there is plenty of money to be made in communication networks. They provide to the general public the capability of communicating the voice and data information necessary for everyday business and private life. As technology has improved, adding satellites and fiber optics linkages to the networks, the costs of using these networks has continually been decreasing.

The same has been true for computers. The computing power of the 1947 ENIAC, which cost millions at that time, is now available in home computers for only a few hundred dollars. This means that more and more people who need access to the overall information processing resource will, as time goes on, get easier and easier access to it. There are no major problems, therefore, in the way of availability of computer/ communications systems.

The other factor is called *bandwidth*. The term originated in radio engineering jargon, but was later adopted in information theory. It basically has to do with how fast information can pass through, or be handled by, an information handling system.

It's a relative term. Faster systems are said to have either *high bandwidth* or *wide bandwidth*; slower systems are said to have either

low bandwidth or *narrow bandwidth*. There are various quantitative measures for bandwidth, but the one most familiar to most of us is *characters per second* or *cps*.

A character is any of the basic symbols used in information transfer, such as letters, numerals, punctuation marks, and special purpose symbols, such as dollar signs, asterisks, pluses, minuses, slashes, and the like. A blank is also a character, as is a *null*, which is a character denoting the absence of any other kind of character. There are also *control characters* which tell systems to start or end transmission, repeat transmission (due to, say, an error having been detected), and *Do you read me? Over*, types of functions. The rate at which systems can transmit these characters, that is, the number of characters per second, is a measure of the bandwidth of these systems.

It's important to get a good concept of what bandwidth is, and what it means for computer/ communications networks. It's a bandwidth problem that puts The Last Great Bottleneck in our way before we accomplish *the greatest transformation in human society that the world has ever seen.*

When I first became involved with computers, in the late 1960's, I had the good fortune to have access to some of the early *timesharing* computer systems. This was in contrast to most computer users at that time who had to use computers in the *batch processing mode*. In batch, a user would punch up a deck of *IBM cards* on a keypunch machine--each card would contain a program instruction statement or

a line of data. He would then give his deck of cards to a computer operator stationed at an access window to the computer center.

It was important back then to isolate the computer from the users. Only the operators and systems programmers could be allowed to have direct access to the computer. All computers were still very expensive. They had to be very closely monitored and managed so that every last penny's worth of processing power could be squeezed out of them. The way to do this was to gather together all of the decks of cards that the users wanted to run, their *jobs*, and put them together in a *batch*, and run the batches in sequence, or sometimes in tandem, if the batches didn't conflict with each other for machine resources. For example, all the programs that didn't require tape drives and only a short run time were put in one batch. Those that required long run times, but still no tape drives, would be put into another batch. Those requiring tape drives, but short runs, would be put into another batch, etc. Each batch would be run on its own schedule.

So the users submitted their card decks to the operators, and then they waited. Depending on how powerful the computer was, and how well the data center was run, they waited anywhere from a few minutes to a few days. They would go to the *output area*, a room in which one wall was covered with shelves divided with vertical partitions into *bins*. The operators would put the results of the computer runs, the printouts and any card decks newly punched by the machine, along with the original card decks, into these bins. The users eagerly awaited these results -- why is something of a mystery, since these results were generally the source of great frustration. The

users would discover that after all that waiting and anticipation, they had left out a comma here and a period there in their programs, or they made a trivial misspelling of an instruction control word, or they had more left parentheses than right parentheses in an arithmetic expression, or that they just plain hit a wrong button on the keypunch. At any rate, their programs didn't run.

They had to shuffle through their card decks, extract the offending cards, repunch new ones, re-insert them back into the decks, and try again, hoping that the new cards were inserted back in the right places, and that the new cards didn't contain new errors. They submitted their jobs again, and waited again.

When the jobs came back, they found that getting rid of the errors that the computer complained about last time (which were hard enough to deal with, usually being cryptic three word phrases, like *SEGMENT ALLOCATION CONFLICT*, for which one had to go to a condescending Consultant for explanation) only allowed the machine to delve further into the program and discover new errors that were previously masked. Again, re-punch the cards, resubmit the deck, and wait.

Now the program results came back again and, yes! The program ran … but it produced the wrong answers. The user accidently said the formula for nuclear energy conversion was $E=mc^3$ instead of $E=mc^2$. What did the computer know of Einstein? It just went ahead and did what it was told.

There were even more steps for the end user to painfully traverse, involved with debugging and the deciphering of manuals. Eventually, say, after a few weeks, the program finally ran correctly. It always amazed me that the computer was supposed to get things done so quickly, yet it took so long to get it to do something right. This was a very low-bandwidth environment, in terms of getting processing into, through, and out of the system efficiently.

As I said, I was fortunate in being able to access a timesharing system instead of having to use batch systems in my work. These machines were set up so that a user could call into the systems by telephone, and communicate directly to the machine via a teleprinter terminal. The breakthrough in technology that allowed this was the invention of multi-user operating systems, sophisticated packages of program software that allowed the computer to communicate with numerous users, in something of a round robin fashion, so quickly that each user could get the impression that he was the only one using the computer, if system response time wasn't too slow (that's more or less the time between the user giving a command and the computer responding that it received the command). Another part of this breakthrough was the interactive editing program, a forerunner of the modern word-processor system, which allowed the user to enter his program through the terminal, rather than using a keypunch, and save the program in electronic form on magnetic disk, rather than on cards. In this form the content of the program could be much more easily edited and corrected.

I could enter a program into the timesharing computer and try to run it right then and there with a short, simple sequence of commands. If

there were errors, I would be informed of them within a few seconds. I could correct them in a few minutes, and try again. The program statements, and errors I made, were essentially the same as they would have been in the batch mode, but, *processing them* was orders of magnitude faster. What took weeks to accomplish in batch could be done in hours under timesharing. This was a much higher bandwidth system, from the information processing point of view.

That teleprinter I mentioned illustrates another, more traditional, aspect of bandwidth. *Teletypewriter* is another name for the same device. The idea behind it is that a typewriter-like device is made to do its typing by receiving electronic signals over a communications link of some kind. In my case, that link was the ordinary telephone line.

The first teleprinter I ever used, back in 1968, was a TeleType, Model 33. What a marvel it was! It could transmit data to the computer as fast as I could type (about two to three characters per second when I went full speed), and it could receive data from the computer at the astounding rate of ten characters per second! Even then, this was not really a *state of the art* device, that is, most up-to-date or least-obsolescent. By the next year, I began to work for the first of a succession of timesharing companies, and I was using an *IBM 2741* terminal. This was simply an *IBM Selectric* typewriter (the one with the golf ball-like typing element) connected to a box full of electronics allowing it to act as a teleprinter. It could receive and type data at about 15 characters per second using a professional-looking easy to read upper and lower case font.

A couple of years later, the *Execuport* terminal made its appearance. Not only could it receive at the rate of 30 characters per second, but it was the first truly portable terminal of its time, capable of operating at such a speed. It weighed only about 25 pounds. It had a built in telephone interface, an *acoustic coupler*. With this terminal, you could now access a computer from any telephone, even a phone booth. It also incorporated some radically different technology from its predecessors. It had a thermal process dot matrix print mechanism that required heat sensitive paper. By 1975, I began to see terminals that could receive at 120 characters per second.

Most people can't even read that fast. I still couldn't type faster than two or three characters per second, *a fact whose critical significance I was then only beginning to realize.*

When terminals transmit data down a phone line, the signals representing the data characters must be converted into the electronic equivalents of sounds, just as your voice is when it is transmitted over the phone. *The higher the data transmission rate, the higher the frequency or pitch is required for these sound signals to be transmitted*, just like in a speeded up phonograph record or tape playback with which you get sounds of higher pitch. The telephone system was really designed only for voice communications; data communications came in only as an afterthought. As a result, there is a limit to the frequency that can be economically transmitted on standard phone lines, and this holds data transmission on such lines down to about 120 characters per second. Therefore, since the mid 1970's, we have not seen any widespread significant improvement in the transmission speeds of terminals designed to use

standard phone lines. It's not that the terminals can't be improved. Rather, we are constrained to use standard phone lines that can't be improved.

Well, no we aren't. It's possible to get special data communication phone lines that routinely support terminals that transmit at 1920 characters per second. If you're really in a hurry, you can use a satellite link that transmits at 5000 characters per second. Contrast this with the state of the art back in the late 1960's. Then, if you were willing to pay for the special data communications lines, you could get a high speed terminal that would go at about 200 characters per second.

Bandwidth, in the sense of overall information transfer speed, is a main ingredient in computer/ communication systems processing power. We have seen it increase dramatically since the invention of the computer. In the late 1940's, when the first electronic computers became operational, TeleTypes sent messages at about 5 characters per second; today, their grandchildren talk at 120 cps. High speed communications didn't exist until the late 1950's, the early systems could do about 150 characters per second. Today we are at 5000 cps and still climbing as fiber optics links promise to bring rates of over 100,000 characters per second within reach by the mid 1990's.

If we consider a broader view of bandwidth, to encompass all phases of information handling, we see similar increases in other aspects of information processing as well. The first computers could process hundreds of instructions (to add, subtract or shift numbers around in memory) per second. Today's computers can process millions of instructions per second, and the supercomputers now on the drawing boards and in laboratories will process many billions of instructions per second.

Main memory, the data storage space that is closest to the processing circuitry with fastest access, in the early computers, consisted of only a few thousand characters. Today's main memories are often sixteen million characters, and tomorrow's look like they will be unlimited, at least in the billions.

Auxiliary storage units, designed primarily for high volume rather than high access speed, used to contain several million characters in a device the size of several refrigerators. Today, with laser storage techniques, several billion characters can be stored on disk that will fit in the palm of your hand.

The early high-speed printers could go at about 1000 lines per minute. Today's laser printers can go at several hundred thousand lines per minute, and microfilm output devices can produce millions of lines per minute.

In the thirty five brief years since the invention of computers we have seen leaps in information processing bandwidth that truly strain our ability to comprehend them. They have vastly multiplied computational processing and memory capacity. They have lifted storage and output transmission literally beyond the sky (via satellite). By the end of this century, we will have systems in which the packing density of information handling components will be equivalent to that of the human brain, and they will be far faster. Work is in progress now toward creating small area networks of large numbers of small computers, *micro-processors*, which will work in tandem as *parallel processors*. They will handle information in ways that can be rather like the coordinated efforts of cells in a brain.

Does all this give you a little shiver? Is there a feeling that we're losing our grasp on things, like we're riding in a wagon and the horses have suddenly developed a mind of their own, deciding to pull the wagon faster and faster, heedless of our commands to slow down? I used to get depressed whenever I would attend a computer trade

show. I've been in the industry about sixteen years and I'm aware that I know quite a lot about computers. Yet, whenever I go to one of these shows, I can see all kinds of new systems that I'm aware that I know *nothing* about. And, this effect increases with each new show. I used to get depressed, I say, but no more. Although I feel a shiver now, it's becoming clear to me that an earthquake is coming, one that will shake humanity to its foundations, but will actually relieve us of the stress of future shock and the information explosion.

- Six -

For all the tremendous increases we have seen in processing power, storage, and output transmission capacity, there is one area in which progress has been sorely lacking. If we transmit data from a machine, such as an astronautical telemetry monitor, to a computer, the computer will be able to accept the data as input just a fast as the telemetry system can produce it. Fine. *But, if we want to transmit data from a human mind into a machine, we are no better off now than we were about a hundred years ago!*

Virtually all business data input is done using machines with keyboards: keypunches, key-tape machines, key-disk machines, CRT (Cathode Ray Tube, i.e., TV tube) terminals, teleprinter terminals, personal computers -- keyboards by the millions. Except for the addition of electric power, the keyboard we use today is about the same as the one introduced by Christopher L. Sholes in 1873. Even the *QWERTY* pattern has held fast despite some challenges. The best typist can reach a rate of about ten characters per second, and keep it up there for only a few minutes. Professional key-entry people usually go at a sustained rate of only about three characters per second. The rest of us are lucky to *sustain* a rate of about one character per second. (In short bursts, we can do better than that, but these short bursts are inevitably punctuated by lengthy periods of stopping and thinking.) This is the way we transfer information from our minds to the machines whose power we so desperately need in order to control the exploding environment of information. (In the early 21st Century, all of this still holds true.)

This is low information input bandwidth, and it is The Last Great Bottleneck in our progress toward fully integrating our desire for access and control of information with the information itself. We know the information is out there, usually. How can we tell the machines fast enough how to get it to us in time for it to benefit us? In other words, if a certain assemblage of information is needed in order to work on a particular problem, and the programming does not already exist to deliver it in the way needed, how can we get that programming into the system fast enough to allow the desired to be of use?

Information is not only the facts, data, opinions, pictures, and whatever else that we find published in books and periodicals, and stored in computers. Our own knowledge and experience are also vital sources of information. How do you recognize when you see an object that's upside down? Getting a computer to be able to do the same is a very difficult problem in pattern recognition, yet you can do it instantly, without thinking (unless, maybe, you are looking at some of the paintings you see in a modern art museum). Remember the story of the frog and the centipede? The frog asked the centipede how it was that he could manage the task of walking, what with all those legs he had. Did he go left leg, then right leg, then the next further back left leg and right leg, or did he move all the left legs, then all the right legs? When the centipede stopped to think of the answer, he found that he didn't know the answer, because he never thought about how he walked when he was walking. Now that he thought about it, he found that he was totally perplexed and unable to move, which made it easy for the frog to eat him.

The point here is, even when we do know how to go about performing a task or solving a problem, we may find that due to its intrinsic complexity it can take a long time to express the necessary steps to a computer in a form that it can *understand,* if, indeed, it's even possible to express the solution as a series of programming steps.

This is all very closely related to the problem of programmer productivity. How can we tell how productive a computer programmer is? The answer is that there is no good way of measuring programmer productivity; there just aren't any consistent standards. We can't merely count the lines of program code the he produces in a day; some lines are simple and some are complex. In general terms, though, we know that while computer hardware costs have been steadily decreasing over the years, software costs have been increasing because software developers earn much more now than thirty years ago, but their capability to develop a number of programs over, say, a year has not increased as fast as their incomes.

It's not that their capabilities haven't increased at all, they have. At first, programmers explicitly had to state each minute machine instruction that was to be performed by the computer. Now, they can write programs in computer languages such that a single statement in one of these languages can automatically generate hundreds, or even thousands, of machine instructions. The trouble is, computer systems are becoming so complex that even with these languages, thousands of these compound statements might be required for a reasonably sophisticated program.

Other approaches to the problem are emerging. Several are embodied in the ambitious Japanese Fifth Generation Systems Project. *Fifth Generation*? Before looking at the fifth generation, let's take a quick look at the other four.

The First Generation computer systems were the first electronic computing machines developed in the late 1940's. They were built around vacuum tube electronic technology, and, although they were the wonder of their age, they were, by today's standards, slow and short on capacity. They were also very unreliable, capable of only a few minutes of sustained activity before some of the tubes burned out, and they were monstrous consumers of power. They were used primarily only in computer science research and a few specialized applications, one of the most notable being the 1950 U.S. Census.

The Second Generation machines began to appear in the late 1950's and were based on transistor technology. A transistor does pretty much the same thing in an electronic system as a vacuum tube does, except that it is much smaller, much more reliable, and much more efficient in consuming power than a vacuum tube. The Second Generation machines were far more reliable and less expensive than the First Generation machines, and began to see use in the business world.

The Third Generation machines came in during the mid-1960's and were centered around integrated circuit *chip* technology. They were far cheaper than the second generation machines, far more reliable, far faster, and far less expensive to operate. As far as the public was concerned, the *Computer Age* began in earnest with the proliferation

of these systems. The computer's impact on society began to be felt. For example, widespread availability of consumer credit became possible only with the advent of these computer systems, which gave businesses the capability of economically keeping the necessary records. Nearly all large businesses could now afford computers; most found they could not afford to be without them.

It's not quite so clear where Fourth Generation machines come in. Integrated circuit technology is still used now, although it is vastly improved over the earlier machines. There are differences in internal machine structure (*architecture*), and *virtual storage* technology is more heavily used now. If anything, the coming of the microprocessor represents a sufficient break with the past to herald a new *generation.* Their processing power is not significantly improved over late Third Generation systems (in fact, they are substantially slower in most cases), but their reduced size and cost, bringing computer power to the people, is truly a revolution.

The generations we just looked at are all oriented toward developments in hardware technology. We have also seen roughly four generations of software technology.

The First Generation software was the process of programming computers in their own *native language*, that is, basic numeric codes. This is extremely difficult and time consuming for humans, as well as being horridly error prone.

The Second Generation software came with the development of *assembler language*, a means of representing machine instructions

with human-oriented mnemonic codes, such as *ADD* for add, *SUB* for subtract, and *MVC* for move-a-string-of-characters. These made their debut appearances in the early 1950's. It still took a high level of dedication to work with these tools, but they were very effective. In fact, even today, when operating systems and other performance-critical programs are developed, they are usually written in assembler language, since they allow the systems programmer to have the ultimate in control over precisely which machine instructions will be executed at any given point in a process.

In the late 1950's, the Third Generation of computer software arrived with the birth of *higher level* languages. The most famous of these are FORTRAN (FORmula TRANslation) and COBOL (COmmon Business Oriented Language). Statements written in these languages bear strong resemblance to mathematical formulae or natural human languages. However, the resemblance is deceiving, since the rules for creating statements in these languages are highly restrictive. Their great advantage is that a single statement written in one of these languages can be used by a machine to generate several machine instructions, sometimes thousands of them. This greatly increased the efficiency and effectiveness of programmers, especially applications programmers, who concentrate on writing programs for end-users, that is, managers, accountants, engineers, analysts, and the public at large.

