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COMPUTER TECHNOLOGY -- THE KNOWLEDGE REVOLUTION

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- o Expected changes in technology
- o Effect of technological changes on:
  - -- Expert systems
  - -- Fourth generation languages
  - -- Integrated data bases
  - -- Image processing
  - -- Voice communication
  - -- User interfaces
- o Specific effects on the actuary and the insurance industry
  - -- Product development and administration systems
  - -- Expert systems in underwriting
  - -- The knowledge worker
  - -- Infrastructure of insurance companies including management, communications, costs and financial reporting

MR. JOHN J. FAHRENBACH: By way of introduction to our topic, it might be useful to revisit some history to gain some insight into our current situation. In 1765 James Watt invented the steam engine. In 1781 one of Watt's assistants obtained a patent on a gearing system which enabled the steam engine to run factories and machinery. One year after the patent on that gearing system was granted, every single statistic on the British economy started upward -- the First

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Industrial Revolution had started. We are still in that revolution. We have replaced the power of muscle with the power of coal, oil, atomic fission, and perhaps atomic fusion in the not too distant future. One positive result of all these accomplishments has been an enormous increase in our standard of living and productivity. Compare the productivity of a village blacksmith in 1750 to a modern steel mill. Or compare the productivity of a farmer in 1750 to our current agricultural setup. There has been at least a tenfold increase, if not more. Many people now believe that we've started the Second Industrial Revolution. We are in the process of substituting computing devices of various types for our reasoning and sensing abilities, just as in the First Industrial Revolution we substituted machines for muscles. And just as we increased our productivity by at least an order of magnitude in the First Industrial Revolution, many people believe that the Second Industrial Revolution will do likewise. Can you imagine what our society would be like if we were ten times as productive as we are now? In particular, what effect that increase in productivity would have on our own profession? My own belief is that much of what we do today will be done by machine in the next five to ten years. Depending upon one's outlook, that either opens up great opportunities for us, or it's time to consider alternative career paths.

DR. HENRY J. BRINK: In the transformation of processing power from manpower to steampower, approximately two orders of magnitude have changed, sparking the Industrial Revolution. Since the beginning of the computer revolution, we have experienced change of seven orders of magnitude. An example of one order of magnitude is jogging here from your hometown carrying your baggage, versus flying here ten times, assuming that you could run six-minute miles all the way. So two orders of magnitude is significant. Seven orders of magnitude is revolutionary and suggests that we have revolutionized society. The message that I bring to you is that you can expect to have constant change at that rate in the information systems processing arena from now through at least the beginning of the 21st century. We are not hitting any limits and we do not need technological breakthroughs to accomplish these goals over the next ten or twelve years. We can just refine the technologies we have today. Breakthroughs in technology will do nothing but expedite what I am going to suggest.

High-tech -- the future in insurance? High-tech? What comes to your mind when that word is used? You might think about jet airplanes, or CAT scanners,

or the revolutions in medical delivery systems. Obviously I would hope you would think about the computer -- something very near and dear to my heart. If you look at the industry and you look at technologies used within it, you would have to suggest that it is an expanding industry. The industry was one of the first users of technology. The first commercial computer was shipped to Franklin Life. It was a UNIVAC I. Yet we have been very, very ineffective in forecasting the use of computers. In 1937 the League of Nations brought together a group of experts and asked them to forecast the future. Among the things missing from their list were: antibiotics, radar, nuclear weapons, the computer, and the jet airplane. These were all things which were working some place in society at that time but they were not even on the list of those things which would revolutionize the future. In 1950 the Department of Commerce forecasted the impact of the computer in the future, and it was suggested that 50 large-scale computers would handle the computing for the world for all time. They missed it by some gauge, so we are not very good at forecasting the impact of technology.

These are the forces that we see revolutionizing our industry -- the insurance industry. Many of these are on the list of things you are concerned about, particularly the complex new products: what it takes to bring them out the door, how fast can you get them out the door, how do you administer them, how do you know what it's going to cost to administer them, are you going to make money or lose money. And last but not least, the impact of technology. Researchers have suggested, as early as the 1970s, that no industry has greater potential for total automation than the insurance industry. Our products and services are based on information. We do not have to pass checks as banking does. In a study done by the Harvard Business School, Dr. Warren McFarland suggests that the use of information systems is strategic for banking and insurance.

Dr. McFarland has also suggested that technology can be used as a competitive weapon. His premise is that those who do not use it well will lose ground to those who do. He is not saying that by using technology well, you necessarily gain an advantage, because your competitors can use it equally well. That brings us to another point: Who are your competitors? Are they really your peer insurance companies? Are they other people in the risk business? Are they the banks? Are they the retailers? Who is the competition of today, and

will that competition be there tomorrow? When we look at technology today, we effectively say it is being driven by competition and by people who are attempting to gain an advantage. Classic cases in the use of technology are United Airlines with Frontier, American Airlines with Braniff, and American Hospital Supply with Johnson & Johnson. In all of these instances, the company that used technology, put together the best packaging, and put it as far forward in the system as possible was the one that gained advantage over those that did not. When American was investing in its marketing system, its reservation system, Braniff was putting its money in a back office expense system for running the maintenance plant and the administration. Braniff's use of technology was very elegant but very ineffective. Using technology terribly well is not enough. It has to be used at the right pressure points.

