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INTRODUCTION

Bermuda has to be one of the world's most enjoyable islands -- a paradoxical plot of paradise in the midst of one of the more treacherous part of the world's oceans. Speaking of paradoxes, I've added to my oxymoron collection while I was here.

Enough of that. Bermuda, ships, and sailors are inseparable and I'm reminded that sailors are one of the more familiar examples of the habit we humans have for ascribing human
characteristics to the tools of our trade. But the computer industry seems dominated by this anthropomorphic mind set. One can only marvel at the wistful — and at times even wishful — thinking that christened a device for recording the presence or absence of an electromagnetic field as a "memory."

Somehow, though, the epitome of all these technological malapropisms is the use of the word "generation" to describe this year's computer model. Actually that's mis-stated -- the industry has not yet reached the cosmetic efficiency of the automobile industry, so it's only been able to turn out a "new model" every five years or so -- thus we have been spared the generation hoopla except on a quinquennial basis. As we gather here tonight, then, we are told that we enjoy the benefits of the fourth computer generation and that the fifth is close upon us. Nonsense. It is just once again a marvelous demonstration of the technologists capability for misusing language as well as their apparent overweening reluctance to try to understand the beings who speak it.
So tonight I am going to talk to you about the real generations of computers. By so doing, I realize that perhaps I am perpetrating the unfortunate practice I have just deplored. But hopefully I can at least provide perspective rather than promotion.

The supposed generations of computers, by the way, are: the first based on vacuum tube technology; the second, on discrete solid state technology; the third -- the integrated circuit, the fourth -- the LSI, and the fifth a somehow mixed affair of advanced circuitry and new architecture -- embodying "artificial intelligence." Now all that is obviously a technologist's view of the world.

A societal view would be a quite different one -- one in which a "generation" of computers is determined more by their role in society rather than by the technology of their innards. As we shall see, not surprisingly, the time span of such a computer generation is about 20 - 25 years.
What we'll do for the next few minutes is look at the arrival of computers in society in the late 1940s as another wave of immigrants similar to those human waves that arrived in the U.S. from Europe in the 1870s, 1890s, and the early part of the 20th century. The process of assimilating those human immigrants into American society parallels very closely the process by which computers are being integrated into our daily lives.

**THE FIRST GENERATION**

As with the great waves of human migration, the computer "immigrants" were preceded by early "explorers" -- the calculating devices of ancient history, the inventions of Charles Babbage, and so on. But the first true wave of immigration, as so often happened with its human counterpart, came in the wake of great social upheaval -- namely World War II.
Out of turmoil of that conflict there arose a restlessness.

First in a trickle and then in large numbers the computer immigrants came -- seeking change and opportunity. The typical computer immigrant arrived on the shores of society just as did its human counterpart -- a thing of basic skills and little sophistication with a tremendous language barrier between it and the society in which it chose to reside.

Society, on the other hand, busy with its many other preoccupations, mostly ignored the newcomer. In certain computer ghettos, however, such as California, there was growing concern as it proliferated. But in general, the new immigrant was tolerated -- the subject of ethnic type jokes dealing with its stupidity in handling customer complaints about bills or its obvious alien characteristics as in "I just heard the boss is planning to replace me but he's got to find a computer that knows how to grovel." Meanwhile, it was
permitted to go about its cumbersome, sweatshop kind of work stamping out payrolls and solving equations of fluid flow. Unable to communicate, it stayed tightly cloistered in ethnic neighborhoods -- called computer rooms.

Teaching this immigrant new skills was a slow and arduous task. By and large, it was so busy earning its keep that only in off hours -- after sometimes working 140-hour weeks, pausing only for brief health checks -- was there time to improve its basic skills. Pidgin English dialects began to come into use. Although most were quite arcane and had strange names and sounds such as FORTRAN, COBOL, and ALGOL, some degree of communication with society began to be achieved. There was obviously still a lot of sign language required.

From shortly after World War II -- for 25 years this tide of immigration grew -- attracting new and more powerful fellow travelers.....all of them sensing opportunity.....seeking to
make their mark. Many were quickly snuffed out in the accident-prone world of industrial America. Some survived and prospered. But all-in-all, these new immigrants were a rough hewn crew stumbling through society. Much as did the early human immigrants to the U.S., they increased the wealth of their industrial masters, and of the whole economy -- they were a new and vital source of energy and productivity. But the computers were also an alien lot, unintegrated and certainly incapable of serving any broad spectrum of societal need. These computer immigrants were, in short, the cheap manual laborers of the new information age.