Again, as with the hardware generations, the dividing line for the Fourth Generation of software is fuzzy. In the late 1960's, *Data Base Management Systems*, specialized software systems for handling large collections of data (many thousands of items), started to gain

popularity. Some of these systems had their own specialized languages developed along side the data handling software. Although calculations are, for the most part, specified the same way in these DBMS languages as in the recognized Third Generation languages, statements for the control of Input and Output (I/O) are generally far simpler and more powerful than those of the Third Generation languages. This could be done because it was noticed that at a certain level of detail, the steps necessary to handle the needs of a wide variety of data processing applications are very similar regardless of the particular application. People who have used both Third and Fourth Generation languages (including myself) generally find that they can be substantially more productive when developing applications in the Fourth Generation languages than in the Third Generation languages. On that basis, it is probably fair to claim that these Data Base oriented languages indeed do constitute another generation.

Now we look toward the Fifth Generation. Although the Japanese are getting the most headline space for their efforts, mainly due to the heavy commitment of the Japanese government in the effort, substantial efforts are also under way in the U.S., Europe and Australia.

There are five areas of technological pursuit in the Japanese Fifth Generation Systems Project:

- Development of much faster hardware (in the hundreds of billions of instructions per second range)

- Development of hardware for basic support of learning, inference and association functions for artificial intelligence applications

- Development of artificial intelligence software systems usable in general application areas

- Development of natural language interfaces based on artificially intelligent systems

- Development of artificially intelligent techniques for mass production of software.

As a result of this kind of effort, fifth generation hardware will, of course, be faster, smaller, cheaper, and more reliable than anything available today. These systems will make much greater use of parallel processing, that is, execution of many instructions simultaneously, as opposed to one-at-a-time execution characteristic of most of today's systems. (The Japanese Fifth Generation Project, as such, was not a success. It turned out that the advantages sought through the use of massively parallel processing eventually were realized through faster microchips, and specialized databases became generally available through the Internet. Artificial Intelligence has not progressed as quickly as foreseen. Other paradigms, such as Object Oriented Programming, have flourished instead.)

Fifth generation software, however, does not have to wait for fifth generation hardware, it already exists. A programming language called PROLOG, first used in the early 1970's, allows the programmer to state facts and rules about a problem, pretty much

without regard to any particular order. PROLOG then picks through this mass of facts and rules and decides by itself which ones are needed, and in what order they should be applied, in order to satisfy any given request for information. Because of many popular fictional depictions of computers, most people not familiar with the technical facts of how computers work have believed all along that this is the way computers operate. Rest assured that until languages like PROLOG became available, computers definitely were not smart enough to take random assemblages of facts and make sense out of them. With fourth and earlier generation languages, the programmer must specify program statements in precisely correct order, or the programs just won't work.

The potentially most fruitful areas in the Fifth Generation Systems Project for relief of the input bandwidth bottleneck will be in the development of artificially intelligent systems for general applications and mass production of software. If these facets of the project are successful, it will mean that computers, under control of artificial intelligence software, will be capable of doing more as we tell them less. For example, instead of having to give a command even as simple as "PRINT SALES-VOLUME FOR MONTHS JANUARY THROUGH DECEMBER FOR SALESPERSONS IN CHICAGO", we might more simply say, "WHAT DID THE CHICAGO SALES PEOPLE DO LAST YEAR?" Indeed, this will improve the efficiency of communications between people and machines.

But isn't it really just a means of circumventing the problem? So we won't have to type in so much verbiage to tell the computer what to do, but, what we do type in, we won't type in any faster. Eventually,

as we demand more and more sophisticated capabilities of the computer, the input bandwidth limitation will still be a bottleneck. Remember Parkinson's Law: *Any endeavor always ultimately consumes all the resources devoted to it, then demands even more.*

The Japanese are particularly concerned with the input bottleneck problem. When the Japanese refer to *natural language interface* they are talking about natural speech recognition and processing. They are very intense on this and it's important to understand why. They have a much bigger problem with computer input that we in the West do. The problem is not with numeric data, but with words.

Although Japanese alphabets exist, the most widespread form of the written Japanese language, especially in business, is the traditional ideographic (hieroglyphic-like) *kanji* script. There is a separate *kanji* character for each word. They're all different. Developing a word processor system to accommodate this is a nightmare. The most effective ones allow input with an alphabetic script, then automatically translate the alphabetic words into *kanji*. Unfortunately, the alphabetic words very often do not translate one-for-one into *kanji*. A single syllable entered alphabetically can translate possibly into dozens of different *kanji*, only one of which will generally be correct. These ambiguities occur often and resolving them slows down the input process greatly.

According to Eric Olsen of Fujitsu Ltd.,

> **'Although Fujitsu has spent years developing and improving its Japanese language word processors (OASYS), they are still far**

from ideal. A faster learner in an intensive course can master them in about two months and can produce copy at triple the handwritten rate. The average office assistant can produce copy at about one fifth the handwritten rate.

'Basic word processing systems in the U.S. sell for around $1,000; our cheapest model is about $3,500, and our top-of-the-line model is $20,000. These machines cannot double as programmable computers.

'Given these problems it is a wonder that there are any word processors at all in Japan.'

The upshot of this is that word processing equipment is very uncommon in Japanese offices, as compared to the U.S. and Europe. All this makes the Japanese even more acutely aware than Westerners of the need to make as much information as possible accessible to, and processable by, the information processing resources at our disposal. In no sense is more efficient input a luxury for the Japanese, it is an outright necessity. It's one reason for the nationwide commitment on Japan's part for such a project. It's also the reason for the emphasis on natural language recognition in this project.

By the 21st Century, of course, most of these problems have been solved. Japanese word processors typically "learn" which *kanji* characters are desired as the user routinely enters text, making them virtually as effective as Western systems.

The goal is to be able to speak to a computer, in plain Japanese, and have it do what is required. Voice input systems for computers already exist. MCE, Inc., of Kalamazoo has a voice input module for use with Apple II or Apple IIe computers that they say will recognize anyone's voice, has an 'unlimited' vocabulary, and has utility routines to accommodate editing the vocabulary, all for $825. The systems of today, however, require the user, typically, to speak a specialized vocabulary, and to be very careful about articulation of the words. The natural language processors envisioned in the Fifth Generation project would remove all restrictions from the speaker.

Where will the Fifth Generation systems lead us? All of the computer capabilities that have been improving over the years, processing speed, memory capacity, software capability, will continue to improve spectacularly. But, given current plans, the Great Input Bottleneck will remain.

- Seven -

Voice input and natural language processing will not solve the problem of transferring knowledge from people to information processing systems faster, for two reasons:

First, speech is conducted at acoustic frequencies, which are very low in comparison to other media, such as normally used radio frequencies, and because of that, it is a relatively low bandwidth means of communication. A given item of spoken communication typically carries less information than an item of written communication, especially if there is no emotional involvement in the communication. For example, if you say 'for sale', it could be interpreted as 'four sail' or 'foresail' or even 'force ale'. This happens because the sounds of these syllables do not carry enough information to allow the person hearing them to be able to differentiate which meaning was intended without further clues from context. This is a consequence of the low bandwidth of sound based communications. A classic example of this problem occurs in French: *'Si six sies sient six cigarres, six cent sies sient six cent cigarres'* (If six saws saw six cigars, six hundred saws saw six hundred cigars). All of the syllables, except '*cent'* and '*garres'*, are pronounced like 'see'. Or this one, punctuate the following to have it make sense: 'Smith where Jones had had had had had had had had had had the teachers approval'. One solution is: 'Smith, where Jones had had "had", had "had had"; "had had" had the teacher's approval'. That's not the only solution, either. The point is, speech as a medium of communication leaves much to be desired, because the low bandwidth of sound means a slow, limited

transfer of information, and that leads to ambiguities in so much of what we say.

All right, let's assume that artificially intelligent systems will become so intelligent that they *will* be able to unravel puzzles like those the same way we do, through analysis of intonation of voice and knowledge of personal idiosyncrasies of the speakers. This still leaves the second problem.

People talk too slowly. On a *sustained* basis, people can't talk substantially faster than a reasonably good typist can type. Of course, that's some improvement, since most people can't type at all, whereas they can speak. But, considering the thousand fold, or million fold, improvements in information processing, storage, and output over the past few decades, an improvement of two fold, or even ten fold, in input speed hardly compares. The Bottleneck will remain.

Is it really a bottleneck? What if we don't get a much better improvement in input speed? The answer to this comes down to the fact that due to the very nature of information, a vehicle for the transfer of intelligent thought or knowledge or creativity or whatever, people are *always a part* of any overall information processing system. Too often information system designers lose sight of this fact, and their systems fail to fulfill their intended purposes.

Information systems exist for people, they are supposed to give their information to people, they are supposed to take direction from people. Their most basic information, the knowledge of what to do with the information they have (in other words, programming),

always ultimately comes from people (*software generators* notwithstanding). The more information the information systems will have (and they will have a lot more in the future than they have now!), the more they will need to know what to do with it. In other words, the smarter they will have to become. Smart is different from intelligent. Intelligent is *being able* to learn and know more. Smart is the state of actually having learned more and of knowing more.

How will information systems become smarter? They will have to learn more and more about how to infer meaning out of the information they have (this, in turn, of course, produces more information). How does anyone learn to infer meaning out of information? The brain scientists are still working on that one, but one thing is for sure, the process is not a solitary one. You learn to infer meaning from other people; it's all tied up in your culture and language.

For example, if you are indoors, that thing at the top of the room, in English, is called a 'ceiling', and in German, it's called a *Decke (pron. DEK-eh)*. In general, the word 'ceiling' can be applied to anything that constitutes a limitation in height or altitude, as in aircraft pilot parlance 'ceiling 2000 feet' or 'price-ceiling'. But, in German, *Decke* really means 'cover', and this same word is used to denote a bed blanket. Although the two words 'ceiling' and *Decke* are applied to the very same thing, the words don't really have the same intrinsic meaning at all. Culture and language make the difference; they are the determiners of meaning.

Culture and language are social phenomena. They arise out of groups of people. If you are going communicate with people, you need to know not only the words they know, but you need to know the meanings of those words *the same way they do*. In order to do that, you must absorb some of their culture. You never really learn French until you go to France or some other French-speaking locale. But, once you go there, how *do* you learn it? By example, by trial and error interaction, by asking questions, by some absorption process we don't yet understand. .At any rate, you don't do it alone, at least not nearly as well as if you interact with other people.

Computer systems will have to undergo some of the same processes as people do in order to learn how to deal with meaning. Internally, the processes wouldn't have to be the same, but externally, the interaction between computer and person will have to be like the interaction between person and person. Otherwise, the person's part of the interaction will be relatively ineffective.

That's not what happens now. We try to imbue machines with the ability to deal with meaning by programming them. But programming is too narrow and too slow. In the long run, programming will fail as a means of getting machines to become aware of meaning. We don't *program* our children in order to get them to understand meaning, we *raise* them. We will also have to raise our computers.

But we can't raise our computers the same way as we raise our children. We don't dump our huge accumulation of information on our children and expect them to process it for us and make sense out of

it, as we will with our computers. In order to be able to do that, the information systems will need to get the rules of meaning from us, and quickly -- faster than we can type or speak them. Otherwise, the increase in the volume of information will outstrip the systems' capability to deal with it. The machines just won't become smart enough fast enough.

Medical-Expert systems are a good example of this today. They can make diagnoses as well as doctors can, but only if they have the knowledge that doctors have. Because medicine uses such a broad vocabulary of highly specialized terms (high-bandwidth, in a sense), the meanings and rules of inference are manageable with today's software technology. So if we can tell the machines the medical facts, they can make good use of them and give us useful information when we ask them questions. But if thousands of medical journal articles are published around the world each week, and this rate of information generation continues to increase, how can we hope to keep the machine up to date?

Yes, we can get the machines to read the published articles directly. But how do those articles get into print in the first place? By typing! And when a doctor reads a medical article, he merges that information in with all the other things he already knows. He draws new inferences and conclusions, he can make new assertions. Machines are limited in their ability to do this, and they are generally unable to deal with totally unexpected inputs. The doctor makes judgments about the applicability and validity of what he reads. These judgments and insights need to be given to the machine,

too. The machine can't read them. And the doctors won't have time to speak all of them, especially as more and more come about.

Just as we have questions of machines requesting information, the machines will have questions of us requesting meanings, just like a child, only in a much bigger hurry. Neither the machines nor we will have time to answer all these information requests in the conventional manner. Much faster means of input will have to come into existence.

- Eight -

All of the foregoing are the reasons and necessities why faster methods of computer input should be developed. Of course, they are *not* the reasons that such faster methods *actually will* be developed. Those reasons are the same reasons that most everything else in our society is developed--competition. If someone invents some means by which you can enter your programs and data into a computer more quickly, efficiently and cheaply than your competitor, will you utilize it? You'd better. You know that your competition will. That's what the Japanese Fifth Generation project is all about -- giving a greater competitive edge to Japan, and I say this in the spirit not of chagrin, but of highest admiration.

What are the alternatives to keyboard input for information that's not already down on paper, that's still in your head? We've already looked at speech and natural language processing. It can provide some measure of improvement, but not the dramatic levels we will need. Let's look at the problem from the other side, how can humans produce output that computers can use as input?

The first human output that was used as computer input was the punched hole strategically placed on a card or paper tape. How did the hole get punched? On a machine with a keyboard, of course! As mentioned earlier, keyboards are the standard method of entering data into machines. To be effective in using them, the skill of typing must be acquired.

For most people, typing is a drag. Especially for managers. They identify typing with the typical activities of their subordinates (clerks and secretaries). With the advent of personal computers, this attitude has started to crack, but it's still widespread. Since managers make the decisions about how to spend money, systems vendors are naturally concerned with providing means of input that will be more attractive to managers.

In the early 21st Century, keyboard aversion has been completely dispelled. People at the highest levels are comfortable using them, particularly on small hand-held communication systems, which still have miniaturized QWERTY keyboards. A clamor of "there's got to be a better way" has not quite yet materialized.

Touch-sensitive screens are available. The computer displays a series of labeled boxes, and you touch the one that seems most likely to make the machine do what you want. Although this method relieves the user of the necessity of keyboard familiarity, in the long run, it's even slower than typing and much more limited. You can select only among the choices given to you on the screen; only a limited number of choices *can* be presented, since the screen is only of limited size. At best, one of the choices will be to show more choices. And, before you know which choice to select, you must read all the choices given.

Again, there's speech input. You don't have to get your hands dirty at all with this, but, as we've seen, it's still too slow. And how *do* we pronounce punctuation marks? Remember the Victor Borge method?

There are systems now that can accept direct handwritten input, such as the one offered by Pencept, Inc., of Waltham, Mass. With this

system, an input form, that is, a paper with boxes in which to enter data, is set on a pressure sensitive pad, As the user writes data values in the boxes, the pad detects the pencil strokes and interprets them as letters, numerals, or other symbols. In many business applications, computer input data are handwritten before being given to key-input operators. With a system like this, the data can be entered directly. I don't know, however, how the system reacts to an eraser. We're still down in the few characters per second range with this system, so it's not the answer either.

Hand signs have been used for many years by the hearing-impaired, also by some American Indians. As long as a conversation consists of words for which signs all exist (as opposed to names or special words that have to be spelled out), communication can proceed with sign language as fast as, or possibly faster than, normal speech. Again, the speed advantage is not large.

There are other ways people produce information beside the verbally oriented ones we have been examining. One that only recently has come to receive attention is Body Language. This doesn't generally refer to the everyday conscious body signs one gives, such as a wink or thumbs up, but rather it deals with the unconscious signals sent out by a body, such as folding arms in defense, or leaning forward to establish rapport. A great deal of information can be transmitted in a short time with this kind of communication. If someone tells you something and you react not by speaking but by raising an eyebrow, it could transmit in a fraction of a second as much information as might require several minutes to speak.

Why is that? Part of the reason is that the raised eyebrow is a conventionally understood abbreviation, albeit non-verbal, for a certain expression of attitude. The other part of the reason is that the information is being transmitted visually, that is, by light waves. Remember we mentioned how the vibration frequency of the transmission medium directly influences bandwidth capacity? The faster a transmission medium vibrates, the faster information can be transmitted on this medium, since *it is controlled variations in the vibrations that actually contains the information* -- the faster the vibrations come, the faster the controlled variations come, and the faster information is transmitted. FM radio uses higher frequency (faster vibrating) channels than does AM radio. This is why FM broadcasting produces 'higher fidelity' sound than does AM. The higher fidelity is a form of faster information transfer, the information being sound quality rather than explicit words.

AM radio (in the U.S.) uses a frequency range of from 550,000 vibrations per second to 1,600,000 vibrations per second; FM radio uses a range of from 88 million to 108 million vibrations per second. But visible light waves vibrate in the neighborhood of about 600 million-million vibrations per second. Light waves clearly have a much higher bandwidth capacity than radio, which already has a much higher bandwidth capacity than sound (about 1000 vibrations per second). In fact, light waves provide the very highest bandwidth communications medium directly usable by humans (not that we efficiently use all this bandwidth capacity, by any means). Any higher and we get into ultra-violet and x-ray radiation, which are hazardous to your health. This higher bandwidth for visible light provides the opportunity for much higher speed communication.

That's what fiber optics transmission is all about. There is definitely a physical basis for the saying 'a picture is worth a thousand words'. Actually, it's a gross understatement. A picture can contain many billions of equivalent words of information, as can, possibly, the raised eyebrow.

Does it therefore follow that we can merely attach a TV camera to our intelligent computer and thereby increase the rate in information input many million fold? Not quite. The computer might learn to interpret body language, but this still provides no help for our humans who want more quickly to transfer the products of their thinking into the computer. Although body language can provide high bandwidth transmission of emotional information, it does not help for 'intellectual' information, that is, verbally expressed thought.

What else is available? There are telemetry systems, devices attached on, or even inside, the body which transmit signals based on whatever their sensors detect to receiver systems, usually computers. Telemetry systems were made famous by the astronauts, who had these systems attached all over their bodies, so that ground control could continuously monitor their heartbeats, respiration, blood pressure, temperature, etc. They can transmit information at radio frequencies, pretty decent bandwidth there, only the transmitting sensors don't give information about what thoughts are being generated by the person to whom they are attached.