The first generation of technology came out of vacuum tubes. The first machine of the current age was a UNIVAC computer at the University of Pennsylvania in 1946. It had 18,000 vacuum tubes, weighed 30 tons, and took up 15,000 square feet of floor space. When it was turned on, the lights in that section of Philadelphia would dim. Several years ago, a system equivalent to that UNIVAC was compared to a Radio Shack TRS-80 just to see how well the TRS-80 would perform. A 9,000,000-step nuclear calculation was used as a benchmark. The TRS-80 outperformed the UNIVAC by a factor of 18 to 1. By today's standards, the TRS-80 is not what you would consider a number-cruncher.

Secondarily, the current generation was sparked by the breakthrough in silicon. Pure silicon comes from sand, which is refined and refined and refined. With the Great Sahara Desert, we don't have a limited supply. Initially, IBM was spending an enormous amount of research dollars on cryogenics because we thought that we were going to hit limits in silicon. People constantly said that you couldn't build lines that were thinner than three microns. Today we're down to a half micron. So the expectations of the technology limits have been expanded. We are still in silicon and we don't see the end of silicon for quite some time. And then there's gallium arsenide and other types of technologies which can come on line if we run out of speed with the ones we have now. Quite honestly, you're not eating up the capacity we are delivering at this time. Therefore, we don't foresee running out of the ability to deliver speed. Our focus now is toward greater function and capability.

COMPUTER TECHNOLOGY -- THE KNOWLEDGE REVOLUTION

From 1948, when the transistor was invented, to 1964, we went from single transistors (remember the old circuit boards that you got with radio?) to a solid logic technology. And in 1979, IBM's first large dynamic RAM (random access memory) chip was delivered in the 4381 series. The chip was small enough to pass through the eye of a needle. This brought another dimension to processing. Not only could we make the bits of information smaller, but we could also make chips having microprocessor series and additional bit matrices so that if one failed we could reallocate it. The chip became self-diagnosing and self-correcting. The two most recent, most dense chips in the IBM company both store one million bits and fit on a 100 yen piece. We are now working on 4 megabyte and 16 megabyte chips, which have been announced. You can expect that we will consistently deliver two times the price performance in memory and logic chips every two years. At that growth rate you are going to have greater and greater capacity, not only in memory chips but also in logic chips. This brings the price performance curve from 1955, when it would cost $14.54 per 1700 instructions in a benchmark and would take 375 seconds, all the way down to 7 cents and 1 second in 1982. Today we are at about 4 cents and .04 second. This gives you an idea of relative measures of performance. Here's another idea of how far we've progressed. The largest mainframe of 15 years ago, costing two million dollars, and a personal computer of today yield equivalent "measures of performance," measured in MIPS (millions of instructions per second). This is, however, a meaningless indicator of performance. You cannot look at a machine and say, "How fast can it run" and understand that it is the throughput that is going through the machine.

Another point I'd like to make is that although you will have something as powerful as the largest mainframe in the world today on your desk in the next several years, it does not mean that they will replace those mainframes. It just means that you will have more power on your desk to be used in some form or fashion. This new technology will be applied equally throughout the spectrum of devices. So at the same time that personal computers (PCs) get more and more powerful, the minicomputers, the superminis, and the large mainframes will be getting more powerful.

One of the big decisions that will have to be made is where should the processing take place? I think that as actuaries and the holders of the keys to the kingdom of insurance companies, you will have to be very concerned about where

the transactions will take place. Should they be located in the most economical place or should we restrict their use? The answer is yes, we should restrict their use, but also put them in the least restricted place that fulfills the requirements of the restrictions and processes as far forward in the system as possible. This just says small is beautiful.

U.S. News & World Report had an article on the ten forces reshaping society. Their comment was that never before in the history of mankind has a device capable of being held in the hand of a man been the instrument of social and economic revolution as the transistor and the micro electronic chip.

There are also great breakthroughs in storage. We're doubling magnetic storage every year, and optical storage will give us more breakthroughs. But in many instances the intelligent devices, the computers themselves, are restricted in their communications dimensions. You can expect high speed communications improvement due to recent breakthroughs in the digital telecommunications arena. I heard a speaker in Carmel last week who said that in less than five years the cellular telephone will cost less than $100. How many people here would not purchase one if it only cost $100? Those who wouldn't don't want to be intruded upon. I know of an individual who's a salesman in the life insurance business who has two different cellular telephones. He's the only person who can say "Will you hold on a few minutes -- my other phone is ringing!" One of our goals is to keep a salesman in front of clients. If he can be talking to his office and a client can be calling him at the same time, all the better. Technology is not good for everybody. Peter Drucker suggested that span of control is going to be replaced by span of communications. One of the elements in span of control is the management principle pertaining to the number of people you can communicate with and the number you can observe and track in a period of time.

Next, I'll quickly cover the advance in bodements. The very first one is artificial intelligence. Some would say that artificial intelligence is better than none. I would suggest that this is a technology made possible by the explosive growth in processing power. It eats up machines. At one point in time the only application available was the game of chess. Artificial intelligence brings some inordinate capabilities. Number two, artificial intelligence does not replace all the experts. All it does is expand their capabilities. The domain of the expert is greater than the domain of the expert system. Expert systems are most

attractive in situations where the system could do 80% of the expert's work with 20% of the expert's capability. It unencumbers the expert to do the things the expert should do and removes the trivial. The obvious application in insurance is underwriting. Although I would have suggested that we were doing a great job in jet-issuing policies up to nonmedical limits of $250,000, I heard somebody say they were moving their nonmedical limits down to $10,000 and requiring blood tests. A first reaction might be that expert systems would not expedite this process, but we might want to scrutinize it again. I would suggest that you don't have enough underwriters to scrutinize all the policies. So the question is, how do you scrutinize them and keep track of what's going on? I also heard a person speak last year who said that they let the underwriters override some of their systems. Overriding should not be done lightly. I'll never understand why the guy didn't have some indication that there was a problem with an address of River Road in Jamestown, where they have large floods. He just said, "Well, I thought we ought to match competition." That "I thought" cost them $10,000,000 in a flood loss.