THE SECOND GENERATION

For the last 10-15 years, the second computer generation has begun to arrive on the scene. The scenario follows that of its human counterpart -- the sons and daughters of first generation immigrants. The labors of the first generation have laid down
a basic economic and intellectual foundation from which the second can go on to greater achievement. This second generation is better educated. That is, its capabilities are drawn from a broader and deeper base of technologies. As a consequence, horizons in society for the second generation have broadened and a greater variety of opportunity is available across which to apply their skills. No longer are its members relegated to the sweatshops of numerical calculus and clerical processes. They've entered other occupations -- e.g. every police department includes them in its roster. Although hardly the equivalent of a good Irish cop on the beat, in their own way they make life safer for all of us. They perform routine chores for air travelers. And a few, under the guidance of the Pied Piper of PLATO, Don Bitzer, have made it into the profession of teaching. Slowly, then, the offspring of our immigrants are making their way into society.
But not surprisingly that is mostly for the more adventuresome. As a whole, the second generation is somewhat torn -- clinging to its attachment to the old ways of the first generation, yet wanting to explore the new horizons now open to it. Language continues to be a problem -- although some can converse in the language of their adopted society, most are still far more comfortable with their native tongue. Some computers and their friends (programmers) still hanker for the ethnic cabals of old and decry the defection from the old ways. And if you will grant me just a bit more poetic license, members of the first generation just shake their disk heads in bewilderment over the doings of their offspring.

Society at large can no longer ignore the second generation's presence. They offer great promise and yet many of us -- such as a lot of educators -- are silently suspicious -- when our backs are turned, will it do us in?
No one observing the introduction of word processing into the clerical function of an organization -- much less the feeble attempts of executive management to use this tool -- could conceivably use a term like "fourth generation" -- much less fifth -- to describe the current state of affairs. I saw an advertisement for a workstation the other day that speaks volumes as to where we really are. In full two-page glory stood a desk with a personal computer on top while down below the bold headline informed us that this was a "smart desk." You can literally see there the doting, hard-working, first generation parent bragging about how smart the kid is.

And yet the pace of change is very great -- we are perhaps a bit more than halfway through the second generation -- by the early '90s the third generation will be fully upon us.
THE THIRD GENERATION

To pursue my analogy, this third generation will be educated and knowledgeable, i.e. based on a spectrum of technology its "grandparents" couldn't imagine. It will be literate and articulate and fully integrated with its human partners. It will be capable of taking its place in every arena of human endeavor -- not only accepted but sought after by society.

The point of all this is obvious. If the metaphor of generations is to be used at all, then it is more than simply misplaced to use it to describe the status of electrical circuits. For the "generations" of computers, in fact, are defined by the ways in which people can use them and, with that in mind, it should not be surprising that roughly 20 years -- not five years -- is the dividing line between the generations. Those are the generations of mankind, and the introduction of computers into society is faithfully following that generational pattern.
TOWARD 2007

It is important to keep in mind that being in the midst of the second generation of computing we are still dealing with an oddity -- a cultural oddity -- at one and the same time more and more visible and accepted and yet somehow still strange to us. The transition to a fully integrated third generation has profound implications -- more so than all computer history to date.

Interdependent Independence

Perhaps most important, it makes possible a non-pathological solution to the state of "interdependent independence" which I described to members of the Summit Conference two years ago. Let me recall for you why such a seeming oxymoronic description of our future state is appropriate.
Interdependence. For nearly 50 years, from Wendell Wilkie's *One World* to Toffler's *Third Wave*, we have been reminded by writers of every ilk of the growing world-wide interdependence. For all the adult lives of everyone in this room, that force has been growing, pressing, and shaping the world around us. And inevitably, as it has grown, the counter-balancing force of individuality has also grown. Look around us. Take energy and food -- the very basics of existence: There is practically no nation on earth self-sufficient in both these necessities. Yet have we seen larger and larger conglomerations of people into nations? Quite the contrary. Fifty years ago there were 79 nations in the world -- today there are nearly 170.

The concept of the American "melting pot" goes far back in American mythology. And yet is was never really valid. In 1916, soon-be-be Supreme Court Justice, Louis Brandies, said
"America has believed that in differentiation, not in uniformity, lies the path of progress. It has acted on this belief." More recently observers, such as John Naisbitt, have discovered this trait, so that again there is a heightened awareness that "it is our [individuality], our ethnic diversity that has made us such a vital, creative country."