Or do they? Polygraphs, or 'lie-detector' systems, are actually very much like telemetry systems. The only real difference is that astronautic telemetry systems usually transmit their data in digital

form, that is, directly usable as computer input, whereas polygraphs usually generate wavy line graphs, analog output, which is readily interpretable by a polygraph operator. But, there is no reason why polygraph systems could not generate digital output that could be fed into computers. Now, polygraphs do give us indications about the thoughts of people attached to them, at least to the extent of whether or not their statements are truthful. Granted, there is some question about the reliability of polygraphs, not to mention the ethical propriety of their use in any given situation. That's not the issue here. The fact is that here is a machine that, at least to a limited extent, can determine information as to whether a person believes what he is saying is true or false. The limitation, though, is that it can only determine if the information given by the person is believed true or false, it can't read the information itself. The person still has to speak or write it.

Are there any devices that can directly read information from a person, other than lie/truth indications? Yes. But, again, they have their limitations. They are the experimental prosthetic devices that detect muscle control impulses sent by the brain and translate them into mechanical movement of, say, artificial legs. In a system being developed at the Michael Reese Hospital in Chicago, control messages sent to upper body muscles are monitored and translated into control signals for lower body muscles. A system like this reads the desire of a person to move limbs and translates them into action. Again, this is a highly specialized system that makes no attempt to do anything even remotely resembling the reading of abstract thoughts. The cardiac pacemaker is an example of a system that reads information from the body and makes use of it for the user's benefit. But, again,

the type of information is specialized and limited, not including abstract thought.

How could there possibly be a system that could directly read abstract thoughts of a person connected with it? I'm not interested in a purely imaginary construct such as might be found in a science fiction story, but rather in something that might come out of technological developments in the works today. OK, what *is* in the works?

The neurosciences, along with the others, are exploding. Yale professor of neuroscience, Dr. Patricia Goldman-Rakic, a researcher of growing prominence, told a conference of the Jennifer Jones Simon Foundation in December of 1982, reported in Psychology Today,

> **'We are entering a new era of neuroscience ... (We) can see precisely which cells fire when (a) monkey is engaged in a delayed-response task that requires it to wait five to ten seconds before pushing a lever. *We can now study neurons that are correlated with a specific mental act.*** (emphasis added)'

Numerous researchers are making use of the PET scanner. That stands for *Positron Emission Tomography* (yes, that's right, positron -- the anti-matter version of the electron). This device displays electro-chemical activity of the brain as it acts through various processes. Currently, however, this device does not appear to give resolution down to the cell level, but, give it time! Dozens of chemical neurotransmitters have been identified, which are at least partially responsible for the physical processes of thought. Specialized

receptors for them have also been found on specific brain cells, again reported in Psychology Today.

Given developments like those, I don't believe it's at all farfetched to expect that in the relatively near future, say, eight to fifteen years, that the neuroscientists will be able to tap into the specific areas of the brain that produce speech or typing finger movements and allow direct connection between those areas of the brain and external systems -- computers. It's a matter of identifying which brain areas generate the information, and deciphering the code used internally by the brain in processing the information. Is this likely to be more difficult than, say, deciphering the DNA code, or sending a few people on a round trip to the moon? I don't think so. (We are right on target with this estimate. Brain-Computer interfaces for game control are already commercially available, and a system to allow paralyzed persons to generate sentences is in early commercial development.)

One reason I don't think so is because of a system I heard described several years ago. I attended a seminar on Office Automation in 1981 which covered issues of computerized phone systems, word processing systems and the like. One day, the instructor went off on a tangent and told us about a system he had been working on even several years earlier. It was an aid for blind people, a set of dummy eyeglasses that contained an ultrasonic transmitter, something like sonar. It also contained a receiver, and when it was pointed at an object, an earpiece speaker would emit a sound whose pitch and loudness would vary with the size and distance of the object in front of the person. The system worked OK, except that the wearer of the glasses had to keep moving his head up and down and from side to

side in order to scan the surroundings, and after a while, that would make his neck tired.

To fix this, the researchers rigged up a device that the blind person could put in his mouth and manipulate with his tongue. By moving his tongue up and down and from side to side, he could direct the sensor beam, without moving his head. His neck no longer became tired, but now, his tongue did. Finally, the researchers developed a new generation of the system which had tiny electromagnetic signal sensors in the temples of the glasses. These sensors detected the electrical impulses in muscles in the person's head. Through the use of an extremely sophisticated filtering system, they were able to filter out the impulses of all the muscles in the head except the muscles that move the eyeballs. Now, the wearer would only have to move his eyes, and the scanner would follow in whatever direction his eyes pointed. In other words, he could control the scanner in the same way a sighted person controls his eyes. Now, if this kind of neurological deciphering is available today, why should not internal cerebral code decipherment be possible within the foreseeable future?

Remember, technological developments that used to take decades now occur in only a few years, sometimes only a few months. Look at the television. The basic inventions necessary for its development started coming out in the 1920's, but it wasn't until the 1950's that it was a commercially viable and popular force in our economy, a 25 to 30 year lag. Now look at the digital watch or the business card sized calculator. The integrated circuit technology that made them possible came in during the mid-1960's, and the devices themselves were to become plentiful and cheap by the late 1970's, the delay here was about twelve years. The first personal computers, based on microprocessors, came in during the mid-1970's, and they are now proliferating in the early 1980's. By the late 1980's, they will be as common as TV's and telephones. The lag is down to about eight or nine years. This is Alvin Toffler's Accelerative Thrust again.

The eight to fifteen year estimate for reading information from the brain might just be too conservative.

Might be? It definitely is! Tapping into neural connections between the brain and the external information dispensers is not the only way a machine can read thought. Research is being conducted in several locations to read information from the human mind through the decipherment of brain waves, directly detected through ordinary electroencephalographic (EEG) sensors. This won't even involve any brain surgery at all.

Now, the concept of directly transferring thought into a machine is not new. It has been a theme in science fiction literature for many years. Recently, two motion pictures, *Firefox* and *Brainstorm*, had direct brain-to-computer systems as central to their stories. Of course, they are fiction, what is the reality?

The reality is, a first generation system, a Wright Brothers' Flyer, an Edison Light Bulb, for the direct transmission of abstract thought from human brain to computer is already in existence. Not on the drawing boards, not under construction, but actually working! The system was developed at the Smith-Kettlewell Institute of Visual Sciences in San Francisco under the direction of Dr. Erich Sutter.

As reported in the proceedings of the 6th Annual Conference on Rehabilitation Engineering, San Diego, 1983, in this system, standard EEG sensors are pasted onto the subject's scalp. The subject looks at a CRT screen showing a display of 32 characters, including letters and numerals. Behind each character is a flickering background with each character having its own particular flicker pattern (this is a somewhat oversimplified description). The subject looks at one of the characters. The particular flicker pattern associated with that character translates into an identifiable brainwave pattern, which is then picked up by the EEG sensor, transmitted, amplified, filtered and processed by a computer (a minicomputer at that!). The computer then displays the selected character on both a video display and an audio speaker for feedback verification. The process takes approximately two seconds. The system is being developed to aid those handicapped persons who cannot speak or write in communication with the outside world. (An

interesting coincidence: when Alexander Graham Bell invented the telephone, he was trying to develop an improved hearing aid!) Granted, the flickering visual component is necessary, but, there it is, *a system that literally reads a mind.*

No, this is not like the systems depicted in the movies. Yes, it is primitive, costly, and not suited to widespread practical use today. But, if you stood at Kitty Hawk on December 17, 1903 as the Wright brothers flew their machine, and told the other spectators, or even the Wright brothers themselves, that within 66 years, just one lifetime, that this crude, clumsy, dangerous machine would be developed into a system capable of a round trip to the moon, would they have believed you? We are at Kitty Hawk again, and I believe that within a lifetime, this invention will lead us not merely to moons and planets, but beyond ... well, what can I say? I believe this invention and the ones to follow it will take us into realms that give us difficulty in maintaining credibility in discussing them.

Yes, I am quite aware of how incredible these ideas will seem, so much so, that although I have had these ideas for several years now, I've continually procrastinated in committing them to print precisely because I've felt that very few could take them seriously while thought-reading computers seemed so far in the future. But, the future comes faster now, doesn't it? A thought-reading computer system is already here. If something as incredible as that can already be reality, can my incredible ideas be entirely fantasy?

But, will a direct interface between brain and computer speed up the interchange of information between the two? If we can't talk much

faster than we can type, can we think any faster than we can talk? We don't have to look very far to see numerous examples of people who can't think even as fast as they can talk. Because of that, every so often, a Cabinet Secretary or some other government official resigns.

It will be a matter of adaptation and training. Ordinarily, people read at a rate of only a couple of hundred words per minute. But, it's possible, through techniques such as Speedreading, to increase this to several thousand words per minute. Yes, there is some controversy over this in that comprehension may or may not be retained at that rate, and the enjoyment of reading may not be the same, but the point is, through training, the process can be accelerated.

What will it be like to work with such a system? Imagine sitting down in front of a word processor machine, or some other computer device. It doesn't have a keyboard. Instead, there is a headpiece you wear that is connected to the machine. The connection is probably wireless, using radio or laser or some other technology not yet invented. You simply think the concepts you want to express, and would otherwise have to type or say, and they appear before you, just as you would want them to appear had you typed them perfectly yourself.

It's interesting to note that our alphabetic languages, or more properly, our alphabetic scripts (systems of written letters), used in many cultures, are not particularly well suited to this kind of interaction between human brain and computer. Alphabetic scripts were developed as a means of representing spoken language in

written form. They are oriented toward the sounds of the spoken language. Sound is, again, low frequency vibration, capable of only low-bandwidth information transmission. One of the reasons people think so slowly is because they think in the language they speak, pretty much at the same rate as they speak it.

We'd do much better in both information transfer with machines, and in our own internal thought processing, if we were to adopt a graphically oriented language, rather than an orally oriented language. In such a language, there would be only graphic symbols that represent concepts, and there would be no particular pronunciation associated with any of the symbols. Each symbol would represent a particular concept, and *vice versa*. There would be no ambiguities in such a system. It could possibly develop into a universal system, not bound to any particular cultural group. It might allow expression of concepts not possible to conceive with present sound-oriented languages. As George Orwell pointed out in his description of Newspeak in *1984*, language can limit thinking, as well as expedite it.

Does such a graphic-symbolic language exist? Sure. Mathematics is precisely such a language. True, the symbols do have names or pronunciations associated with them, but they can be ignored. The problem comes in, however, when you try to express a concept such as, "it's a beautiful day, today," in mathematics. As it exists now, mathematics is too specialized.

Are there any other graphically oriented languages available, suitable for everyday use? Of course. The most popular ones are

Chinese and Japanese. What an irony! The very same ideographic system which so vexes the Japanese now in their attempts to automate their office workplaces, will ultimately prove to be much better suited to direct interface computer input than the alphabetic systems of the West.

Will we in the West be forced to learn Japanese in order to communicate directly with computers? No. But we will find it desirable to adopt some kind of graphically oriented communication scheme which may well have much in common with the Japanese and Chinese written languages (which are basically the same). Any such language will grow and gain currency through popular usage, much as happened with CB radio jargon, and not be imposed by decree, which would only meet with resistance.

Do the Japanese think faster than Westerners because of their graphically oriented written language? If they used their written language in their thought processes, they might well be able to. But, as with everyone else in the world, their children learn to speak before they learn to read and write, therefore, like everyone else, they grow up using their spoken language in their thinking rather than their written language, and naturally carry that practice into adulthood.

Note, for anyone, spoken language and written languages are two entirely separate and rather different things. Just ask any adult who grew up illiterate and had to learn his written language later in life. Written English and spoken English are almost as different from each other as spoken English and spoken German. The only

similarity comes in due to the semantic equivalence, for example, of the written word ‘ceiling’ and the spoken word ‘seeleeng’. Even different parts of the brain are used to process spoken and written languages.

One of the secrets to Speedreading is that you make a concerted effort *not* to say words to yourself as you read them. Once you become adept at this, you will have succeeded in recognizing *and using* the separation between spoken and written language, and also, you will now take advantage of the higher bandwidth afforded by communication with light waves.

There’s more. Go back to imagining the word processor sitting in front of you without a keyboard. It doesn’t have a screen or other display device either. Its printer won’t be turned on until the final finished version of the document is to be generated. So how will the draft versions be displayed so you can work on them? Come on. You already know the answer to that one. If you can think at the machine, obviously the machine is going to think back at you and put an image of the draft copy of your work directly into your mind.

Whoa! A machine is going to *think at* me? It’s going to put an image *directly* into my mind? OK, this bears some explaining.

First, how could a machine put thoughts into our heads? For many years, brain surgeons have been stimulating the brains of patients who are awake during surgery, with the patients’ permission, of course. As they do this, with probes that are sometimes electrically active, they find that the brain will turn on memories and the patient

will actually relive experiences while in surgery. These are very crude experiments, again, like the Wright brothers airplane. Once we get more sophisticated at this and learn, say, how to transmit appropriate signals directly to the brain-side terminus of the optic nerve, we will be able to have computers generate 'virtual' images directly into our brains. Bear in mind, the eyes only receive light waves, it is the brain that actually does the *seeing*, that is, interpreting neural signals and forming images.

How far down the road is this? Hang on! The work has *already* begun. At New York University, neuroscientists have inserted an array of 64 tiny electronic probes (8 by 8 in a space about a millimeter across, the thickness of a dime), into the visual cortex of the brain. With suitable stimulation, the patient can be made to 'see' a pattern of lights, that is to say, his brain tells him that there is a pattern of lights in front of his eye although in fact there is not. The pattern of lights is not unlike Braille code.

This is only the beginning. There is a brand new technology emerging that is going to make the silicon microcircuit-based computer processor, as it is known today, look as obsolete as the steam locomotive. It's called biomolecular electronics. At Gentronix Laboratories in Rockville, Maryland, James McAlear and John Wehrung have already obtained patents for processes that biochemically produce organized molecules, potentially well suited for computer logic switching, that are fabricated through a process of 'self-assembly', something like reproduction. They are busily working on development of computer processors, the first working models of which they hope to have running in the late 1980's. 'Biochip' based

computer processors could be from a millionth to a *billionth* the size of current silicon chip processors. In other words, the computer processor which once occupied a large building, and now is as big as your telephone, will, under this new technology, be only a big as, say, a brain cell, or maybe just a gene inside the nucleus of the brain cell.

Shrinking a computer processor gives us far more important benefits than merely saving space or allowing a computer to be attached to another system more easily. One of the main things that determine how fast a computer can compute is the time it takes for electrical signals to travel from one place in the processor circuitry to another. This, in turn, is dependent on two factors, how fast the signal travels, and far it travels.

Electrical signals travel at the speed of light and there's not much we can do about that. How fast is the speed of light? You probably remember from your grade school science courses that it's approximately 186,000 miles per second. That's a difficult way of looking at it; it has virtually no meaning when stated that way. There is a better way to conceive of this speed. If you have followed computer technology at all, you probably know that the faster computers can do calculations in nanoseconds. A nanosecond is a billionth of second, that is, 1/1,000,000,000th of a second; a billion nanoseconds make up a second. That's still impossible to visualize in any practical sense. The only time most people are routinely exposed to the concept of a billion is in discussion of federal government finances. What's a billion dollars? If you spent a thousand dollars a day every day, it would take you over three and a half years to spend a million dollars, and it would take you 3,653 years to spend a billion

dollars. But, of course, it takes the U.S. government only about half a day to do it. [In the early 21st Century, that's down to about a quarter of an hour!] Getting back to the electrical signal inside a computer processor, although it can travel 186,000 miles, over seven times around the earth, in a second, at that rate it can travel only about *a foot in a nanosecond*.

Although computer circuits are very small, the signals inside those circuits must do quite a good deal of travelling before calculations are completed, and the total distances traversed in currently available circuits can, indeed, add up to distances in the order of feet, hence the nanosecond processing times.

In a biochip computer, however, the signal, although not travelling any faster, might only have to traverse a total distance of millionths of a foot, or even substantially less, in order to perform a given calculation or other process. This means that such computers would have processing speeds *millions of times faster* than the best ones available today. Artificial intelligence applications which might be impractical today, due to their complexity and resultant overburdening of the best of today's machines, would become humdrum on a biochip computer. At least as important, searches for desired pieces of information among the exploding mass of information would virtually be guaranteed to be fast enough for anyone's needs. Not only that, but storage density would also be vastly increased -- the entire U.S. Library of Congress, one of the largest libraries in the world, could have its entire contents stored in a space the size of your nose.

Now, Dr. McAlear tells me it is within the realm of practicality to go a step beyond the New York project for direct stimulation of the visual cortex. Using biochip technology, an array of several thousand stimulation points could be fabricated on a protein based platform and attached directly to a small assembly of brain cells in the visual cortex, in hopes of actually creating an image *directly at the site of vision processing in the brain.*

Would it work? I, for one, would not care to bet against it. In the December 20, 1983, issue of the Washington Post, Margaret Engel reported that at Sibley Hospital in Washington, D.C.,

> **"A 41-year-old federal worker yesterday received an inner ear implant that will allow him to hear for the first time in 10 years, the first such surgical procedure performed in the Washington area."**
>
> **"…The device, which allows sounds to be transmitted electronically to undamaged nerve endings in the ear, represents one of several recent medical advances made by doctors and engineers seeking to restore lost senses, particularly hearing and sight."**
>
> **"'With vision, we're about 10 years behind what we're doing with hearing because it is more difficult, but by shooting electrical current temple to temple, the optic nerve can be stimulated,' said (Lloyd Ferreira, president of Bio-Stim, Princeton, N.J.) 'Up to this point, medicine hasn't placed much**

emphasis on restoring senses, but the combination of electrical engineering and medicine is changing that.'"

We could go further. If we also get at the brain-side terminus points for other sensory nerve systems, our computer could also generate emulations of feeling, taste, smell, motion sense, body orientation, etc. Just as in Aldous Huxley's 'Feelies', or the *Brainstorm* system. Of course, those systems were imagined as only recording and replaying someone's experiences. Our actual system will also be capable of *synthesizing* them, just as, say, computerized flight simulation trainers do now, only in this case, the simulation would, if done right, be totally indistinguishable from reality. 'Reality', if it survives at all as a practical concept, will take on a whole new meaning.