These are the rules for expert systems. The process must be cognitive; it cannot be intuitive. There are many processes in our industry that fit these rules. Another requirement is that the skill can be taught to neophytes. Obviously actuarial science is not something that can be taught to neophytes, but there are many functions that the actuary is encumbered with that the actuarial assistant or Associate could handle. Again, consider underwriting -- there are many people who are just processing paper.

Another expert system, "Prospector," built by SRI, found the molybdenum load on Mount Washington. For 60 years, the best geologists had been drilling all around Mount Washington knowing that there was molybdenum there someplace. Prospector was able to take all the data and process the data. The geologists found molybdenum in the very first place that Prospector told them to drill. This was just a precursor to what expert systems could do. "Internist" is an internal diagnostic system which can pass the State Board of Exams in all 50 states. And that's nontrivial. Looking at its extensions, it could be used, if it were accessible, by the practitioner in the boondocks providing a service to humanity, or by the nun working in Africa who doesn't have the training to help improve the life of mankind. "Epistle" is an expert system that is running at the Yorktown IBM site. You can give it an article of 5,000 to 10,000 words, and

it can generate an abstract of 500 words. Somebody said, "That's not so great. Let me give it an abstract of 500 words and have it write the article. I want the inverse." Just think of all the information that comes across your desk each day that you don't have time to read, or even skim. Suppose you had a system that could take this information, ingest it, create the abstract, and then provide you with the abstracts to read on your terminal. Secondarily, suppose it let you pick the ones you wanted to look at in more detail and had those sent to you, with the system automatically paying for all the processing. You get away from information overload.

One of the things that can surely be done is to take an insurance specialist who is marketing in today's dimension and the brokerage specialist who is operating in the financial area, and overlay and strengthen some skills of the insurance person; although, with the recent stock market events, I am not sure that the insurance people who are focusing on equities will ever return to them. As we look at designing products which shift the risk to the insured, after we have shifted the risk, the question is, do they want it? Do they understand it? And who may get sued in the next several eons if people were damaged? Expert systems can do financial planning, they can extend the capabilities of designing products.

Much research has been done on the number of products an individual can handle at once in any business. The most that any competent person can deal with is seven. Seven is the number of digits on a local exchange that you memorize quite easily. It happens to be the number of dials on a power meter. So seven seems to be an inhibitor in traditional brain power. On the other hand, when we extend it to expert systems, we extend the capabilities of learning and we can use them as learning capabilities. There is a thing called an inference engine, which means that you don't have to start from scratch. Take an underwriting example. The shell does the inference logic and all you do is build the rules. The data comes in from outside. The underwriters and the actuaries build the rules for processing and the system uses a process of inferencing to come to a conclusion.

Perhaps you have seen the voice commercial from IBM. It shows a PC with a 20,000 word vocabulary. You can speak to the PC and it transcribes your voice. The example in the commercial is, "Please write Mrs. Wright and tell her

that she is right." As you speak, the sentence flashes up on the screen. Next time, look closely at the commercial. The first time you see the sentence, it will use all "writes." Then the screen blinks and comes back with "Please write to Mrs. Wright and tell her that she is right." The system is 95% accurate with 20,000 words. The average vocabulary of the individual in this room is about 100,000 words, and the English language has 300,000. So if you were to expand it to the entire portfolio, it would take machines of significant capability. One possible application would be to dictate to the machine, have it do the rough draft and submit it to your secretary to correct. About 50% of the work being done today in computer research is in linguistics. We will improve the terrible and horrible language capabilities of our society despite themselves. (Although I believe that we should be able to dangle participles, split infinitives, and do all those good things. It's a very narrow mind that can only spell a word one way.)

Electronic books are also on the horizon. The *Transactions* of the Society could come out on a small diskette and you could put it in a PC and leaf through it. If you wanted to abstract paragraphs out of the *Transactions*, for your own file, you would be able to pull those out, take the disk out, put it in your printer, print it out, and distribute it to your colleagues, assuming you are not failing in a copyright.

The terminal of the future will have graphics, voice, and image and will be able to integrate text and data, which it can do today. If you were in the furniture business, you could bring clients in and, using icons, show them how the furniture would look in their office. Extending this concept, you could actually take pictures of the office and pictures of the furniture and show the client how it would really look with the furniture. This would burn up tremendous capacity.

Or suppose you were in the insurance business and had a profile of property and casualty insurance. At the time you were doing an analysis of an individual's portfolio, the system could be searching data banks which kept track of all the property sold in that arena in the last couple of weeks and assess it, update it by current assessments. You could be reviewing the insurance portfolio to find out whether you should replace it with your product or whether it's exposed to replacement with somebody else's product. You could be using this system to really provide the services. We will be selling financial planning

and financial services, but right now we are not set up to provide the service once the products are sold.