So optimisic achievement can and will result if we effectively manage this "interdependent independence" of our lives. In Control Data, this process is well underway. We are already experienced in large company/small company cooperation, in network structures, in cooperation (i.e. interdependent), technology development and independent marketing. While the structure will continue to evolve, a great deal has already happened since the Summit Conferees of 1982 took a look at Control Data in the year 2007. For example, we have added more than [_____] affiliated companies in the past two years. Our
equity ownership in most instances is a minority position, but strategically each of them has an important role to play. The businesses involved relate to nearly every one of Control Data's product lines. The formation of ETA Systems to develop and market the supercomputer part of our business is another piece of the "2007 strategy." Over time, this interdependent network of market focused divisions, subsidiaries, affiliates, and distributors will grow but already the statistics are impressive. Today, it consists of [number of subsidiaries (i.e. 100%), divisions, affiliates, distributors, independent marketing reps].

The Third Generation at Work

Let me move on now to a more close-up view of this third generation computer (and its human companion) at work. A few brief scenes will serve to illustrate the powerful and integrated systems of endeavor which are possible as these more capable grandchildren come into the workforce.
Take for illustration the matter of health. Soaring costs of healthcare are a much discussed topic in recent years -- a drag on economic growth and productivity, a growing source of conflict between labor and management as business discovers it can't afford what was committed in more halcyon days, and a very hot potato in politics as government discovers the same.

The second generation computer's role in society's frustrated attempts to address this problem is one of monitor or scorekeeper. Through their labors we are well informed as to escalating insurance costs, checks are issued to pay those costs, and some computers are out in the trenches helping to monitor the critically ill. In business, the personnel department is awash with safety reports, absenteeism reports, health insurance cost reports. But all of this scorekeeping does little to improve the basic health system. As the third generation comes into being, that will change, partially
because of improved capability technologically, but much more
because of a changed perspective -- a more complete and
integrated understanding of the man-machine team and how it can
function to improve the total healthcare system.

Time doesn't permit looking at every aspect of this but perhaps
three snapshots will suffice: The computer assisting in
improving the learning process of healthcare providers; the
computer assisting in providing more cost effective, better
quality treatment of the ill; and, perhaps most important, the
computer in the workplace -- helping people stay healthy and
assisting management in its responsibility to help employees in
that regard.

The learning process -- it can take a quantum leap through the
ability to include real world problems in simulated form. In a
recent address, Professor Francis D. Fisher, Henry Luce
Professor of Ethics and the Professions, Haverford College, described a program which is designed to teach gastrointestinal disease diagnosis. The following is his description:

"The scene opens (on videodisc) with the patient being wheeled into the hospital room.....he describes the dizziness he experienced and other symptoms. Stop. The computer takes over, asking you, the 'student' doctor, what is wrong with the patient? What additional information do you want? What tests would you like performed? A menu of a wide variety of tests is presented. You select some and the test results are displayed. Do you want to ask the patient some questions? You can select those also -- and get answers. If a picture of the patient is necessary, as in answer to the question, 'Show me where it hurts,' the laser picks up a TV segment showing the patient pointing to the appropriate spot. And you can stop the picture at any time for closer examination, or get 'instant replay.' You can also obtain expert opinion on certain matters."
"When you make your ultimate diagnosis, the computer criticizes it, aware of the context of knowledge you had about the patient at each point you made a preliminary diagnosis or decided what question to ask. 'Yes,' the computer tells you, 'it was an ulcer, just as you guessed after the first test, but at that time it was a poor guess,' the computer points out, 'for there were strong counter-indications that were not explained away until later.' With a series of such cases, it is going to be possible to give a physician ten years of gastrointestinal experience in a few dozen hourly sessions."

Let's move on to the hospital and a system called HELP.

HELP does everything that computers traditionally do in hospitals. It keeps track of billable charges for the patient and inventory in the pharmacy. The patient's medical record is kept in the computer. But HELP is a third generation computer system and does much, much more. HELP uses artificial intelligence techniques to assist the doctor in reaching the correct diagnosis. It remembers allergies and treatment rules. With HELP the computer prompts the doctor to follow the treatment protocols that the hospital medical staff adopts.
This will improve the quality of medicine and help contain costs. The computer compares new patients to similar previous patients. By doing this, the probability of success using several different treatments can be evaluated. The doctor makes the treatment decisions for the patient but the HELP system is a good and reliable assistant with a very large memory. At one and the same time, it makes possible more individualized treatment based on each patient's unique characteristics while bringing to bear the knowledge gained in treating those who suffer similar ills.