It looks like we missed the mark with biochip development. The research is still going on, but it is not as close to commercial availability as I had predicted. Silicon chips are still too cost effective vs. biochips, at least at this point.

This should not be a source for discouragement. In 1956, I watched a TV program that was describing the world of 1976, as seen from that viewpoint. It was predicted that by 1976, among other things, flat screen televisions would be commonplace, as would videophones, personal helicopters, and geodesic dome houses. It turned out that flat screen TVs and videophones didn't become commercially available until around the turn of the 21st Century, and personal helicopters and geodesic domes are still in the future. (I would think that for safety concerns alone, personal helicopters will not become available until a centralized computer directed automated flight control system becomes available.) Also, such developments as space travel, pervasive use of computers, and such medical advances as heart transplants

were not even envisioned in the 1956 program. Sometimes, these predictions will miss the mark; that's the nature of predictions.

Second, I did say the machine would 'think at' us. Ever since the first vacuum tube lit up in the first electronic computer, the question has continually come up, 'Can computers think? If not now, will they be able to in the future?' When the experts answered 'no' to the first question, they were quite confident about it. When they answered 'no' to the second one, they crossed their fingers behind their backs.

How would we be able to recognize a thinking machine if we encountered one? After all, we are still trying to nail down what really happens when our own brains think. What would we look for? The theoretician Alan M. Turing probably came up with a creative answer. Simply stated, he said that if a computer does something that we cannot distinguish from whatever we recognize as thinking, then, by golly, the something that the computer is doing must be 'thinking'. 'If it looks like a duck, and it quacks like a duck, and it walks like a duck…' A little more precisely, if we can't find a way to differentiate between what the computer does, and what we call thinking, no matter how we try, then it thinks. There are still problems with this scheme.

If we can't differentiate today, we still might be able to tomorrow. And how do we know we are using a good thought yardstick against which to measure our computer? Turing's test technique actually centered on comparison of a computer's *behavior* against human *behavior*. You, the observer, would work with two terminals, one of which is connected to another terminal controlled by a person, the

other is connected to a computer. You type questions or other information into each terminal, and watch how they react. A really smart computer would be able to mimic a human's typing, with its lack of speed, its inconsistency of pacing, and overstriking of mistakes, along with being able to mimic the kinds of reactions a person would be expected to give. If the computer did a good enough job of mimicking the behavior of a human, so that you couldn't tell which terminal was connected to the person, and which to the computer, then, for all practical purposes, the computer could be said to think.

By that standard, I feel there's no question that computers will be able to think. Back in the mid-1970's an article appeared in *Datamation* describing Parry, a computer program that emulated the conversation patterns of a paranoid person. It did it so well that experienced psychiatrists usually could not distinguish when they were being shown a transcript of a psychiatrist's conversation with Parry vs. a transcript of a conversation with a paranoid human.

The big concern will not really be if computers will be able to think. It will be if they will be able to have *preferences*, likes and dislikes. Will they like us? If they don't, what will they do about it? The answer to this will probably come down to whether they can 'experience' things, rather than merely record them, particularly pain and pleasure. Ordinarily, I'd think we would do well to avoid giving computers that ability until we get to know them a great deal better, except something else is going to happen before that problem arises.

- Ten -

James Martin is one of the great men of renown in the field of information science. Author of over a dozen classic books on the subject, he has many interesting views about the future of the computer industry and the world of information processing. He is a steadfast booster of the use of modern software tools in business to overcome the problem of programmer productivity. He extols the virtues of not only *fourth generation languages*, but *application generation* systems, and *provably correct* software as well. He envisions the 1980's as the Age of Automation of Automation, that is, a period of the blossoming of techniques that will allow computer (software) systems to generate other computer systems, under the benign guidance, presumably, of people.

The 1990's he sees as the Age of Artificial Intelligence, especially in view of current efforts on the fifth generation computer projects of the Japanese and others. During this period, the computers, together with robot assistants, will be given much of the labor now done by people, not just physical labor, but administrative and professional as well. For example, many decisions which are based on 'educated guesses' today will be based on highly processed information handled by the artificially intelligent systems of tomorrow. The role of people will be for making decisions based on preferential judgments.

Beyond the year 2000, Martin sees an Age of Technological Chain Reaction, the results of which he says he will leave for others to ponder. During this time, the convergence of otherwise diverse technologies, such as genetic engineering, space exploration and

development, and artificial intelligence, will give rise to new technologies with such speed and impact that they will be indescribable in today's terms.

I particularly like the imagery of the chain reaction. Have you ever actually seen one? In the late 1950's, I saw a TV program in which a scientist illustrated the meaning of chain reaction as part of a discussion on nuclear fission. Under a plastic dome about two feet high and five feet across he had a few dozen household mousetraps set in the 'armed' position.

Resting on the spring-arm of each trap were two ping pong balls in such a way that they would be catapulted into the air, hitting the dome, whenever the trap would be sprung. Through a hole in the top of the dome, he dropped a single ping pong ball. It fell on one of the traps, setting it off. This in turn shot two balls into the air, bouncing off the dome, and then onto two other traps, setting them off, sending up more balls, etc. I could distinguish the first one or two traps being set off, but after that, there was merely a continuous roar of traps and blur of flying balls. The whole process was completed in about two seconds. Even when shown in slow motion, once the chain reaction was under way, it was impossible to distinguish individual trap-springing events, since they came so thick and fast. The scientist made the point that this was illustrative of how a neutron split a uranium atom, which in turn sent out two neutrons to split two other uranium atoms, each of which sent out two more neutrons, and so on. The demonstration made it quite clear how a chain reaction causes such a powerful explosion in an atomic bomb, even

without regard to the fact that each split caused only a small portion of the atom's matter to be converted to energy.

This then is James Martin's model for understanding the effect technology will have in the 21st Century. It may well be an *understatement*, for eventually, explosive chain reactions that we experience on earth come to an end, when fuel is exhausted. But, what fuel will be exhausted by the chain reaction of technological developments breeding more technological developments in ever faster cycles?

Let's sit back down in front of that word processor again, the one with no keyboard or display screen. By now, it should be plain that it's not merely a word processor, either, but rather a general purpose information processing *and retrieval* resource. Suppose you are composing a document on the U.S. Civil War, and right in the middle of working on it, you discover that you need to know the date that the battle of Shiloh was fought. Must you get up from the machine and find an encyclopedia or other reference book and look this up before proceeding? Of course not! You will merely think to the machine that you need to know the piece of information in question, and it will automatically query one of the innumerable online data bases at its disposal (thousands of online data bases are already available today), and it will insert the desired information, in the desired format, into the desired place in your document. (Even today, word processors can check and correct your spelling with built-in dictionaries.) Further, when you are done generating your document, containing whatever insights and facts you have assembled into it, are you going to print it out? Not a chance! You will merely think to the machine that you

are done, and that the machine should store the document in an appropriate data base, either one that you choose, or more likely, one that it will choose, *in concert with other machines*.

Clearly, such a system would be far more convenient to use than any in existence today. Just conjure up thoughts and they would instantly be transformed into palpable images to be manipulated at will, merely by further thought. The images would include not only visions of words, but all sorts of graphics as well. And sounds. And odors. And textures and tastes and ... But, again, would the system serve the need of speeding up the distribution of needed information, and breaking the input bottleneck? In order for the system to be effective, people using it would have to adapt to not only a 'Speedreading' technique, but to speedwriting (I'm using 'writing' here in the computerese sense of producing output, rather than making marks on paper.) and speedthinking as well, all likely based on some kind of graphically oriented (no pun intended) system of symbolics.

Will people do that? It seems like a lot of trouble to go through just to avoid tapping on a keyboard and shuffling paper. Besides, Speedreading has been around for many years and only a very small portion of the population practices it. Also, how would people react to the concept of allowing machines to have some kind of direct access to their minds? We'll return to this question in some detail.

The kind of information handling system that I describe will give the user much more than mere convenience. It will give the user at least three things which, in combination, should prove irresistible, and overcome any indifference that might naturally be expected to greet

new developments that challenge complacency, or even any resistance at having to learn new means of dealing with the world.

One is power. Knowledge is power, as they say. It doesn't take much imagination to envision the vast increase in knowledge which will be put at the disposal of the user. Any source of information to which the system is attached would become, in effect*, an immediately accessible extension of the user's own brain memory*, or recallable information resources. Would you be a more powerful person, in any sense, if you 'knew' the entire contents of an encyclopedia, or a library? The user would also derive power in being able to 'project' his thoughts or fantasies into the system and have them be dealt with as if they were 'reality', at least, in an abstract sense. Not necessarily abstract. If the user were an automotive designer, he could think up a design, and if the system were attached to suitable fabrication robots, his design could actually be brought into physical reality, all by mere thought!

Another benefit to be received from this system is entertainment, such as never has been available to people before. Imagine a video game where you don't merely look at the action and exert limited control with a crude joystick, but rather you are in a scene, which could be as realistic or fantastic (or both) as you wish, where all you perceive could seem as real as the page you're looking at now, and your own participation is as limitless and far-reaching as you desire. You wouldn't just have to watch Pac Man ambling around the maze, more-or-less responding to your clumsy manual dexterity, rather, you could be Pac Man himself, gobbling tasty morsels as you gambol among the ghosts. Or be the Red Baron, or a Le Mans race driver,

and feel the g-forces as you round a hairpin turn. Try and keep your kids away from that!

Try and stay away from it yourself! The concept of becoming hooked on an attractive or entertaining electronic information system is not at all new or even unfamiliar. 'TV addiction' is commonly understood. Even in the movie *Brainstorm*, one of the characters is depicted as becoming addicted to, and indeed, overdosing on, a, let us say, stimulating thought-experience recording.

The third attraction is implied in the other two, but it will stand out so prominently that it deserves mention on its own. It's *feedback*. You want to know something, and you immediately know it. You want to express something, and in an instant, it is expressed in the form you want. Your thoughts produce results and effects as soon as you think them. You can consider these outputs and, if you want, you can immediately change your mind, and the results, as often as you like, as quickly as you like. Have you ever gone to a museum that had exhibits you could only look at, but not touch? Then have you gone to another museum with 'hands-on' exhibits, ones that you operated yourself? Which one did you like better? Wasn't it more fun to be able to sit in an airplane cockpit and work the controls yourself, more than just looking at the airplane? Didn't you get more out of it if you could actually scratch the glass with a real diamond than if you just saw a picture of someone else doing it? That's feedback. Isn't a person more interesting if he/she pays attention to you, and acts as if you are important? That's feedback, too. Yes, people find it very attractive and interesting.

Feedback is also instrumental in the learning process. It's well known that high feedback learning experiences generally are more effective than low feedback experiences. Not only did you enjoy that hands-on museum exhibit more than the look-at-only one, but, chances are, you learned more from it as well. The thought interfaced information processing system of the future will provide such a high level of feedback that not only will it supply the ultimate in enjoyment, but the ultimate in aiding you to learn how to get the most out of it, as well.

Is any of this really anything more than pure science-fiction background trappings? Is there any chance a system like this will actually be built? I think there are two factors to consider in answering these questions.

First, all of the technology necessary for such a system is either under active development, or already in existence. Yes, I know, when the first abacus was built, it could have been said that the technology for the computer was at that point 'under development'. Well, it would have been true enough. It's just that the builder of that first abacus, had he been able to envision the computer, would have had to concede that it was to be many centuries before the electronic computer could be built. And, indeed, not all of the technology was under development at that time. Electricity, for example, was no more than the frightening curiosity of lightning. Thought decoding, direct input into the brain, ultra high-speed processors, ultra-dense storage, ultra-fast data communications: these are the technologies necessary for the thought-directed system, and they are *all* the subjects of active development, *now*.

Second, and the clincher, I think, is that military applications of a system like this are very obvious. So obvious, in fact, that both motion pictures I mentioned, *Firefox* and *Brainstorm*, have military application of thought directed systems as prominent, if not dominant, themes. In *Firefox*, an American agent is sent to the Soviet Union to steal a fighter plane, named the Firefox, which is controlled by its pilot's thoughts. In *Brainstorm*, a group of scientists succeed in

building a system which records a person's experiences, and then plays them back in another person's mind, so that the second person completely relives the experiences of the first. Later it is discovered that the system also records memories and emotions, even the very experience of death itself. As ever, the military characters are portrayed as villains in the movie, perverting the technology to evil ends, but the point about the military being naturally interested in such a system is well made.

I'd expect the military to be very interested, indeed, in planes or tanks or missiles that home in on targets by mere direction of thought of personnel controlling them. I'd be highly disappointed, in fact, if it could be confirmed that the government is not already pursuing research into such a weapon system in some super-secret laboratory. I'd also be highly surprised if I could be convinced that the Soviets weren't, especially in view of their long standing interest and active research in psychic and parapsychological phenomena (even though a system such as I describe is *not* based on paranormal mechanisms). It's a matter of public record that the U.S. Navy is actively interested in the development of the biochip technology.

The question is not whether the system will be built, but when. Given the current pace of developments in all the necessary technologies, not to mention adjunct technologies such as artificial intelligence, and given that the pace is increasing, just as it always has been, I expect the first working laboratory model to be demonstrated, conceivably by the year 2000, and almost certainly by about 2010. [Lately, many people are focused on the year 2012, when the ancient Mayan calendar comes to an end. Could the Mayans have had a premonition…?]

Widespread application of such a system would follow only a few years thereafter. This coincides well with James Martin's expectation of Technological Chain Reaction. The development of this system would be the detonator for the explosion.

As if the suggestions I've posed thus far aren't astounding enough, the most shocking and interesting facets of thought interface systems have yet to be considered.

Through the use of systems such as I have described, it's easy to see that all the power of a computer system is put at the total and instant disposal of its user. The computer, in effect, becomes an extension of the person, completely freeing his mind to reach its full potential. The computer itself, of course, is far more powerful in speed and memory capacity than any in existence today, thanks to molecular electronic technology, or whatever might succeed that technology by then. However, as I mentioned before, the computer doesn't work in a vacuum. In order to be truly useful, the system must act in concert with other systems so that its information may be accessible to them, and their information may be accessible to it. There will be data communication networks of these systems, just as there are today, except they will be far more complex, will be far more wide-ranging, and will carry much more data. As a result, the user will have at his disposal all of the information available *to all of the systems on the network, just by merely wishing for it*. In effect, *all of the systems of the world will become merged into a single, integrated super-system.*

But, this global network of thought actuated systems isn't going to be developed for the use of only a single user, is it? There are going to be thousands of users 'logged in' to the system at any given time, aren't there? Maybe even millions, maybe billions. *And if any two users want to communicate with each other, wouldn't they find that their communication would be much more effective, much more understandable, indeed, much more satisfying, if it were done via the thought system than with mere speech or ordinary writing?*

If you would want someone else to know what you are thinking or feeling, why not send those thoughts and feelings directly to him, rather than putting them into mere words, which never completely carry all the meaning, all the information, you want? Couldn't you understand someone else much better if you could receive pictures in your mind of the images in his mind, than if he had to draw them by hand, especially if you are on the telephone? Even today, there are echoes of this future system. The December 26, 1983, issue of Newsweek reports that

> **CompuServe, a consumer-oriented communications and data-base company, runs a nationwide electronic conversation network -- an electronic version of citizens band radio: [personal computer or other computer terminal] users sign on with a 'handle' and join conversations scrolling by on the computer screen. It is one of CompuServe's most popular services.**

This, of course, is what we recognize today as a Chat Room. But what I'm suggesting here is a super chat room in which all the chatting consists not

just of words, but thought, emotions, and all other possible kinds of mental content. Also, the interchange of all of this information would proceed *orders of magnitude faster* than in comparable interchanges today.

Now, we're getting somewhere! The expression 'speak your mind' will take on a new and literal meaning. But, the implications for this system go far beyond merely allowing individuals to conduct more graphic, information packed conversations. For one thing, large groups of people will be able to have each of their members in total communication with all other members *simultaneously*, thanks to the organizational abilities of the network, as controlled by artificial intelligence processes.

Don't we do this now? No. If you have ever attended a meeting of a group of any size, you know that in order for anything to get done, only one person should speak at a time. If everyone speaks at once, as sometimes happens, no one hears anything of value, and nothing gets done. How inefficient. With our thought distribution system, however, we will be able to do just that.

For another thing, if anyone makes an assertion about anything other than his own personal emotions and feelings, that is, about anything factual, the facts can be immediately verified by all concerned, and by the same token, before anyone makes any assertions, he can check out all the relevant facts so that the assertions will at least be based on truth, if not logic (then again, the computer system can help him out with the logic!)

Do you see a pattern emerging in this? We have a view of the world in the not-at-all-distant future in which people have at their disposal, not only all of the information available in the world, but all of the thinking of many other people, and interaction with this system is so satisfying, so enlightening, and so entertaining, that people will be loathe to disconnect from it to attend to such mundane chores as sleep. Again, even today, the tribulations of computer widows are familiar.

Now, there's the interesting concept -- direct linkage of numerous minds through the thought processing network. Can we imagine what it will be like? Think of the laboratory in which the first successful transference comes about, in the late 1990's. [Another prediction date off the mark; maybe a better guess would be the 20-teens.] It might well be a one way transmission as portrayed in the opening scenes of *Brainstorm*, but, unlike that depiction, I believe the receiver would maintain his own consciousness while receiving the consciousness of the other person. Undoubtedly, this would take some getting used to, but, not necessarily as much as might be expected. Bear in mind that this thought transference is not direct 'mental telepathy', although the net effect might seem the same.