While the PCs are getting stronger, the maxi-machines are also. Forecasted for 1990 is a different type of machine able to process a billion instructions per second, or one thousand megaflops. A megaflop is a million floating instructions per second. We can conclude that all God's children, all these intelligent beings, will continue to intrude into your domain and get bigger and bigger, faster and faster.

We're bleeding at the seams with products flowing in at agencies and at home offices. We're selling products of other companies. We are expanding left and right, and we are creating chaos within the home office. Many of these systems are standing alone, nonintegrated. We can use them for service, but we can't do anything as far as bringing them together. The property and casualty side is equally bad. I think we are going to have to go to a client view. That's going to require the use of new database structures and relational systems. We are going to have to shift to a client view, particularly if we are going to be able to compete with the banks and other entities. This will involve expert systems to manage the cash, manage the assets, manage the plans, and keep track of the investments. If you had an expert system financial advisor, maybe you would not have been as bloodied as we all were in the October stock market.

Two examples. The first is the Phoenix Arizona Fire Department. They have 148 fire engines, ten administrative stations, and ten telecommunications areas. They have 26,000 buildings in their inventory. They can tell you where the gas cutoffs are, where the fire escapes are, whether the building is sprinklered or not sprinklered, where the one-way streets are, how close it is to a railroad siding, how close the building is to a hospital, how close is it to underpasses, what the one-way way streets are around it, where the fire hydrants are located, and where to strategically park. All that's put down into the fire engine in the first ten seconds out of the firehouse.

The second example is a life insurance company. I won't tell you who it is -- see if you can guess as we go along. They were using a single system, but are moving to a distributed system to provide total services in the competitive arena. The system is very big, very expensive. They began working on it in 1986.

They expect to deploy it in 1988. It will take 22,000 man-months at an estimated cost of $390,000,000. The company is NIPPON, the largest insurance company in the world. They are bigger than even Prudential -- 80,000 agents, 70,000 sales agents, 1,800 branches.

The most important message I bring to you is that you need to be involved in planning for the use of technology. If you are not, we have the problem of rearranging the decks. You are very important in the product. Number two, please don't be too comfortable with the technology you have today. Don't believe you can ignore it. Any of you that got hurt in the stock market, you can't ignore it, you may have ulcers as a result of it, but why worry about things you can't control. That's high technology in our future. I think it really is going to be something that will be bright and fun. We should look at, figure out how to use it, and remember that competition is driven by competition.

MR. THEODORE E. BALEDES: This speech was worked on very early in 1987 by Joe Brophy and me. Joe has delivered it a number of times internationally this year, most recently last month at the IBM Users Group international meeting on the West Coast.

Michael Porter said in his book, *Competitive Advantage*, "Technological change is one of the principal drivers of competition. It's a great equalizer and it can change the rules of competition." For us at The Travelers, the application of technology is a strategic consideration. We are using it as a competitive tool. To compete we must apply technology strategically to support our people, our knowledge workers, and to serve our customers. Today I am going to paint the portrait of a knowledge worker, explain what we think it is, how we define it, discuss certain management issues that are relevant in a world of knowledge workers, talk about a few trends, and finally, discuss our objectives in linking the knowledge work force.

Winston Churchill once said in a speech at Harvard, "The empires of the future are the empires of the mind." Now I don't know whether Winston Churchill thought of it this way, but he was, in a sense, talking about knowledge workers -- people who work, or build, or create, by exerting their minds. Knowledge workers are a diverse lot. In fact, that is one of their characteristics. But

there are some attributes that they share. They are tolerant of ambiguity, change, and uncertainty. They may welcome or even initiate change. Knowledge workers are problem solvers. They are self-directed in carrying out their responsibilities and they are creative, imaginative people. Perhaps most to the point, knowledge workers possess and apply expertise. They work by using their minds.

With workers like these we are going to need technology solutions like we've never seen before. It's time for a change in the way we use technology to manage an enterprise. It must focus on the support of the knowledge work force. Before we talk about managing a knowledge work force, let me mention that the managers, the smart ones, are becoming knowledge workers themselves. We read about AT&T, General Motors and other corporations that are resizing their operations. A recent article in *Fortune* magazine on management in the 1990s states that the managers who survive downsizing will be those who tangibly improve the company's products and profits. Managers will spend less time looking over the shoulders of their staffs and spend more time adding value. The managers as well as the troops will possess and apply expertise. With knowledge specialization we are moving to a flatter organization. Communication is increasingly horizontal as knowledge workers and managers confer with their peers in different areas of expertise throughout the organization, thereby enhancing the time value of information.

Our management environment is changing. We're moving from an environment where the manager is controller to one where the manager is a facilitator and enabler. As our organizations are flattening, we are moving from vertical to horizontal communications. We aren't giving and receiving orders as much as interacting in a collegial and consultative fashion. Rather than closely supervising our knowledge workers, we increasingly find that they are a self-directed and self-motivated group, and our environment is becoming more complex and less predictable. We live with change, ambiguity, and uncertainty. I see these as positive changes which can free us to do our best work, our best knowledge work.

Managers must be team-builders. At The Travelers our technology focus is not on the productivity of the individual so much as the synergistic productivity of teams of knowledge workers. The members of a manager's team may be at a

distance from each other or work at different times. The manager must be able to facilitate interaction within his or her group. Being a facilitator doesn't stop there. If the organization is successful in attracting top talent, managers will find that their knowledge workers' expertise will surpass their own in some areas. Smart managers will work at enabling their staffs to use and apply their particular expertise. Knowledge workers will also be communicating horizontally with their peers in other areas of their organization. The manager will be coordinating horizontally with managers in those areas. Finally, managers need skills that allow non-hands-on management. If we need to look over the employee's shoulder to know what he or she is doing, we're in trouble. We need to establish performance objectives and be able to communicate and to listen. Perhaps most importantly, there must be an atmosphere of mutual trust.