Finally, there is the computer helping management in providing a total health system for employees. A crucial element is data gathering -- the sensory element of the system. A sensing capability requires more than checking boxes on a standard form and processing that into a report -- it must be a dynamic, personalized process.

For example, in a real-life health system, we encounter extreme states that must be sensed. We do this at Control Data with something called Employee Advisory Resource. Through EAR, we try to catch serious employee personal and work-related problems before they cause some tragedy.
Counselors are trained to stabilize crisis situations, make diagnostic assessments and offer referrals. That's at the extreme pathological end of things. But that's important! The total wellness system must sense the limits of stress just as computer-aided design does for the engineer, or a computer-aided flight system does for the pilot.

In the more normal range of activity, "STAYWELL" is designed to keep employees fit and conscious of good health habits. The STAYWELL process recognizes the particular needs, commitments, and characteristics of working people. Each element of STAYWELL can be tailored to effectively address the diversity of different demographic groups. This is absolutely key, and the thing that makes it possible is a computer-based education system.

Management, meanwhile, through analytical reports coming out of the health claims processing system, is able to guide developers toward improved training material for STAYWELL. Note that management is not dealing with hypothetical data or some kind of national average. The employee population, through the act of filing claims, describes precisely, yet anonymously, the health problems most needing attention. And it does this for "a specific work force" in "a specific location." The result will be a more vital -- a more productive -- organization.
Problems

Realizing the potential of the third generation will not be automatic. It depends mainly on the policies and attitudes -- the approach -- society at large takes. In this regard, too, we have a direct analogy to the waves of human immigrants who reached America's shores.

And as with all potential for advancement, there is the contrary potential for human exploitation and suffering as well. This is not the place for a digression into the perils of computer fraud, privacy invasion, and human manipulation which are possible as a result of a fully computer-integrated society. Suffice to say that those of us in this room have a doubly important role to play both as to what computer technology can do for people and as to whether it will be done responsibly.

CONCLUSION

Let me close with a few observations on you -- the Summit members -- who are providing the leadership that Control Data, and your communities as well, must have to effectively use what technology makes possible as the third generation arrives.
In his new book, *America's Third Revolution*, Irving Shapiro, former CEO of DuPont, says:

"America has launched three revolutions. The first was for political freedom. The second, the Industrial Revolution, was technological and material in focus. It took a nation rich in potential and made it rich in fact. Though we think of that revolution as history, it is still going on. The third revolution, unnamed, lies even more in the column of unfinished business. It is a revolution to make real the notions of social justice and equality, a revolution driven by a vision of a nation as rich in quality as in quantity.....one of its premises is that a wealthy society has few, if any, excuses for not being just and humane....."

As I survey the achievements of those of you in this room -- which, of course, epitomize the achievements of Control Data, I realize that while Irving Shapiro can write knowledgeably and articulately about such things, it is you -- we -- who are the actual revolutionaries -- who are making reality out of his words.
Certainly the quantitative discussions of your achievements are impressive. Look around the room -- this small group managed and sold nearly percent of Control Data's total sales in 1983 -- some worth. But those are only numbers. More exciting and more impressive is that you are the ones helping to truly introduce the third generation of computers. Technology may not quite yet have given us the power to fully employ expert systems or artificial intelligence, but its precursors are here -- in hardware technology, and in applications expertise. And you are helping to make it happen. As a result, more than million people in the world are benefiting from your leadership. Computer-aided design is opening new horizons to mechanical and electrical engineers -- and the consumers who will benefit from their increased ability to innovate. I've already mentioned HELP. No more significant computer application has been developed in the history of our industry. Home buyers not only benefit from the variety and productivity made possible through Custom One, but the Remote Mortgage Origination system brings a heretofore unavailable innovation to the not so mundane task of financing that new home purchase.
Education, government leaders, lawyers, doctors, scientists, builders, buyers, planners, doers, entertainers, marketers, you explorers, and, most of all, just plain everyday people can and are benefiting from what Control Data is doing. In the most fundamental sense of the phrase we are "creating new wealth" for people everywhere.

It is your task and your privilege to be Control Data's representatives in the marketplace -- to bring awareness to our clients and customers of where we are and what we have that will help them. No one could ask for more from life. It's my honor and my privilege to be your leader. I can't conceive of anything more rewarding. Thank you for what you have achieved, but thank you most of all for your achievements yet to come.

Thank you.