The computer monitors the bio-chemical-electrical-physical activity of the sender's brain, extracts information and meaning from it, to whatever degree the computer software might allow, digitizes the information, stores it, then re-transmits it back to the receivers brain, converting it into signals such as might be produced by his own eyes, ears, skin and tongue, and by his own thought processes. When the receiving person gets these signals, they might, indeed, at

first interfere with his own signals, but I expect these difficulties can be overcome. For example, the signals might be pumped into the receiver's brain at a very low level at first, so that he can gradually become accustomed to them. Then, the signal strength might be gradually increased so that eventually the received signals are as significant as the receiver's own internal signals. At this point, the receiver will see with four eyes, hear with four ears, and almost be thinking with two brains, except that he will only be 'reading' the sender's thoughts and not be influencing them. The really interesting experiment will come about when the first two-way simultaneous transference is -attempted.

Of course, this won't be easy. There will be problems with it. For example, If Able and Baker are the two participants, the system would send mental information from Able to Baker and from Baker to Able, both at the same time. But, when Baker receives Able's thoughts, Baker's thoughts now become the sum total of both his own thoughts and Able's also. Now, when the thoughts of Baker are transmitted to Able, it would seem that that sum total would be transmitted, so that Able would receive not only Baker's original thoughts, but the thoughts that Able had previously been sending to Baker. In other words, it would seem possible that Able would receive not only Baker's thoughts, but echoes of his own thoughts as well.

Likewise, Baker would receive not only Able's thoughts, but the echoes of Baker's also. This is what is called a *feedback loop*. If you have ever been in a meeting room where the microphones of the public address system were placed too close to the loudspeakers, you would have experienced feedback when you heard a loud squeal over

the loudspeakers. In order to prevent the thought transference equivalent of this squeal, the transmission system would have to have built into it some kind of filtering mechanism to prevent the echoing of one's own thoughts from forming a feedback loop. Yet, the mechanism must also be intelligent enough not to filter out the thoughts of another person which might happen to seem to be the same as one's own. Artificial intelligence techniques will be well applied here. Once this two-way transference is worked out, the participants will, indeed, each be thinking with two brains.

Assuming problems like this can be solved, the next logical step would be to add more members to the network. Through the facilities of the highly advanced artificial intelligence controlled network, each member is able to be in communication with any and all of the other members, at any and all times, to whatever degree he would desire.

This raises a crucial question: how much of your thoughts, memories, and feelings, that is, how much of the information content of your brain will be subject to transmission into the network for all others to receive, and, likewise, how much of the information contained in the brains of others will be at your disposal? After all, you have your own private store of knowledge, your own set of secrets, your burdens of guilt, which you *never* reveal to others, even those closest to you, maybe not even to yourself. These are the memories of your transgressions against others, your secret prejudices, your hypocrisies, your lusts for passion and revenge, your ambitions, your fears ... all the things that are 'nobody else's business' but your own. I think it's safe to assume, at least for the moment, that no one would even be *asked* to participate in development of the thought

communication technology without extremely firm and convincing assurances that he would be able to maintain complete control over the content of information leaving his brain. I believe that this would be the case not only because it's extremely unlikely that anyone would volunteer to participate otherwise, but also because it's likely that concern over public reaction would also prompt such safeguards (even if the work were initially conducted in secret, we'll see that it wouldn't take long for the public to become involved). Let's take this as a *given*.

It's extremely difficult to imagine what membership in such a network will be like, having not only the information in the domain of all of the computer systems on the network at your disposal, but direct mental access to all other people on the network as well. *But imagine it we must, for once the population of individuals on the network begins to grow, the 'shattering' effects of technology on society that we keep hearing about will become plainly evident.*

All right, how can we imagine this? Let's go back to being logged in to our system. We have at our beck and call not only the information of the computers on the system, but the knowledge, experience and wisdom of all the other members logged in as well. Suppose you have a problem to work on, say, you're a doctor working on a cure for cancer or AIDS or the common cold or some other malady not yet conquered by that time. A great deal of the work you have to do involves not laboratory experiments, but research into what others have already done in the field. Especially in the medical field, it would be terrible waste of time, possibly costing lives, if you spent time accidently duplicating someone else's work.

This will never again happen if you are on the network. You will always have at your disposal all the information related to your work (assuming it has been entered into the network), and all the results of everyone else's work. But further, you will be able to communicate directly with any and all others concerned with the work, and in tandem, cooperatively and continuously digest all of the information available, and all the new information as it becomes available, whether discovered by you or others, and proceed to work on the solutions to the problems at hand. All of the information you discover in your laboratory or field experiments would immediately be made available to all the other researchers, and all of their discoveries would immediately be made available to you. Everyone's hypotheses and evaluations about the newly discovered information would immediately be made available to everyone else. Requirements for further research would immediately be known to all the researchers, as would be the knowledge of which researchers would be best prepared to do it. If something is still missing, such as a piece of equipment not yet invented, or, more likely, funding (until the concept of money becomes obsolete), the knowledge of whatever is required would immediately be brought to the attention of whoever else on the network might be in a position to do something about it. How much faster might you reach the solutions if you worked that way, rather than the way you work today, inefficient, uncoordinated with others, *isolated*?

The widespread availability of assistance of all kinds will be an extremely attractive aspect of the network. We have already seen how assistance in getting work done will greatly increase the

productivity of anyone participating in the network, but a much wider scope of assistance will be available as well. In line with the medical example we saw, suppose you are ill and in pain. Instead of merely telling a doctor, "there's a sharp pain here," you will be able to have a whole staff of doctors *experience your pain, just as you do yourself*, enabling them to understand your problem, and treat it promptly, as never before possible.

Or, suppose your garden isn't growing as well as you would like. Everyone on the network who has had experiences like yours could immediately counsel you on what to do to help your flowers. Today, there are numerous talk radio programs centered around cooperative assistance. The host announces the specialty, and callers dial in with their problems or suggestions for helping other callers. I have heard such programs centering on financial advice, personal situations, sex, medicine, psychic advice, gardening, home repair, federal employees' problems, political opinion, sports, religion, job seeking, repairing and purchasing automobiles, personal computer selection, and many others. The limitation of doing this via radio is that generally only one caller can be heard at a time, some do not express themselves well over the phone, usually only the host is available as the expert available for giving advice, and time is limited.

On our help network of the future, everyone who needs help will be able to bring his needs to the attention to everyone else who can give it, and the whole process will take place *virtually instantly* in comparison to the way things are done today. *Problems that take years to handle today will be dispatched in days, or maybe seconds,*

once the great communications barrier between individuals is broken down.

Again, the reason things take so much time to get done today is that the information needed, if available at all, is transferred via low-bandwidth media such as speech or speech-substitute printing, on a strictly hit-or-miss basis. We already see improvements in this situation as more and more computer/communication power becomes available. With the advent of the system I describe, this problem will vanish, *along with nearly all others*.

The huge increases in productivity and the availability of assistance will in turn lead to two very strong incentives for rapid growth of the membership of network participants.

First, those who are not members will quickly find themselves at a very serious disadvantage economically, if in no other way, compared to those who are members. Since the members would be far more productive than the non-members, they will have much higher earning capacity and much more wealth; they will have access to much more information (a gross understatement) enabling them to make profitable investments and avoid both financial and physical losses.

Also, the members will enjoy a far greater level of security and protection, due to cooperative assistance and, again, access to information enabling them to develop whatever protections may be needed against whatever hazards may arise. For example, if a network member is threatened or attacked by a criminal, all the

other members will instantly know it and be able to come to the immediate aid of the endangered member, giving him much more security than ever before possible.

We saw these same effects, on a much smaller scale, when telephones, and later, computers, came on the scene. By the 1920's, virtually every business had to have a telephone, or else face early demise. Likewise, today, virtually every business having more than about thirty employees needs a computer of some kind, or else it finds itself overburdened by government mandated paperwork, if nothing else. [In the early 21st Century, of course, every business, no matter how small, has computing power.] The non-members will clamor to get access to the network, just as a matter of survival.

Second, those already in the network, no matter what size it may be at any given time, will very quickly realize that the productive capacity and assistance potential of the system will always increase as more members are brought aboard. Each individual brought aboard, no matter how poorly educated or inarticulate, will always know *something* that no one else knows, and through high-speed educational and rehabilitative assistance available on the network, will always be able to be 'lifted' to the level of productivity, in some sphere, of everyone else. This may sound altruistic or naive and over-optimistic; however, it would be required to maximize the overall effectiveness of the network, and to prevent internal conflict. Each time someone new joins the network, the *power* of the network increases for production and cooperation among the members, and this increases the benefit to all members. Note that control over individual members is virtually non-existent. Since each would have

to have unlimited access to all resources of the system (otherwise those having limitations become less productive), each would have as much power as any other in the system.

This flies in the face of all human experience, thus far. It has always been necessary to have some kind of power structure headed either by nobles, entrepreneurs, or commissars. A basic reason for this is what the economists call *The Law of Scarcity*, which says that if you look at any commodity worth having, with very few exceptions, there isn't enough of it to go around for everyone who would want it. In order to determine the distribution of commodities, to make the decisions as to who gets what, power structures evolve which do the job, generally to the liking of not all serviced by these institutions. In systems based on centralized power, such as absolute monarchies and communist states, the production and distribution of economic factors (goods and services) are based on the political imperatives of the leaders, and are generally quite inefficient. In a decentralized capitalist system, production and distribution are usually based on economic productivity, so that more productive members, by the current standard, are able to trade their productivity for greater shares of available commodities. Distribution and production in such systems tend to be substantially more efficient than in centralized systems, however, political competition is usually increased, partially due to perceived inequities among those less closely associated with the power structure, often due to cultural differences.

In the *informocracy* of the future, however, productivity of society at large will be tremendously higher than it is at present. This is because the availability of information will enable the network

members to determine why any scarcities exist, what must be done to relieve them, and how it is to be done most efficiently and effectively. As scarcities are relieved, distribution of commodities will become a mechanical matter, handled, of course, entirely by the computer segment of the system. That being the case, no economically derived political power structure will be necessary, and the ultimate democracy described above will, I feel, be the natural outcome.

As the network grows, it's inescapable that a new human society will emerge. It will be completely different from society as we know it today. *It will be as different from ours as ours is from the Stone Age!* The word 'end' can mean 'finish', and it can also mean 'result' as in, 'the end justifies the means'. Using 'end' in both senses, we can reasonably say, '*The world is coming to an End*'. Not to worry. It's happened before, plenty of times: when Moses lead the children of Israel out of Egypt, when Greece rose or Rome fell, when Martin Luther nailed the handwriting on the door, when Gutenburg replaced handwriting, when Galileo reordered the universe, and when Einstein reordered it yet again; when Washington began the dismemberment of the British Empire, and when Armstrong and Aldrin landed on the moon. Each of these events marked critical changes in the history of the world, so much so, that they heralded the end of one kind of social world, and the beginning of a new one. It's just that each time the world ended before, it happened so slowly that you didn't necessarily have to recognize it as such. People still went hungry, they still fell prey to disease, they still fought wars, they still lived in poor housing and wore poor clothing, they were born, they aged, they died. Things still seemed to remain the same.

Not this time. Things will be different when the world next comes to an End. In the new world of the network, the condition of humanity will be totally changed in a way it has never been, and it will happen in a period so brief that there will be no gradual passing to disguise it. Everyone *will* be completely aware that it is happening as it happens. What changes will we notice?

There will be no more hunger. Between the general productivity gains due to increased availability of information and interchange of thought among people, and the strides to be made in genetic engineering, production of food will be massively increased, both on land and in the sea. It will become totally mechanized; only hobbyists might continue to do it by hand.

There will be no more disease. As described earlier, the cooperative efforts of medical researchers, together with the availability of all the latest information necessary to understand the source of any given disorder, will be available to the thousands, nay, millions of individuals of all backgrounds working *in concert* on the problems. Under this assault can any disease withstand? Even today, despite the relative disorganization of the attack, diseases are yielding one by one. Yes, new ones sometimes come up, such as the dreaded Acquired Immune Deficiency Syndrome (AIDS), but in time, they yield up their mysteries, as is happening with the Legionnaires' Disease, which burst forth suddenly and killed many dozens. Only in the future, through the organization of the network, *the pace of this progress will be condensed many thousand fold.*

There will be no more war. Obviously, among the network members, there will be no conflict, as shown before. But, what about those who are not members and refuse to join? More importantly, what if various countries form separate networks? As for the non-joiners, they will likely number very few, perhaps several million, perhaps only a few thousand. There will always be some, just as there are people today who refuse to have TVs or phones. There would be no cause for conflict between them and the network. If they refuse to join, the network would need nothing from them anyway, since there would be no benefit at all to the network in having someone join against his will. It would be no strain on the network to provide the non-joiners with any material benefits they might desire, since it would produce enough for all in any event. The non-joiners could live freely among the network members, or they would be free to form their own separate societies.

Insofar as separate networks are concerned, remember that nations are reflection of power structures, which, as we have seen, will become obsolete. During the early stages of the development of the network technology, there probably *will* be multiple nationally oriented networks. As each achieves productivity levels sufficient to meet not only needs, but desires, of its members, economic stresses that typically engender wars will disappear. Finally, in order for separate networks to be able to communicate with each other, they will have to establish such wide-bandwidth communication links to accommodate the huge volumes of information transfer to which they will become accustomed, that *they will, in effect, and in fact, have to merge with each other, like drops of water that touch*. Even if they initially use different languages, when they come in contact they will

of necessity have to learn each other's language, and that will result in a new language being formed, the sum total, as it were, of the original two.

Why doesn't something like that happen now? After all, today's communications are such that if countries desired, they could merge to form larger countries, and the governments could still keep control. So, why doesn't that happen now? To a small extent, it does. During this century, there have been numerous attempts at forming coalitions and leagues of countries or groups of nations. From the League of Nations, to the United Nations, to the European Common Market, to the United Arab Republic ... the general idea has been that some kind of merge process is desirable; the actual workings have been something else. There is still an essential lack of communication among the leaders of the member states of these groups that prevents greater success in these endeavors. The same lack causes intelligence agencies to have to operate in secret. There will be more to be said about this.

Returning to the End of the World, we will see the end of deprivation of all kinds. For any problem that faces mankind, instead of isolated persons or groups groping for solutions among vast uncoordinated masses of information scattered among the libraries of the world, contributing to published knowledge in a willy-nilly fashion contingent upon publishing capacity or scheduling constraints of editors, we will have all of the problem solvers working in coordination with each other, with complete access to all information bearing on a given problem, even as it becomes available, as well as complete access to each other. It's as if we were to compare the

transportation methods of centuries ago, with oxcarts and horse-drawn wagons on disorganized cow paths or animal trails through the wilderness, to the highway and air lane networks of today.

And among the first of the problems that the masses of solvers are sure to tackle are the problems of aging and death. Even today, great strides are being made against these ever present enemies of the human psyche, but when our network forms, our strides of today will seem like the pace of a turtle. Life, healthy and vigorous and fulfilled, will potentially last ... as long as you would want it. How much more precious will it be then, compared to its value even now?

A world without hunger, disease, war, or death? Here I am, as I have said, not a radical, but a conservative, not an artist, but a technician. I have always fancied myself, and others have generally perceived me to be, a level headed fellow, not given to hysteria or mania (not that artists, or even radicals necessarily are). Yet, as I follow the trends of today's technology, and imagine them taking us around the curve of the acceleration of change, here is where I am taken, to a world so startlingly different from the one of today, that even to attempt to describe it makes me feel that I must fight madness itself. Further, the most startling conclusions are yet unmentioned.

Surely, such a radically different environment for mankind will engender social forces *totally alien* to those we know now. Obviously, anything we would say about them would be sheerest speculation, but, if our vision of this world is to have meaning, we must have logic as our guide, and imagination as our vehicle.

- Twelve -

To recap.: the *information explosion* has at once lead and followed the development of information processing technology. As this technology has expanded, we have seen astronomical growth in data processing, storage, and output production capability, but virtually no progress in input capability, we are still stuck with the century-old technology of the keyboard. As the capabilities of systems expand, people, as better and better integrated components of these systems, will need improved capability for controlling and driving these systems. They will need means for expressing their thoughts to these systems with far greater bandwidth than is currently widely contemplated. Touch sensitive screens, and even natural language speech input will not fill the bill, for even they will still be much too slow.

The only logical and competitive solution to this problem is the development of direct interfaces between human brains (or at least the thought processing facilities of brains), and the information processing systems, *for which solution the technology is just now beginning to emerge*. As the powers of information systems grow, the systems are becoming ever more standardized, more coordinated, and more integrated. As thought interfaces to information systems improve, the people will become more integrated with the systems, deriving ever more power, learning, entertainment, and satisfaction from their interactions with the systems. As the share of human population integrated with the systems, or, more accurately, *system*, grows, the overall power of the system to benefit its members grows, providing a dual incentive for further inclusion of more members, both among current members, and non-members alike. As this power

increases, mankind will attain ever more capability to overcome any and all of the problems that have historically beset and bedeviled us.

Now we can see why the advanced development of artificial intelligence in our machines will ultimately not be a threat to humanity. At the same time we are developing higher and higher levels of intelligence in our machines, we will be getting more and more merged or integrated with them. In fact, it will be much more economical to merge natural human intelligence into the overall network of information processing resources through thought interface, than it will be for us to attempt to duplicate this intelligence in the machines themselves. Eventually, the network will be developing its own intelligence, *but we will be a part of it, actually inseparable from the machine component*. That being the case, there won't be competition between human intelligence and machine-artificial intelligence; rather, in a very real sense, they will be one in the same.

As a result of all of this, what will become of us? This is the big question, and I believe that given the new environment I have described for mankind, some big changes are in store for our lives. First, consider the connection between man and the network.

Better yet, make that: consider the connection between *you* and the network. I've already given some reason for putting it this way, there will be more later. Most labor will be performed by and controlled by the artificially intelligent machine segment of the network. Your connection to the network will serve the purpose of allowing the system to know what your personal needs and desires are, so that

they can be taken into account by the system as it controls production. Your needs and desires, and everyone else's needs and desires, will be input to the machinery. As far as possible, all these wishes will be satisfied. And given the ever growing power of the system, that will be very far, indeed.