Let's move on to some trends. Right now the data processing industry is in a period of transition. It's not just a soft market. We are in a period of transition from a transaction processing environment to an information processing environment. We believe that toward the end of this year the application of technology will begin to accelerate again at an unprecedented level and will sustain that growth for the next decade. We think the technical catalyst generating the momentum for this growth will be the 386 chip (the one megabyte computer chip in the personal system that IBM has just announced) and the IEEE network standards, coupled with success of local area networks (LANs), LU6.2, which is the protocol being established for peer-to-peer communications, and the availability of large bandwidth at very reduced prices. Image and voice subsystems lag behind, and expert systems are only beginning to emerge. We believe advancements in these important areas will be rapid. What do these technologies mean to us and our customers?

We believe that technologies will let us focus, for the first time, on improving peer-to-peer communications and, further, leveraging productivity. In other words, information and communications exchange not only between the machines, but even more importantly, between knowledge workers, at home and in the office, will be so pervasive, so leveraged by expert systems, and so synergistically integrated to voice and data communications that it will provide us with a qualitative leap in our capabilities to manage and operate a large complex service organization with a razor sharp focus on customer service. At The Travelers, this year is our year of customer service. The whole corporation is

focusing on just that one issue. We believe these technologies will enable us to differentiate ourselves in the service arena through the provision of high-quality communications and distribution of knowledge expertise, both internal and external, to provide expert service to our customers. As Hank mentioned, we've seen exponential growth since 1965. Right now, IBM is testing the four megabyte chip. We started with one transistor on a chip in 1965 and now we are at four million in the very near future. By 1990, I think that number will be one billion. In the October 1985 issue of *The Financeer*, Roger Smith, Chairman of General Motors, was quoted as saying, "Total integration of computing communications and database technologies is required for U.S. corporations to compete in the 21st century. Companies that want to compete have no choice but to develop a total systems approach linking engineering, marketing, financial and manufacturing, with no chance of divorce." Roger Smith is right on the money. The key concept is a total systems approach -- total integration. Roger Smith is not talking about technology for technology's sake. Read his article. Smith is talking about GM people, the GM management process, and GM customer service.

These two trends represent our fundamental belief. My first point is that the thrust of office automation is misdirected. It has been directed toward clerical or labor intensive productivity. That's not where the real benefits are -- the real benefits come from increasing the productivity of the professional employee. The Travelers' thrust is directed toward office communications -- not office automation. Using technology to improve communications among knowledge workers has leveraged their productivity to where the real payoff is. The second development trend we see is the electronic marketplace. The competitors in the financial services industry are increasingly using technology as a competitive weapon to distribute products and services electronically.

A demographic shift has been under way in our society for well over a hundred years -- from a society of farmers to a society of knowledge workers. Robert Kelly says that "gold collar workers will be 60% of the work force by 1990." At the same time that this shift in the knowledge work force is taking place, we will be seeking the best people among increasingly scarce qualified workers. We're looking at more competition in the growing marketplace. Tax reform and deregulation are going to lead us to a more rational competitive economy -- one which will accelerate the creative application of technology to benefit society. The focus of technology will be the consumer, and it will key off large scale

computer communication integrated with customer information files and linkages for electronic distribution of products and expert services to retail locations and into the homes of the customers. Increased competition and an information-rich society will probably drive us from market pricing to cost-based pricing. All that really means is that you can't survive by simply being the low cost producer. Low cost, high quality production service is not an objective. It's a given. Companies can no longer overlook the fundamental changes that are occurring in the demographic profiles of their organizations. Technology is changing the infrastructure as we move from a clerical work force to a professional work force, from people management to technical management, from administrators to knowledge workers, from vertical to horizontal management. This demographic change has very significant implications from a technology point of view. Vertical communications are being replaced by horizontal communications.

This brings me to a point that is central to what we are doing at The Travelers. The thrust of technology must focus on technology to improve communication among knowledge workers and leverage their productivity. Moreover, the focus is not only on the productivity of the individual, but rather the synergistic productivity of the teams of knowledge workers. Here is a very graphic example of what is happening at The Travelers. What has traditionally been a large clerical work force is changing rapidly to a professional work force. We are becoming a company of knowledge workers. The skilled knowledge worker is increasingly becoming a scarce resource. As we move into the 1990s there will be fewer new entrants into the labor force. Young people ages 16 to 24 will not only be a smaller proportion of the labor force in 1995 but are projected to decline in absolute numbers. The Bureau of Labor Statistics has projected the 1995 labor force several times since 1980, and each projection has resulted in a progressively lower 1995 labor force estimate. The problem is compounded because the basic skills of applicants are continuing to deteriorate. Given the skills our positions require, which go far beyond the simple ability to read, write, and compute, we are facing a serious shortage of future qualified knowledge workers. At the same time, our need is growing. Between 1986 and 1995, jobs will increase 50% faster than the labor force. Jobs in the service industries are growing three times faster than jobs in the other sectors. The fastest growing occupational category is professional and technical work -- that is, knowledge work. Consequently, the shift to the knowledge work force at The

Travelers is happening at a time when we are having to compete for top people among increasingly scarce qualified workers.