The connection will also serve the purpose of allowing you to know whatever you want to learn and know, that may be within the scope of the network, *which scope will include all the other members of society*. This knowledge will most definitely not be confined to cold, hard facts and figures. At your disposal will be images, sounds, odors, textures and tastes, both actually recorded and synthesized. In other words, *the entire experience of the world, both real and fantasy, will be at your disposal.* What does fricassee of octopus taste like? Express the desire to know, and the knowledge will be yours. What is it like to kiss someone two feet taller than yourself? Want the knowledge, have the knowledge. Not the kind of knowledge you get from having someone tell you something, but the kind of knowledge you get from doing something yourself.

Of course, by the same token, all of your knowledge and experience will be at the disposal of the rest of the world. What's that? Now, you are becoming uneasy? It's OK to tap into the knowledge of everyone else, but you've still got your own private secrets, your skeletons in the closet that you don't want to have go public. That's understandable in today's world, but in tomorrow's …

Now we come to the very crux of the matter. What is it that truly differentiates you from me or from anyone else? To be more specific,

when we each say the pronoun 'I', what is the difference between what you are talking about, and what I am talking about? Today, the fact that we have two separate physical bodies, aside from anything else, would suffice. No matter what we would like to do, we are destined from birth to become *separate, and separated*, persons. You grow, learn, and gather your experiences, and I gather mine. They can not be the same. We are never in the exactly the same place at the same time, although if we both watch the same TV program at the same, the experience, albeit limited only to narrow sight and sound, comes close. Even so, our eyes, ears, and brains are not precisely the same. Particularly our brains: we selectively limit our perceptions. There are many well known psychological experiments, beloved by defense attorneys, which show that several eyewitnesses of an event will generally report significantly different versions of what they saw, and most will be wrong.

So, we are differentiated by the fact that our bodies and brains are physically different, and our brains contain differing sets of information relating to knowledge and experience. On top of that, the means of communication to allow us to exchange knowledge and experience are woefully inadequate. We depend on spoken and written language, and a limited amount of visual or graphic presentation to exchange knowledge. These are just as likely to contribute to misunderstanding as to communication, and are actually the basis for most problems in the world among people. That is, we fail to properly understand one another due to improper communication, and when we do understand, we must do it too slowly for it to do as much good as it could.

And compounding these problems is the economic Law of Scarcity, that dictates that while we miscommunicate and misunderstand one another, we must also compete with each other for the world's resources (jobs, promotions, money, food, power, prestige, sexual satisfaction, land, security), thus we group together to form families, clubs, companies, countries, churches, armies, nations. When we deal with others, are they really being sincere when they appear to be helping us, or are they really just pursuing their own interests? Are they telling the truth, or are they lying?

Is it any wonder that in such an environment, we hunger for friendships while we drown in acquaintanceships, we know right from wrong, but are ever faced with having to choose the lesser of two evils, we fail to say what we mean, we smile when we want to cry, we give hostility and conflict when we desire love and harmony?

In order to appreciate fully the magnitude of change that society will undergo, it must be understood that the separateness of individual people, such as it has always been throughout our history, is the fundamental fact of life underlying *all of our social institutions*. Our governments, families, employment situations, schools, recreational activities, and social groups are all constituted the way we find them now because of the separateness of their members. The pecking orders, the political squabbles, the status symbols, the schools of hard knocks: these are all the result of never being sure what is going on in the other person's head. How could it be otherwise? That's the way we are … now. You meet someone. He seems friendly. You act friendly to him. You can keep it up for a while. Yet it may take years before you feel you can really trust each other. You don't

really know what his motives are, except by observation of his behavior. You develop trust in him. Usually it is well founded. Occasionally, you are betrayed. Maybe it isn't deliberate betrayal, only misunderstanding. How can you tell? If you can't get inside his head, you can't tell. It's this innate inability to communicate across the separation between individuals that has always caused our inability to form overall successful social and political groupings on a global scale that I mentioned earlier.

But, what will happen in the new environment? What will happen when you can have access to all the information you need and desire about anything that is known to anyone, and so can everyone else? What will happen when you can make your thoughts completely, correctly, and quickly understood by all others, and they can make theirs likewise understood to you? What will happen when you have total access to the world's resources to fulfill your needs and desires, and there is no longer any need to compete for such fulfillment? What will happen when disease, aging, and death no longer look over your shoulder and breathe down your neck?

You will be able to know everything that everyone else knows, and everyone else will be able to know everything that you know. But, will that happen? Or will you still hold on to your secrets and keep your skeletons locked away in your closet?

Back in the early 1970's I had occasion to give demonstrations of a timesharing computer system with which I worked at the time. One of the favorite demonstrations for people seeing such a system for the first time was the ELIZA program. This was a program that appeared

to be able to carry on a conversation with you in the style of a psychiatrist. Over the years, this program became widely known. A typical interaction with ELIZA looked something like this as you communicated with the computer through a teleprinter and, naturally, a keyboard:

You: Something is bothering me.

ELIZA: YOU SAY SOMETHING IS BOTHERING YOU? WHAT DO YOU FEEL SOMETHING IS?

You: My boss is breathing down my neck.

ELIZA: ARE SUCH THINGS OFTEN BOTHERING YOU?

You: Yes, and it upsets me.

ELIZA: IS ANYTHING ELSE THAT BELONGS TO YOU BREATHING DOWN YOUR NECK?

Actually, the program was not at all an artificial intelligence application. It merely recognized personal pronouns (I, you, he, she), generally reversed them according to simple rules (I love you. YOU LOVE ME?), and repeated much of what you told it back to you in the form of a question.

Very often, when I would have people try out this program, just for fun, they would do something which, at the time, shocked me. After interacting with the program for only a few minutes, the users would

start typing in personal information, *very* personal information. They would express complaints about their employers or their lovers. They would tell some of their very personal fantasies or ambitions. They would tell of their desires for revenge.

Usually they didn't mind if I watched over their shoulders as they typed. Sometimes I became quite embarrassed to see some of the things they said. I might have been able to understand this behavior had they not allowed me to eavesdrop, as it were. After all, they would know that the computer on the other end of the terminal link really didn't understand anything they were saying, so, from that standpoint, they would not really be revealing anything to anyone. Yet, even if I stood right there, they would continue to express those private, personal thoughts to the computer, *thoughts that I don't believe they ever would have expressed to me directly through normal conversation.* Why? I think it's because no matter how outrageously personal the information given to the computer, even with me quietly watching, the computer, like the good psychiatrist it was designed to mimic, would *never react in a judgmental manner*. Certainly not in a negative judgmental manner (HOW TERRIBLE OF YOU FEEL THAT WAY!), and not even in a positive judgmental way (I AGREE WITH YOU COMPLETELY.) It would merely accept anything said to it, and encourage the user to tell more.

Somehow, the environment in which these interactions took place would cause the people involved to open up, to release information about inner feelings, which I don't believe they otherwise would have. Perhaps it was the novelty of using such a system, but I believe it had to do both with the non-judgmental nature of the computer and

the feedback that it provides. I believe that whatever it was, the network of the future will provide the same encouragement, only orders of magnitude stronger.

Certainly, you will not want to expose those innermost secret thoughts you harbor to someone else if there is any hint that you are being coerced to do so. Just as certain, you wouldn't reveal them to someone else who might use the information against you, or laugh at you, or show disappointment in you, or heap guilt on you, or gossip the information to others.

But, if you had the information at your disposal to make you aware of how to react to someone in such a way that he would feel comfortable opening up to you, sooner or later, I believe, he would do it. And, if everyone else had that psychological knowledge available to them, and they made you comfortable in opening up to them, I think that sooner or later you might do it, too, and so would I. Now we would definitely have to establish some rules to prevent trickery, such as intentionally giving you a jolt of sexual gratification each time you revealed an innermost secret thought. If you had an expectation that that kind of thing might be going on, you might consider it to be a form of coercion and decide not to participate in the network, then again …

The point is, the network will provide an environment conducive for people to break down the mental barriers between them. Remember, you will be interacting not particularly with other individuals, although that option will always be available to you, but rather, you will interact with all of the rest of humanity as a whole, together

with the overall information processing resource network. You will no longer necessarily have a different set of information occupying your brain from that which your neighbor has. Rather, all data, facts, knowledge, experience, and wisdom of the entire host of mankind will be at your disposal and the disposal of everyone else, all at the same time. You will sense, experience, and know what everyone else does, and everyone else will sense, experience, and know what you do, all at the same time. You will directly witness a volcano in Hawaii, through the eyes and ears of all the Hawaiians in its vicinity, at the same time as they witness the waterfall that you are watching, perhaps alone, in some wilderness. We all can become One, and I believe we will.

Now, you are really upset. You are convinced I am totally nuts.

I don't blame you. What I am saying goes completely against all of your cultural conditioning, going back throughout your entire life. You have always had drummed into you, especially if you have been raised in Western cultures, the supreme virtue of being an individual, of being your own person, doing your own thing. And, given the nature of humanity and society as it has virtually always existed, those attitudes have served us admirably. We do well to cherish them. Individualism, today, fosters creativity, diversity, growth, change, and progress.

There is, in fact, in our culture, a good deal of antipathy, you might even call it prejudice, against the concept of a society in which members are closely linked together, mentally, with each other. The theme continually recurs in our literature of how individuals in such

a society become subjugated to the system, and lose all freedom and happiness. In the motion picture, *The President's Analyst*, shown in the late 1960's, the protagonist is beset by all manner of misfortune and misadventure which, by the end of the film, it turns out, are revealed as largely the responsibility of "The Phone Company" which, in turn, is attempting to manipulate the government into passing legislation to allow them to implant microscopic telephones into people's brains at birth. In the durable TV series *Star Trek*, there are no less than seven episodes in which the crew of the *Enterprise* encounters societies whose members are, to a greater or lesser extent, mentally connected either to each other or at least to a central system, which invariably turns out to be a malfunctioning computer. Four of the societies are humanoid, two are alien, and one is composed of robot-androids. In every case, Captain Kirk feels constrained to act against these societies, usually disbanding them, even when the members of these groups might take no hostile action against his crew or ship. The rationale for this is that (at least in the humanoid situations), the societies are being deprived of the benefits of individuality, they are stagnant and are not making the progress that human society should, at least by Kirk's standards. Also, even though one of the crew members, Spock, has the ability to form a 'mind link' with other living creatures, he is always reluctant to do so, pointing out that in doing that, he violates his own personal individuality. [In the various sequel series' to *Star Trek*, the arch-villain in many episodes is the *Borg*, a mentally-linked "hive mind" society whose only apparent reason for being is to brutally force those they encounter to "assimilate" into their society. They are uniformly portrayed as the epitome of evil, dressing and living in a style that can only be characterized as Futurist-S&M-Gothic.] In *Brainstorm*, the technology developed by the

hero for recording and replaying consciousness is perverted by the military for mental torture and brainwashing.

Perhaps this antipathy is based on an underlying assumption of the absurdity of such a situation ever coming within the realm of possibility for humanity. Given human history, it would surely seem an unlikely prospect that mankind would ever achieve unity, and given the character of those who have ever made attempts at even politically unifying those under their control, such as Stalin, Hitler, Mao Tse-Tung, and even the comparatively benevolent Napoleon, it's clear that had they succeeded, mankind would generally have been the worse for it.

Are we to lose our individuality? The only way I can respond to that question is with another: when automobiles were invented and came into widespread use, did we "lose" our horses? Anyone who wanted to keep a horse still could, but for transportation, something better was now available, and most people found that they could expeditiously dispense with ownership of a horse, in favor of a car. Individuality is great … for now. But, hard as it is to imagine, something better is on the way, and the choice of keeping individuality or going on to that next something will be yours to make in complete freedom.

- Thirteen -

Look at our history, and yes, Unity is Absurdity. But look at our future, look even at just the progress being made in unlocking the secrets of the brain, never mind succeeding generations of information systems and genetic engineering, and it's clear that we are about to learn things that will forever change the basic human condition. We are learning how the brain works, down to the very nerve cells. Even if we do nothing else but learn how to do away with mental diseases through, say, direct brain therapy, wouldn't that in itself engender sweeping changes in society that would transform the world? - The only question is, what will the transformed world be like? I say, success in answering that question requires a very open mind.

The view I have been advancing is that our society is on the threshold of a total transformation. All of our civilization, our culture, our institutions, our nature, will be radically changed. We will experience Fusion. It will be not so much a traumatic experience, as a thrilling one. Even in the early, experimental days of the network, significant changes will become apparent.

It's considered rather unfashionable today, by most people, to spend much time concerning themselves with issues of morality: good and evil, right and wrong. The prevailing attitude is, keep that stuff in its place, in houses of worship, on weekend mornings. If God isn't dead, for sure He's out of town. Look out for Number One. Do Unto Others Before They Do Unto You. Unfortunate as these attitudes may be, there's a certain practicality to them in these times. (Not for

everyone, of course. Plenty of people get along fine operating on more humane principles.) Given the isolation and resultant widespread alienation among people, it's only natural that so much of the prevailing morality is oriented toward personal defensiveness and self-actualization even at the expense of others. If you mistreat others, or they mistreat you, you can always retreat from them, or attack them, or sue, move away, or get a divorce. Ayn Rand promoted an enlightened Selfishness as being a virtue. I can see that if it's done right, as she suggested, it wouldn't necessarily be an evil, but how often is it done right?

In the years to come, however, as it becomes increasingly evident that a new world is coming into being, one in which we will stand openly before all others, and they before us, I think people will decide that issues of morality are a lot more relevant than previously held. I think there will be a period of great concern about who should be allowed membership into the network, and who should be excluded. After all, we wouldn't want criminals or the insane to gain control over such a resource and use it against the rest of us. For the majority of us, I think there will be a tendency to want to do a great deal of soul-searching before facing what might seem to be Judgment before all humanity already on the network. Any fear this might engender will be unjustified. After all, everyone else will have been in the same boat. After the network gains a certain size and power, I believe that through the availability of psychological and social rehabilitative resources at the disposal of the network, it will heal anyone who enters of any criminality, insanity, or other mental disorder that he might bring.

What will humanity be like, once all who desire entry into the network are connected to it? “Connected” is an apt word. As indicated earlier, nearly all of your daily activities will be conducted through the network, all work, virtually all recreation, all communication. You will probably consider it most desirable to be *permanently attached* to the network, you and everyone else. At that point, there will be no longer any distinction between any of the people, and the overall system. That is, there won’t be any point in saying where people leave off and the rest of the system begins. We will all together comprise one unified system. Fusion. All of the trappings of today’s society and civilization will become obsolete, and will whither away, except for those few stubborn individuals who will insist on remaining separated from the network.

What will governments be like? Governments will be obsolete. Today’s governments exist to minimize conflicts among their psychologically isolated citizens, protect against attack from psychologically isolated citizens of other countries, and to preserve the power structures necessary for allocation of scarce resources. Under the network, no one will be psychologically isolated from anyone else, and productivity will be so high that no resources will be so scarce as to require restrictive schemes of distribution.

What will work be like? Work will be obsolete. The mechanical segments of the system will perform all physical and administrative labor, solely for the purpose of meeting the needs and desires of the people.

What will education be like? Education will be obsolete. Once an individual is connected to the network, he will know everything that there is to know. That's an oversimplification. I think it will be more like he will *remember* whatever is necessary so that if anything is needed to be known, he will know how to access or bring it into personal *memory* instantly. Imagine that now you remember whatever it is you have thus far experienced, then, suddenly, you will remember everything else, that is, everything that everyone else remembers, and knows. And also whatever the machine segment knows as well. Actually, there will no longer be any distinction between you and the machine … and anyone else.

What will sex be like? Sex will be obsolete, for three reasons. First, the pleasures now derived from sex will pale in comparison to the experiences that the network will be capable of providing. Even today, there are some people who prefer to play video games than to eat or have sex, for a while, anyway. Second, the intimacy provided by sex will be supplied by the network; that is, you will be intimate with potentially everyone else in the world, all the time. Yes, that's tough to imagine, but that's what the total relationship among all of the people amounts to. Third, since the network's power continually increases as its human membership increases, it will be desirable to have a population growth rate *far in excess of anything that could be achieved through mere sexual activity*. All human reproduction will be carried on the same way all other production is done, through optimized mechanical means. Don't worry; you won't miss doing it the old way.

Families? Yes, they'll become obsolete also. Families are based on marriage, which was originally an economic arrangement that later became a social institution. From marriage, we are supposed to have various needs satisfied: emotional, physical, psychological, social, mental and economic. Yet, from the network, will be able to have all of these needs satisfied, more effectively and more easily. Emotional and other psychological needs will be better satisfied because your consciousness will be in direct contact with the consciousnesses of everyone else, or, at least, as many others as it will take to satisfy your needs, including the network machinery itself. The economic and mental needs will be taken care of, as we have already seen. The social needs, primarily the raising of children, will also be satisfied by the network. Although nurturing mechanical devices will physically handle the children, the children also will be on the network and in total contact with all of humanity. They will receive nurture as never before possible, and will grow up *without the isolation* that we take so much for granted, that it is most difficult for us to conceive of a world without it.

And love, what about love? Will it, too, become obsolete? That's a tough one to answer because love, like thinking, is something that is so hard to define. I believe that love has two main components. First is attraction: it usually starts out as physical, that is, sexual attraction, but it could just as well be purely emotional, as between close family members. Next is a partial breakdown of the separation of consciousness between those in love. "Two hearts beating as one" is the traditional description of this phenomenon. Two people in love get to know each other, their personalities, their preferences, their histories, what they are likely to be feeling or thinking.

Unfortunately, these attributes of love can be all too temporary. It is possible for people to fall out of love as well as into it.

Now, sexual attraction is tied up in desire for fulfillment of sexual fantasy, as well as hormonal activity (adrenalin, as well as sex hormones ... "chemistry"). The network will be able to provide gratification for these desires to degree presently unimaginable through either purely synthesized brain stimulation, or synthesized stimulation combined with stimulation provided through interaction with other members' fantasies. The communion of consciousness provided by the network will, as we have seen, far exceed anything we, as isolated individuals, have ever experienced or imagined.

All this leads us to expect that love, although it will be different in its having us being involved with all of humanity rather than individuals, will be a far greater force in life for all of us*. In fact, through the fusion of the network, we will attain the ultimate possible in love,* again, unimaginable on the basis of our experience in isolated existence.

If you think about it, you will see that all of our basic human institutions have, as their foundation, the separation and isolation of individual humans. Our languages, cultures, customs, mores, traditions, and biases all serve to provide organization to our separated beings. Our governments, corporations, clubs, houses of worship, and recreational centers give structure to our lives, and all operate on bases founded in the separation of people. This has always gone without saying. Why bother saying something so fundamental and obvious, that we are separate? Nothing could ever be done about

it. Not until Fusion. And without the separation and isolation, what becomes of the institutions, all the trappings of humanity? What becomes of humanity itself?

Humanity, will be totally transformed and transfigured. Our civilization, our culture, our very nature will undergo a complete *metamorphosis*. That's a particularly appropriate word to describe the process. Usually, *metamorphosis* is applied to the change from caterpillar to butterfly. The change before us will be no less dramatic. And like the caterpillar looking at a butterfly, most of us at this point in history will look at the Fusion Network and say, "You'll never get me up in one of those things!"

As I mentioned in the introduction, I can attest from personal experience that this is the case. Most people with whom I've discussed these ideas since writing the original manuscript, have responded with a reaction somewhere between apathy to outright confrontational hostility. I have had people look at me with an expression of "Why am I in the same room as this crazy person?" while explaining these ideas. I have also had someone fall asleep right in front of my face as I was explaining this to him, and only him. I have had people react with near physical violence, as if I had given them a personal affront.

If I had no evidence that anyone else has ever had a vision of the future like mine, I would probably have the same doubts about my sanity as you do. As it turns out, many of the views and conclusions I have about the future were reached dozens of years ago by the French theologian and philosopher Pierre Teilhard de Chardin (1881 - 1955), although not via the same trains of thought. In *The Thought of Teilhard de Chardin*, Emile Rideau tells us of Teilhard's insights:

"...because more intimate and more a denial of the longing for intercommunion of persons, is the 'agony of isolation'. Torn asunder in his own self, man is constituted also in a state of social separateness: the autonomy of the person arises only from the foundation of a totality, from which it severs itself, but which it must nevertheless regain.

As early as 1917, Teilhard came to recognize this agony and so introduced one of existentialism's favourite propositions: 'It seems to me that terrestrial beings, as they become more autonomous, psychologically richer, shut themselves up in some way against one another, and at the same time become *strangers* to the cosmic environment and currents, impenetrable to one another, and *incapable of exteriorizing themselves*.' He goes on, very rightly, to attribute this to a necessity in nature, that splits up the vital current among individuals, and to the fact of moral responsibility, as a structure of consciousness, which can 'become intoxicated by independence and seek to dominate or repel others'.

He goes on to describe the psychic consequences of such a dissociation: nostalgia for fusion with the whole, the horror of ice-cold solitude, the bewilderment of freedom and choice, the fear that history may be simply one great failure, endangered by the very development of personal thought. This is a most penetrating passage, which throws a new light on Teilhard's position and brings out the existential character of his project. It is no surprise, again, to see him, without denying the

gratuity of Christ's intervention, appealing to him as the *solution of unity*, for man and for history.

Later, developing this in a more organized way, Teilhard was to return to this analysis, describing in turn the 'agony of plurality' and the 'agony of differentiation'.

Further, his own personal experience was more than once to make him realize the unbridgeable gulf between both intellectual points of view and moral options, and the part played by incompatibilities of temperament. ...

In 1918 Teilhard had described the groaning of the universe: 'All around us we can see nothing but irreconcilable division and innate antagonism: everywhere the worthless is mixed up with the precious -- the wheat growing up with the tares. Everywhere we see uselessness, wastage, loss ... superficial incoherence ... deceptive appearances ... the universal lament of creatures imprisoned in inert matter' organic isolation and deliberate egoism (among the monads [separated individuals]). ...

...in *Le Milieu Devin* [The Divine Environment]: 'Man is constantly torn by the separations which set distance between bodies, which set the impossibility of mutual understanding between souls, which set death between lives. Moreover, at every minute he must lament that he cannot pursue and embrace everything within the compass of a few years. Finally, and not without reason, he is incessantly distressed by the

crazy indifference and the heartbreaking dullness of a natural environment in which the greater part of individual endeavour seems wasted or lost, where the blow and the cry seem stifled on the spot, without awakening any echo.' ...

'A true "geopolitics" will finally replace the wretched parish-pump disputes which is all that history has so far amounted to.' And, if this is to happen, it is urgently necessary that man should channel and organize the undisciplined super-abundance of his industry and production.

At the same time, for all the importance of the role of technology, 'machines and industry are already here and now taking second place to an even more powerful agent. Not only ... are the differences between laboratory and factory rapidly disappearing, but, in the coalescence of the two, it is the laboratory that has the dominant position. All in all, it is not an industrial age we have entered, but an age of research'.

Moreover, if the aim of science is to construct a complete picture of the universe, coherent is all its parts, not by simply illuminating a datum but by extracting new being from it, then the peak of evolution will coincide with a systematic completion of world-knowledge, 'in a supreme act of collective vision'.

Finally, technology is in a position to augment and complete man's mental capabilities, not only by electronic computers but also through the possibilities, that may well be realized at some time, of a higher development of the brain.

Technology is also becoming progressively more *collective*: 'For a long time past there have been neither isolated inventors nor machines ... every machine comes into being as a function of every other machine, and all the machines on earth, taken together, tend to form a single, vast, organized machine.' 'Accelerating and multiplying their own growth,' they form 'a single gigantic network, girdling the earth'; and the 'inventive core of this vast apparatus' is 'the thinking center of the noosphere [Teilhard's term for the intellectually integrated environment]'. From being an appendage to the human body, the tool is 'transformed into a mechanized envelope (coherent within itself and immensely varied) appertaining to all mankind'. 'All these material instruments, ineluctably [inevitably] linked in their birth and development,' are 'the manifestation of a particular kind of super-brain, capable of obtaining mastery over some super-sphere in the universe and in the realm of thought.' Thus, even what would appear to be the most dangerous and two-edged inventions, such as the applications of atomic energy, indicate 'the birth into the world of a mankind both inwardly and outwardly at peace ... the coming of the *spirit of the earth'*. This is the more emphatically-so in that 'nothing brings souls more closely together than a common pursuit of the same truth: in the course of genesis, knowledge links together not only brains but inevitably hearts as well'. ...

'Zoologically and psychologically speaking, man, seen in the integration of his destiny with the cosmos, is still only at an

embryonic stage -- beyond which looms a wide fringe of the ultra-human.'

Our present age is still, in fact, characterized by a dispersion of conscious minds, separated by their individual and collective egoisms, and is hardly emerging as yet from a phase of exaggerated respect for autonomy; nevertheless it shows many signs that herald a coming together of men. Evolution, that seems to have come to a halt on the biological plane and to be marking time, is taking a fresh leap forward, like a multi-stage rocket, in a *social* form, through the creation of mechanisms and metabolisms [Remember, this was written long before the advent of genetic engineering!] and of an 'indivisible' network of interdependence; these are being stimulated by both technical progress and also by extensive collective movements toward unification, of which totalitarian regimes are simply aberrant exaggerations. 'An informed organization imposes a geometric order on the masses and seeks to give each individual a specialized function.' Mankind progressively develops its structure and accepts the laws of a common order that assembles its different elements. ...

What is more, under the inspiration of collective research, the organized progress of science produces simultaneously a convergence of minds, a global increase of *psychic* energy and (through the development of instrumentation) a sort of interiorization of matter itself.

In the order of the *heart*, too, the network of human inter-relationships is beginning to be charged with more intimacy and sympathy. 'From the moment when men have woken to an explicit consciousness of the evolution that carries them along, and begin to fix their eyes, as one man, on one same thing ahead of them, by that very fact they must surely begin to love one another.'

'Relationships become ties of friendship.' 'The atmosphere in which man lives becomes sustaining, warm and consistent.' 'With the sense of "universal unification" to which he is now alive, a wave of new life penetrates to the fibre and marrow of man's most trifling activities and desires. Everything lights up. Everything expands. Everything is filled with an essential flavour of the absolute ... And everything is animated by a sweet breath of presence and love --which, rising from the supreme pose of personalization, sustains and nourishes the mutual affinities of individual existences as they move toward convergence.'

Moreover, mankind's internal conflicts cause it to seek more complete unity. 'The whole of history shows us this: after every revolution, and after every war, mankind has always emerged a little more cohesive, a little more united, in closer forms of organic relationships and with a stronger expectation of its common emancipation ... After each crisis we find it more differentiated and yet more one ... So how will it work out this time? If we are not already today witnessing the last convulsion of discord, then it must be here at any moment: the hour is at

hand when the human mass will close in on itself and gather all its members together within a finally achieved unity, with one and the same governance, mind, and orientation, reaching out to embrace the never-ceasing diversity of individuals and peoples. A little while still, and we shall form one bloc. The whole mass is *setting*.' ...

There still remains a *last stage* to be gone through. Modern man is without doubt open to two temptations: that of selfish autonomy, which arises from intellectual loss of balance or from intoxication with freedom, and which fragments or disintegrates; and that, again, of mechanical socialization which stifles personality and reduces it all to the same level in the anonymity of the mass. The serious dangers inherent in progress can be overcome only by 'a know-how-to-do [type of personality], sufficiently expert to avoid the various traps and blind alleys' and a 'will-to-do [type of personality] strong enough not to retreat before any tedium, and discouragement or any fear met on the road'.

Man, it is true, will always remain master of his own choice; but in the long run (so far at least as mankind as a whole is concerned) love, under the influence of the spirit and through its gratuitous action, cannot fail to win the battle against hate, unity to triumph over disintegration, the person over the pressures exercised on it.

'Spirit will always, as it has so far, succeed in standing up to determinism and chance. It represents the indestructible part

of the universe.' 'The world contains in itself the warrant of ultimate success'; 'it must, by its very structure, emerge into the absolute.'

Thus, by an infallible extrapolation, we may foresee, after the requisite states of maturity have been achieved, and in contrast to some vague becoming, a final state, a paroxysm, an historical fulfillment that nothing can suppress. 'In virtue of its convergent nature,' the progress of socialization 'necessarily determines at a finite distance in the future, a critical meeting point or peak.'

This new critical point will be defined by the inauguration of a *perfect community of persons*, linked together by a mutual recognition of their freedom and their collective adherence to an absolute ideal of love. It is in the direction of a single 'heart' even more than in that of a single brain that we must look if we wish to picture ourselves the final 'super-mankind' --that 'higher biological state that mankind seems destined to attain if ... it succeeds in totalizing completely upon itself'.

But this 'end of the whole', higher in order than the 'ends of the elements', is by nature incapable of being 'halted and closed in on itself'. Thus, once mankind has reached its term and is incapable of any further synthesis, and at the same time is more eager than ever for the absolute and for eternity, then it will be ready to 'break through the experiential framework of time and space to escape somewhere towards an ultra-centre of unification and consistence, where there will finally be

assembled, comprehensively and in detail, everything that is irreplaceable and incommunicable in this world'. 'Happy the world whose end is in ecstasy.'

Granted, a good deal of Teilhard's thought was oriented toward a metaphysical and religious prophetic view. He went on to describe the unification of mankind as an 'Omega Point', which is strongly tied to a convergence within Christian theology. But even setting the metaphysical aside, it is astounding, in my humble view, that he saw unification, what I call Fusion, riding in a saddle of technology, apparently more than in mysticism.

So, the concept of all mankind becoming unified in mind and consciousness is neither new nor necessarily bizarre. What is striking, however, is fact that *the technology necessary to make it happen either already exists or is currently under active development.* Not only that, but the necessity to make it happen, engendered by the information explosion, as well as the necessity of our having confidence in our abilities to maintain peace in the presence of ever more destructive weaponry at our disposal, is also present.

The questions remain, what will it be like? What will we become? Compared to the way we are now, as we have seen, we will have so much more knowledge at our disposal that we will be relatively all-knowing. Using this knowledge to create the machinery to satisfy all our needs and desires, we will be relatively all-powerful. And since our consciousness will be united and aware no matter where any of us may be, we will be all-present. In more traditional terms, we will be, relatively speaking, omniscient, omnipotent, and omnipresent. Are we acquainted with anything to which those terms might be applied? Of course. Those terms were, I suppose, invented just to enable us to talk about a special Being Who is regarded as all-knowing, all-powerful, and all-present. We call it God.

Am I saying that we are going to replace God? No. (Although if God is becoming tired of the Deity business, He might have precisely that in mind.) What I am saying is that compared to the way we are today, tomorrow we will be relatively like a god, maybe something like an

apprentice to God. There are two reasons why this should not be at all surprising.

First, it has happened many times before. Imagine a Rip van Winkel who goes to sleep in, say, 1784 and awakens in 1984. What would he make of automobiles, television, atomic weapons, space shuttles, computers and heart transplants? To him, we would seem as gods. And if another Rip van Winkel fell asleep in the year 1200 and awoke in 1784 to see the world of our first Rip, wouldn't he marvel at muskets and windjammers, at printing presses and the idea of a declaration of independence from a despotic monarch? Might he not find the world of 1784 just as he would imagine Olympus? The only difference for us is that it's not going to take us centuries to achieve the next level of relative godhood, rather, due to the 'accelerative thrust' of technology, it will be only a few decades, very few.

Second, doesn't your religion characterize humanity as 'the children of God'? (Deut. 14-1: Ye are the children of the LORD your God). That's not always the case with Eastern religions, but in Western faiths, that's usually the view. Well, in general, don't we expect children to grow up to resemble their parents? To be sure, we don't expect them to be exact duplicates, but we do expect some very strong resemblances. So, it shouldn't be too terribly surprising that we should grow up to resemble God. This, also, is not a particularly new concept. In Arthur C. Clarke's *Childhood's End*, we see this theme almost precisely. In fact, the scenario I have described for the development of the human race over the next several decades could easily be taken for the fulfillment of numerous prophecies, both

religious and secular (e.g., Nostradamus) that envision Mankind as reaping the inheritance of God.

I must point out that regardless of the reference to God or gods, I am still not describing a system particularly based on spirituality, but rather on physical and technological existence. To be sure, however, the nature of such a system and what it will foster for the social life of humanity will likely be held to have strong spiritual overtones for its members. We might even become comfortable in referring to such a system as a god-system for humanity. The Christians among us may, perhaps, even prefer calling it by the abbreviation G-SYS.

I keep saying that the things I point out are not really new. As isolated bits of information they are, indeed, not new. But assemble the pieces into a picture of the future, and perhaps something new does emerge. But regardless of that, the reason I wrote this work is to note that this vision of the future is not merely for our remote posterity, nor even just for our grandchildren or children. It is for us, too. I believe, as I have said, that the first steps toward the true linking of conscious minds will occur within twenty years. I further believe that the process of linking everyone in the world who wants to participate in the network will be gradually completed not more than twenty years beyond that, given not only the current acceleration in technology, but the increased acceleration that will be prompted by the growth of the network itself.

“Gradually”, I say, but that’s a relative term. The growth of the network will be gradual by the standards of the network builders of the future, but by our standards, it would undoubtedly seem quite

sudden. Once the participants become accustomed to interacting with each other at the new higher speeds supported by the network, the various transactions among the individuals will take place much more quickly than can possibly be done now. For example, if this book were available on the Fusion Network, instead of taking a few hours to read it, you would only take a few seconds, or maybe only a few fractions of a second. All interactions among people will likewise be accelerated.

If you are under seventy years of age as you read this, there is a very good chance that *you, personally, will live to see all of this happen. Not merely live to see it happen, but be a part of it*. If you are under fifty, it is virtually certain that you will. Is twenty years really enough time? Remember, in 1950, talk of going to the moon was considered sheerest speculation and fantasy, not to be taken at all seriously. In fact, at that time, some branches of the government, particularly in the military, forbade the use of the term *rocket* in official publications and memoranda for fear that use of that word would diminish the credibility of any documents in which it might appear. Yet, by 1970, a trip to the moon was history. Also, in the late 1940's, electronic computer systems were barely being invented. It was predicted at that time that only a very few would ever be built. By the late 1960's, no major corporation was without them, by the late 1980's they will be as commonplace as telephones. If you want to count digital watches and calculators as computers, they are already more common than telephones!

Twenty years is getting to be a longer and longer time in which to accomplish things. What used to take twenty years to do now might

take only twenty months. That's about the time it took between the public becoming dimly aware of the existence of personal computers and finding them on department store shelves. Twenty years? It's time enough to remake the world.

It's only natural for us to face the prospect of growing up to be like Our Father much as a young adolescent does when he first becomes aware of the realities of the adult world. Sure, it's confusing, perhaps frightening, certainly overwhelming. Maybe we would rather not think about it, after all, it's going to happen anyway, and once it does, judging by how I described all of our needs and desires being satisfied, it's going to be very pleasant, to say the least.

There is, however, one way in which it can be avoided, the same way in which anything may be avoided -- death. As a society, we have continuously faced the prospect of nuclear war ever since atomic weapons were developed. If a nuclear war breaks out, and its effects are as bad as we fear, we will achieve doom rather than the fulfillment that should be our destiny (whether the one I have pictured or another).

We must be very smart in finding means to avoid this catastrophe. It won't do to go about naively clamoring for disarmament, certainly not unilateral disarmament. Nations, as presently constituted, must be able to have confidence in their security. As long as they do, they do not have an incentive to go to war on any rational basis -- only when they believe that their neighbors are about to breach their security would they consider striking first to avoid being stricken first. Nations used to go to war for glory or for improvement of their

economic lots through conquest. I believe World War II put an end to that as far as major nations are concerned. There is still the possibility of war through attempts to spread revolutionary activity or through irrational motivation.

The nuclear freeze concept, whereby all major nuclear powers promise in some presumably verifiable fashion to suspend further production and deployment of nuclear weapons, addresses these issues, but it has the same shortcomings as a wage and price freeze in the face of inflation. If it could be made to work at all, it could only be a very short term solution -- technology will not freeze, and nations must still pursue their own security without relying on others to provide it for them.