An important issue that's related to the development trends we discussed a moment ago is competitive cost dynamics. Competitive cost dynamics is a very difficult equation and perhaps not fully understood. And it is one of the reasons that we are in a period of transition. Improving technology, such as the introduction of expert systems, is introducing a new era in information processing which will bring about a qualitative change in how we use technology to manage an enterprise. It is important to understand this phenomenon. The qualitative change lets us focus on the changing work force -- the demographic shift to knowledge workers I just talked about. I will mention again that our requirements for greater skills in the work force come at a time when skills of applicants are deteriorating.

Historically, we have focused our technology on the trees -- the transaction processing systems, like a claim system. And we have all done a good job. The focus of office automation, however, has been on the branches -- peripheral clerical productivity. And it has been less than effective because it has been misdirected. In many companies, the major transaction processing systems themselves have been automated, leading to the reduction of labor intensive clerical activity. Additionally, an increasing percentage of transactions are being captured electronically, computer-to-computer from sources outside the enterprise. This allows for the efficient capture of new data at the source. It is cheaper to capture and transmit more data items and storage costs are decreasing, so our data bases grow, providing more data to create better decision support tools, which in turn stimulates more effective information processing and a demographic shift to a knowledge work force. With this reduction in clerical activity and growth in knowledge activity, it is now time to step back and to focus technology on the forest. In other words, focus technology on an enterprise vision: to support and further leverage the knowledge work force, to get our products to the market, and to provide expert services to our customers. Better information per se leads to improved profitability and enables greater investments in product integration. But here's an important point. The time value of information is increasing. Therefore the pace must quicken. We can't afford the luxury of sharing information up and down the bureaucratic vertical hierarchies. With the trend toward greater knowledge specialization, it is

essential to facilitate the sharing of information peer-to-peer, across the whole organization, with knowledge specialization. It has got to become a team effort. Technology and competitive cost based pricing will level the playing field in terms of efficient transaction processing. With a level playing field, the key differentiator will be value added in terms of higher quality information-based products and services.

A point which I would like to harp on is that paper can and should be eliminated. The cost of moving and storing paper is expensive, but more important, it is a grossly inefficient way to communicate. Voice communications, voice annotation, and voice synthesization are preferable because they are simple and much more information can be transmitted effectively through a voice message. We are testing voice and data integration for voice applications at The Travelers. Through voice annotation of text documents, electronic mail documents can be responded to with voice messages. Through voice synthesization, electronic mail text documents can be read and translated into voice sounds. Something we must keep in mind as we develop information technology solutions for the knowledge work force is that we can't just automate an activity as it exists; we can't just go through the same motions electronically that we have been performing manually. We must rethink activities and processes and apply technology to them creatively in order to really transform the work, so that we are getting full benefit of applying information technology. In the environment I have been describing we must continually strive to enhance the effectiveness of information communication.

Our approach is enterprise communications -- using technology to improve communications among knowledge workers and leverage their productivity. The work station is the knowledge worker's technology support tool, where user applications reside. It is from the work station that the knowledge worker has access to host power resources and data bases. In the near future intelligent work stations on the desks of knowledge workers will be as powerful as the host computers of the early 1980s. Knowledge workers will have access to vast amounts of data and automation tools, including expert systems technology, to perform their activities. The LAN is the communications technology we have chosen to support a collegial interaction among our knowledge workers. Our applications require reliable high speed enterprise communications networking to support our knowledge workers. We've decided to use the LAN to support

electronic mail and messaging and to share word processing, spreadsheet, product management, and administrative management work files. The LANs are linked to our wide area SNA network, which provides alternative paths through the network for backup and recovery purposes. The wide area network interconnects over 35,000 terminals, including more than 16,000 personal computers, with host computers in our data centers. It supports our knowledge workers with voice, data, teleconferencing, and some video. It provides interfaces to voice mail, automatic call directors, automatic teller machines, remote dial-a-PC, and international packet networks. All the work stations have both peer-to-peer interconnectivity and host connectivity, which means that all personnel, as well as our agents and customers, can share information and communicate easily with one another. The future looks promising in terms of supporting the growth of our knowledge work force with expert systems and increased computing power at their fingertips. Workers will find their productivity and creativity enhanced. Communications networking will be the glue that pulls knowledge workers together into synergistically productive teams. The focus is on using information technology to support communications among knowledge workers, that is, people-to-people communications.

MR. ALAN P. BLACKWELL: To start discussing expert systems, let's talk about what various groups of people are supported by what kinds of computer systems. First, we all know about administrative systems. We sell VECTOR; others exist. Companies use them to issue business, collect premiums, pay commissions, and set up reserves. Those systems support clerical people. Most of the work done by these systems was previously handled by clerks. Data base systems support managers. When the boss wants to know what happened last quarter, being able to reorganize and report the information in a suitable manner is a function best handled by a data base.

Finally, we get to expert systems and decision support systems. These systems support professionals. The popular examples of decision support systems for actuaries are the 20 or 30 asset-liability matching packages on the market. And you've heard a lot of mention today of the expert systems that exist. The one you see on television helps doctors make diagnoses. As another example, Campbell Soup became very concerned when the chief chef who cooked the soup in giant kettles was about to retire. They hired Texas Instruments to produce an expert system to make sure that future chefs would cook the soup in the same

fashion and it would all taste the same. Expert systems relevant to insurance include systems which support life underwriters, advise on stock and bond portfolios, support health claim adjusters, and support worker's compensation underwriting and claims. With this list of current experts in mind, let's look at how they work, how they are developed and what types of expert systems there are.