As before, I believe the answer lies in the availability of information. We may never see the day under today's social and technological conditions when nations as separate entities will choose to cooperate in a total exchange of security related information, but there is no threat in any nation bringing more and more resources to its information gathering capability. If the USA and the USSR both continue bolstering their information and intelligence gathering capabilities, they can indefinitely maintain confidence in their respective abilities to maintain their security. Also, we can maintain the means to know how to deal with de-stabilizing effects of revolutionary or irrational third parties (even if they are not entirely independent of the other side). I don't think we need to worry about the USSR failing to support the information gathering efforts of the KGB. Lately, I am heartened to see the USA beginning to re-emphasize the role of its intelligence gathering agencies. *We must*

realize that these intelligence gathering activities are not a luxury, but a necessity; they are not evil, but rather a definite positive Good, the best means of averting our worst nightmare of Armageddon.

If we succeed in avoiding destroying ourselves through a general war, we are still at risk of death as individuals. Up until now, the question, "What is the purpose of life?" has always been rather difficult to answer. Usually, it's relegated to philosophers and theologians to tackle in obscure and arcane terms. Nature seems to provide answers only in terms of reproduction of the species or providing food for other species. For humans, the answer has always been elusive, somehow tied up in the concept of fulfillment. And fulfillment? That's also elusive. Someone may spend his life to achieve a financial, artistic, social, political, or some other goal, and upon reaching it, still feel unfulfilled. And if he does feel fulfilled, what does he do for an encore? But now, the question of the purpose of life becomes very easy to answer. You are a piece of a god on the brink of assembling itself. You are about to take a huge quantum leap up the evolutionary ladder. Life is no longer a matter of just living through this day, getting just enough food, shelter, or physical gratification to get by. It's not even a matter any more of getting intellectual or spiritual satisfaction sufficient to be worthy of your humanity. We are going beyond all that, far beyond. Our purpose is to prepare ourselves to make that leap, and become as a god.

If life was precious before, it has become much more so now. You can look forward not merely to the fruit borne by your investments, or to the vicarious thrill of the achievements of your children, but to the ultimate fulfillment of the state of being a more grown-up Child of

God. That's not to say that there are no longer things worth dying for. But certainly, it would now pay to think harder of a way to gain what you want that wouldn't require your death. Some accidents can't be avoided, but now, it becomes evident that there is a definite value to avoid those that can. Wear your seat belts, give up smoking, watch both ways before crossing the street. You now have much more to lose than a mere isolated, frustrated, near-meaningless life whose necessity was never too clear. Even if you feel absolutely certain about the existence of reincarnation or resurrection, you might now have some new alternatives to consider as to how these may actually come about.

True, there is no certainty about the coming of Fusion as I have described it, but, if technology is not leading us toward that end, then imagine what you will about the nature of our future. If I am right, though, in the long run, Fusion will be as sublime a state as any heaven or nirvana supposed in religions.

This brings us to the ultimate purpose behind my having written and updated this work. After all, I don't expect that someone is going to read this, then go out and start building the Fusion Network, just based on the inspiration of the thoughts expressed here. It's going to be built anyway, and, if I'm right, very soon. Rather, the idea is that now, as never before, life is worth living. Since even before the time of Ecclesiastes, who pondered the meaning of life even from the viewpoint of perhaps the wisest and richest person in the world of his time and long after, the quest for the foundational meaning of life has tempted and teased the mind of man. Now, the fulfillment of that quest is within our grasp.

So, hang on. Don't give up. No matter what your burdens, your ailments, your trials, stay with us. Fusion is coming. It will sweep away all your encumbrances. Preserve life, both yours and others'. Think again about people on respirators and about fetuses. Only another three or four more decades and …

And what? Once we become a unified godlike creature, what will we do? Never having been there, we find that a tough question to address. All we have is our imagination to guide us.

I think that we will devote a lot of energy to learning. Once we learn what we need in order to satisfy our own needs and desires, what more would we desire? Knowledge, I think, more and more knowledge. The only thing not in our power to have at any particular moment, is knowledge *beyond* whatever we already had. That will be our driving force, to keep expanding the frontiers of our knowledge. We will explore the remainder of the earth not yet under our dominion, its interior and its oceans. Then, we will expand outward, to the cosmos. We will invent means, impossible to conceive with our isolated limited minds, to travel across the void of space with ease and speed not limited by physical bounds that our separated, lonely intellects currently perceive.

And if life is not an accident or divine experiment unique to Earth, then chances are it wouldn't be long before we encounter other civilizations that have already achieved their own Fusion. If achievement of unified network Fusion is a prerequisite for widespread interstellar travel, then that would explain why cosmic travelers might not communicate with us now on a regular or reliable

basis. We might not be able to recognize them any more than bees can recognize human civilization. If we do encounter alien Fusion networks, how will we deal with them? I feel that both they and we will have achieved, by that point, a level of social maturity such that we would not instinctively fight each other. Rather, once we work out the communications problems, we will probably merge with them as well as we will have done with each other, forming an ever larger astronomical Fusion super-network. Eventually, the scope of our purview will become cosmic, even universal. Then what?

Now, although the stars are extremely hot, deriving their energy from the physical process of thermonuclear fusion, they are so far apart that the average temperature of the universe is only a few degrees above absolute zero. This means that to us the universe, our laboratory, would appear on balance as a dark void. To one concerned with acquiring ever more knowledge, this might strike us as something of an annoyance, so, to remedy this, what else might there be to do, except to say, “Let there be light”?

Afterword

Maybe that last line was a bit of a stretch. I wouldn't be too sure, one way or the other. The Impossible has a funny way of happening, just when you least expect it.

How is The Impossible doing on its way to coming into being now? Let's look at a few examples:

- From http://computer.howstuffworks.com/audeo1.htm:

  The Audeo is based on the idea that neurological signals sent from the brain to the throat area to initiate speech still get there even if the spinal cord is damaged or the motor neurons and muscles in the throat no longer work properly. Thus, even if you can't form understandable words, neurological signals that represent the intended speech exist. This is known as subvocal speech. Everyone performs subvocal speech -- if you think a word or sentence without saying it out loud, your brain still sends the signals to your mouth and throat.

  A lightweight receiver on the subject's neck (a small array of sensors attached near the Adam's apple area) intercepts these signals. It functions much like an electroencephalogram, a device that can receive neurological signals when placed on a subject's scalp. The Audeo receives specific speech-related signals because it is placed directly on the neck and throat area. The sensors in the receiver detect the tiny electric potentials that represent neurological activity. It then encrypts those signals before sending them wirelessly to a computer. The computer processes the signals and interprets what the user intended to say or do. The computer then sends command signals to the wheelchair or to a voice processor.

Here is an example of the Audeo system in action: You want to say, "Hello, how are you?" and say it silently in your mind. Your brain sends signals to the motor neurons in your mouth and throat. The signals are the same as the ones that would be sent if you had really said it out loud. The Audeo receiver placed on your throat registers the signals and sends them to the computer. The computer knows the signals for different words and phonemes (small units of spoken speech), so it interprets the signals and processes them into a sentence. It works in much the same way as voice-recognition software. The computer finishes the process by sending an electronic signal to a set of speakers. The speakers then "say" the phrase. If you want to control a wheelchair, the process is similar, except you learn certain subvocal phrases that the computer interprets as control commands rather than spoken words. The user thinks, "forward," and the Audeo processes that signal as a command to move the wheelchair forward.

- From BBC News:
  http://news.bbc.co.uk/go/pr/fr/-/2/hi/science/nature/7423184.stm

  Monkeys have been able to control robotic limbs using only their thoughts, scientists report.

  The animals were able to feed themselves using prosthetic arms, which were controlled by brain activity. Small probes, the width of a human hair, were inserted into the monkeys' primary motor cortex - the region of the brain that controls movement. Writing in Nature journal, the authors said their work could eventually help amputees and people who are paralysed.

Lead researcher Dr Andrew Schwartz, who is based at the University of Pittsburgh School of Medicine, said: "We are beginning to understand how the brain works using brain-machine interface technology. "The more we understand about the brain, the better we'll be able to treat a wide range of brain disorders, everything from Parkinson's disease and paralysis to, eventually, Alzheimer's disease and perhaps even mental illness."

Natural Movement

With the probes inserted into the monkeys' motor cortices, computer software was used to interpret the brain's electrical impulses and translate them into movement through the robotic arm.

This arm was jointed like a human arm and possessed a "gripper" that mimics a hand. After some training, two monkeys - who had had their own arms restrained - were able to use the prosthetic limbs to feed themselves with marshmallows and chunks of fruit. The researchers said that the movements were fluid and natural.

The monkeys were able to use their brains to continuously change the speed and direction of the arm and the gripper, suggesting that the monkeys had come to regard the robotic arm as a part of their own bodies.

The success rate of the experiment was 61%.

Dr Schwarz said: "In our research, we've demonstrated a higher level of precision, skill and learning.

"The monkey learns by first observing the movement, which activates its brain cells as if it was doing it. It's a lot like sports training, where trainers have athletes first imagine that they are performing the movements they desire."

Complex brain

He said the research could eventually benefit the development of prosthetic limbs for people with spinal cord injuries or for amputees.

He said: "Our immediate goal is to make a prosthetic device for people with total paralysis." "Ultimately, our goal is to better understand brain complexity."

Commenting on the paper, Professor Paul M Matthew from the Hammersmith Hospital, said: "The challenge of interfacing the billions of nerve cells in the brain that control the full range of limb movements directly with a mechanical prosthesis has seemed impossibly difficult.

"However, this important paper confirms that the brain controls movement just by planning where to go, rather than by directing individual muscles how to make the limb get there.

"The study shows that fewer than 100 tiny electrical signals generated in the specialised area known as the 'motor cortex' can command even complex arm and hand movements.

"This moves the day when patients disabled after spinal cord injuries or amputations can use brain-controlled bionic limbs from the realm of science fiction towards science fact."

- From Reuters, May 29, 2008:

  Computer trained to "read" mind images of words
  By Maggie Fox, Health and Science Editor

  A computer has been trained to "read" people's minds by looking at scans of their brains as they thought about specific words, researchers said on Thursday.

  They hope their study, published in the journal Science, might lead to better understanding of how and where the brain stores information. This might lead to better treatments for language disorders and learning disabilities, said Tom Mitchell of the Machine Learning Department at Carnegie Mellon University in Pittsburgh, who helped lead the study.

  "The question we are trying to get at is one people have been thinking about for centuries, which is: How does the brain organize knowledge?" Mitchell said in a telephone interview.

  "It is only in the last 10 or 15 years that we have this way that we can study this question."

  Mitchell's team used functional magnetic resonance imaging, a type of brain scan that can see real -time brain activity.

  They calibrated the computer by having nine student volunteers think of 58 different words, while imaging their brain activity. "We gave instructions to people where we would tell them, 'We

are going to show you words and we would like you, when you see this word, to think about its properties,"' Mitchell said.

They imaged each of the nine people thinking about the 58 different words, to create a kind of "average" image of a word.

"If I show you the brain images for two words, the main thing you notice is that they look pretty much alike. If you look at them for a while you might see subtle differences," Mitchell said.

"We have the program calculate the mean brain activity over all of the words that somebody has looked at. That gives us the average when somebody thinks about a word, and then we subtract that average out from all those images," Mitchell added.

In my own case, The Impossible happened a few years after I wrote the first manuscript. I was raised in a non-religious atmosphere, and I got a degree in physics in college. I always fancied myself a logical, scientific thinker; I prided myself on being an agnostic, and expected that I always would be. When I reached my early 40's, my teenage son Got Religion, which in our family's case, is Judaism. He challenged me from the Orthodox Jewish perspective with some intensely logical arguments as to why this Belief System accepts the existence of God and all that follows from that within Judaism. It has to do with the gross improbability that an entire nation of people, especially such argumentative and "stiff necked" people as the Jews, could be made universally to accept and *maintain in consistent national tradition for thousands of years* the story that God appeared before the entire nation (at Mt. Sinai, as asserted in Exodus 20), if it were not actually true. One would have to believe that were the story not true, then an entire nation

participated in a conspiracy to accept such a fabricated story, which, in all other contexts, is an idea that is taken as patently absurd.

Anyway, the details of this argument are beyond the scope of this work, and I have no intention of turning this endeavor into an advertisement for conversion to Judaism (which is actually forbidden in Jewish Religious Law, in any event.) But, there it happened: I, a secular humanist if there ever was one, became a religious Jew.

But, what that has to do with this work is that I discovered, much to my own surprise, that there are things in Judaism that seemed to me to be strangely related to the ideas of this work. Particularly, there is an assertion in the Talmud to the effect that when the Messiah comes and builds the Third Temple on the Temple Mount in Jerusalem, universal peace will be brought about among all mankind, and *this Third Temple will be "made of fire"*. Now, one would normally want to interpret that in some symbolic fashion, such as meaning that the temple would be build amid a horrific conflict. And there wouldn't seem to be any way to interpret it literally.

Except … when electricity came into common usage in the late 19th Century, the leading rabbis of the time were faced with the question as to what to do with this new technology on the Sabbath, when it is commanded in the Torah, not to "kindle a fire". Since electricity could come in the form of sparks, and since sparks were adjudged to be equivalent to actual fire, especially since sparks can literally kindle a fire, it was decided that electricity is a form of fire, and one may not turn electrical devices on or off on the Sabbath. [This decision was *not* made in a casual or haphazard manner. The rabbis involved made extensive analyses into the physics of both fire and electricity before making this decision.] Hmmm, if the Third Temple being "made of fire" could be interpreted as being made of electricity, and particularly the electricity of communication signals among computers connecting people's minds together,

which would certainly be conducive to universal peace, that would seem to be consistent with the observation in the Talmud.

Also, it is mentioned in the Talmud that the nature of punishment for sin in the Next World is essentially *embarrassment* at having the sin exposed before the Heavenly Host. It would seem that this might be very much like what would happen to someone as he first entered the Fusion Network, until, at least, it became obvious that his sins were probably very much like everyone else's.

Regardless of any relevance of Judaism, though, it strikes me that even if the Fusion Network doesn't result in a merging of all the minds of humanity, there will still come a solution to many of the Big Questions that continually produce public controversy:

- Are there really Secret Conspiratorial Groups that pull the strings behind the scenes, manipulating the political, economic and social dynamics of the world?
- Are governments hiding information about UFOs and possible contacts with intelligent life from other worlds?
- Are medical advances being withheld, which could extend life by many years, due to fears that such advances might lead to world overpopulation?
- Are parapsychological or psychic phenomena real?
- Did people who had "near death experiences" really die?
- How can people who hold views contrary to yours possibly do so in view of how logical and reasonable your ideas are, and how nonsensical and foolish theirs obviously are?

Why do such questions even exist? Because, of course, we have no way of knowing what's going on inside other people's heads. They can always have secrets that inure against our own interests. At least, that's the way it is for

now … Once we *can* know what's going on inside everyone else's heads, such questions will finally be resolved.

When this system comes about, we'll have other capabilities that we can't even dream of. Speaking of dreams, we'll be able to record dreams, then play them back, compare them to the dreams of others, edit them, bring into reality objects and entities created during them (I'm sure we'll be very careful about doing this!) Only our imagination, our collective imagination, will be the limit.

As mentioned in the original text, the concept of individuality will undergo a drastic reworking, to say the least. The same is true of the concept of privacy. In today's world of separate individuals, privacy becomes an absolute necessity. Even in communes where everyone eats and sleeps in the same common room, privacy is still necessary. People will still have their own opinions, their own secrets, their fears, their insecurities. Privacy is our tool for protecting our psyches; it is our shield that keeps our psychological vulnerabilities from being exposed or attacked.

But once we all become Connected, there will no longer be any such thing as privacy. Nothing I say generates more hostility than that statement. Nobody wants to think of giving up their privacy, or at least their right to privacy. In our society of today it's sacrosanct, and well it should be. But privacy is a defense mechanism against others, and in the Fusion Network there will be no 'others'; there will only be Us. We won't have any more use for privacy than we would if one of us were stranded alone on a desert island. Or more to the point, it will be like the need for privacy that our right hand has from our left hand.

Although death from "natural causes" will substantially be conquered as a result of spectacular medical advances, there will probably still be a few accidental deaths, or possibly deaths due to sudden unpredictable natural

disasters. We will know exactly what the victims of these situations will experience. If members of the Fusion Network truly have psychic powers that enable them to contact deceased souls, then we may be able to follow these victims of physical death into the Next World.

But This World is a strange enough place as it is. What we usually refer to as the "real world" is anything but real, and this is confirmed by both Science and Religion. Aside from the fact that most things we perceive directly are not at all as we perceive them (e.g., the sun and moon appear to be the same size, but they're not; the stars appear to be small objects about as far away as the sun and moon, but they're not; the earth seems to be flat, but it is not; etc. etc.) in fact every object we perceive is, in its true nature, not what we perceive. Any "solid object" is, in fact, mostly empty space, i.e., the space between atoms and molecules, and the empty space inside atoms themselves. And even the sub-atomic "particles" themselves are not truly particles, as we understand the concept, but are rather fuzzy quantum mechanical entities who existence are functions of probabilities rather than definite positions and masses. We think it's amazing that we can see through glass, but the really amazing thing is that we can't see through everything else!

My own suspicion about This World is that is it a training ground, or boot camp, that prepares our souls for the Next World. As such, the Master Drill Sergeant puts us through difficult situations for the purpose of "training" us, in some sense, for the Next World. This nicely explains the existence of Evil in the presence of a Good God, and why Good people suffer while Evil ones might prosper. When the Fusion Network comes, we may actually get to find out if this is the case.

There are other possibilities as well for this network. We might experiment with linking animals into the network. There's no telling where this might lead.

I'll stop now. I wouldn't want to blow your mind. I once wrote a letter to a prominent person summarizing the highlights of ideas I've been discussing here. Shortly after I sent the letter, he suffered a stroke. I don't know if one thing had anything to do with the other; I don't know if he even ever read the letter. But I don't want the same thing to happen to you.