How do expert systems work? They are based on heuristic techniques. I can loosely define that as an exploratory problem-solving technique that utilizes self-educating techniques such as evaluating feedback to improve performance. The best example is from the recent movie "War Games." The computer learned to play tic-tac-toe. That's a heuristic technique. Expert systems are data driven rather than program driven. Schemata are developed that respond by outputting other data, based upon the interpretation of data received. If the incoming data are such that several schemata could be generated, an inference engine is developed that uses pattern matching to determine which of the several schemata are to be used and in what order. Hank showed you an example of an inference engine earlier. The idea is to attempt to duplicate how people operate, rather than force people to duplicate how computers operate. As the data force various rules to fire, an opinion is developed. When all the various schemata, heuristic rules, and data have gone through all the necessary convolutions, suggested results are obtained, such as, "Get an APS from Dr. Smith," or "Request a death certificate for claim #12347."

How are expert systems developed? For PALLM, the major task was hiring away an artificial intelligence (AI)/expert systems professional to work for us. The main technique used to develop expert systems is interviewing the experts. Standard references are used to develop a small, crude body of knowledge. Several experts are interviewed in a manner such that gaps in the body of knowledge are gradually filled. The use of many experts improves the validity of the system under development. The computer-based expert system is created in conjunction with the expanding body of knowledge. Complex input requiring finer areas of judgment is tested and refined. Some areas require subjective judgment. The interviewer relies on one person at that stage. This process is continual, as schemata and heuristics are added and the body of knowledge changes to keep up with current happenings. Most systems are based on the computer language LISP, which is short for list processing. The source code is

such that there's no real structure that could be shown by flow charts. I talked to our AI man about this because I was very accustomed to using structure charts, since I work a lot in the mainframe environment. Without them, we have severe problems. He said you could do flow charts, but you could never trace the flow once you had them all set up. Occasionally there is a need for computations in the expert system. When this need arises, it is normal to go outside LISP and use a more conventional language to perform the computation, such as C. By the way, this gives us an expert system that duplicates what a person does, but still calculates faster. On the horizon are computers being developed as neural networks so that the computers act more like humans. A neural network sends data simultaneously to several neurons that are programmed to take the inputs and provide outputs to continue along the network. It's not the same process as a very few items of information coming in and simple things coming out. The analogy would be closer to a transistor or a group of transistors that have a computer at each step along the way. It's definitely not the same as parallel processing.

What kinds of expert systems are there? Most expert systems are classified as active or passive. The passive system can best be described as providing peer support. The budding professional submits the particulars of a specific situation to the expert system, and the expert system suggests actions to take. This allows a professional to treat the system as a helper. Active systems make decisions. They direct needed inputs, actions, and results. Active systems would replace people rather than help people. Bringing in expert systems to replace people is a very political issue in most companies. At this stage, most companies indicate that their systems are indeed passive.

With this background I'd like to briefly discuss one expert system that I have knowledge of -- my company's workers' compensation underwriter expert system, PALLM CUE. The CUE is for "commercial underwriting environment." If you are not familiar with workers' compensation, it provides compensation for loss-of-time plus some accidental death and dismemberment that arise from industrial accidents. It's like group in that it's sold to an employer to cover the company's employees. Rates are reviewed often. In lots of ways it's similar to group, but with no underwriting. The system takes information about the industry, payroll, past history of claims, building inspections, safety, exposure to catastrophic claims, and other data that affect rates, and suggests further

actions to be taken, such as inspecting the buildings again but this time for toxic waste. CUE also offers advice on whether or not to take the case, and what rates to offer. The system is passive and is intended to help the professional workers' compensation underwriter. PALLM interviewed several underwriters in the development process, and we have one currently on staff to make the system more robust and more like an expert than an apprentice. The process of developing expert systems is very complex, and it's easy to make mistakes. We have the remains of an issue work station in our expert systems area that was used to mimic the process. In that case, we attempted to go through the process: bring in the application, have equipment read the printed application, and go through the underwriting process all the way out to issue. The vendor of some of the original hardware has since gone out of business and there were additional complications along the way. Developing an expert system is very tough to get started and very money intensive.

Let's go on to the impact of the expert systems on people. The normal reaction is to assume that when an expert system is purchased, the professional will be displaced. That's just not true. Currently, experts systems are in their infancy and require very careful salesmanship. It would be politically impossible to bring in a system to replace existing staff professionals. Over an extended period of time, it would be possible to replace those on the lower rungs of the ladder. This could not occur everywhere because of the need to have future professionals to interview to refine the expert system. The replacement of some people at lower levels of training does imply that in order to avoid menial work, more education will be required than in the past. Both of the previous speakers mentioned this. It also implies the need to reeducate displaced workers. Because active systems can make decisions, expert systems could take a vast chunk out of middle management, most of whom have achieved middle management status from a professional, technical background. The best hope for impact would be for expert systems to relieve the professional from the complex but mundane parts of the job, so that the professional could invest more time in being creative and expanding the horizons of his or her profession. I am sure all of you would rather be working on the next product after Universal Variable Group than trying to figure out how to program the current variable product you have right now. There is another more subtle impact on people. That is when the boss realizes that clerks can run the computers that drive the expert systems, and fires all the experts. After this occurs, let's assume the system makes a

clearly bad decision -- charges term rates that are less than half of what the qx is. The expert who would have caught the improper answer is gone. Should the clerk operating the system be expected to spot such unacceptable results? Should the boss catch them? Who is responsible? It's a tough problem with no obvious solution.

Finally, I'll describe some limitations of expert systems as well as a couple of benefits. Expert systems can't learn -- yet. Despite claims to the contrary, my resource person at PALLM is adamant about this fact. The example he gave was an AI system that was given tremendous amounts of knowledge in the physical sciences and, on its own, started developing a lot of theories that currently exist. Over time it got through most of the theories that currently exist, but could go no further. That seems to be a current limitation. As a result, such systems do not solve problems that humans can't -- they're only as good as the current experts. The speed of solving problems is currently severely limited by the hardware. As neural networks are developed, this will be mitigated. Expert systems seems to be one of the few applications that still eats the hardware that's on the market. I noted that to support CUE, we have a very expensive machine, about $25,000 per user, and it still can't keep up.

A big benefit of an expert system is its training capability. As the system is working through a problem, the operator can stop it and ask why it made a certain decision. With current emphasis on everyone working smarter, not harder, this would be a boon to professions that tend to rely on apprenticeships. In our own situation, imagine the 4-exam actuarial student pricing a product through an expert system. The expert system could teach the student strategy for making the new product profitable while convincing the marketing man that it's the best thing since sliced bread. Another benefit is that the expert system can take advantage of ongoing changes in expertise. The facts can be changed, as well as the rules and even metarules (rules that control rules).

To conclude, I would like to digress from expert systems and talk about picking mainframes. There have been a number of sessions at this meeting about how to get products to market quickly. When I go in to visit clients, I find that the actuarial departments have not talked to the data processing departments, don't know that there are manuals around for the systems they are working on, and

develop their product without looking at the system to see if it fits. I would strongly suggest that for any new product you are developing, you ought to see if it's going to fit the old system. If you are buying a system, you ought to try it first. If you are buying that system for a single product, you ought to figure out whether you are going to sell enough to support that million dollar decision being made to buy the system. I don't know of a vendor yet who can really get you up and running on a major system for less than that number. The going-in rate is a lot lower, but it will easily cost a million by the time you are done. You also need to look at the ease of change. Nobody's system is going to handle everything that's on the market. It gets down to how easily and how quickly you can go in and modify the system to fit what you have now.

MR. CARL J. STRUNK: To utilize some or all of this new technology that's currently available today, let alone in the future, are companies limited to buying one or more of these expert systems? Or are we forced to hire a tremendous number of new computer programmers?

DR. BRINK: There are a large number of software houses working on expert systems that, in essence, are expected to do about 80% of the job. If you are looking for an area for competitive advantage, you probably will add the other 15%. Secondarily, there are decisions to buy or to build. When I go into a company, I may see as many 13 specific, unique individual life insurance processing systems. The product revolution has caused horizontal proliferation. You cannot get commission statements or reports that make any sense or that are synchronized. So there is going to be a major replacement. You either are going to have to build, or buy and modify, because very few of those systems, except in the very simplistic situations, are going to fit in as a drop-in. You're going to have to add to your inventory of specialists, who will have to be more qualified. Also, you will find more and more of the large companies that, in the past, built everything from scratch, now buying. There are not a lot of NIPPONs sitting around that will spring for $390,000,000 off the chart. By the way, they expect to recover their costs in less than four years. So it's not a spaghetti throw -- it's a very calculated move on their part, driven primarily by competition from the large Japanese banks. They were not driven by the insurance carriers. Every one of the secondary insurance carriers is scrambling all over the U.S. looking for a system they can put in place in a year and a half

and which will not cost $390,000,000. By the way, to build from scratch is enormously time consuming.

To return to your question, you will have to invest in programmers and expert systems people, because even if you buy a system, the uniqueness will come from modification.

MR. BALEDES: We have been working with expert systems for a few years now. Expert systems currently are PC or microprocessor based and aren't too prolific on the mainframe or host computer. There are affordable structural building block tools for expert systems on the PC. You don't hire programmers. Expert systems require knowledge engineers, people who can understand how a particular decision-making process is performed and what rules are involved in any particular problem and who can structure the "expert" into a set of rules for managing the data exchange. A knowledge engineer is a logician and not necessarily a programmer. It's not that expensive to work on expert systems in your own operation; by spinning off a few people and identifying a problem you want to solve, it's less than a $50,000 investment.

MR. ALBERT K. CHRISTIANS: Looking at the facts presented, the question that immediately strikes me is, with seven orders of magnitude improvement, who has gotten the benefits? In addition, if we are going to have increasing numbers of knowledge workers, increasing orders of magnitude, and increasing efficiency of systems, does that mean we will have orders upon orders of magnitude increases in output within our industry? Is it going to be a one hundredfold increase in the amount of insurance produced in the United States? Who will get the benefits of all this productivity? It appears to me that there is a very large capital investment and that the so-called competitiveness you mention does not necessarily benefit the consumer. Take American Airlines, which is now using these decision support systems not to produce more efficiently or service the consumer better, but rather to discourage competition in markets where they essentially have a monopolistic control and to determine what the traffic will bear in terms of airline fares. The competitive force drives them to look at anything they can do to improve their particular situation and to recover their cost of overhead in building these giant systems. It appears that there is not necessarily any benefit in all of this. I wonder if you think this is going to

shape our society in a way that is going to actually improve our satisfaction with what we produce? And who gets the benefits?

DR. BRINK: I don't accept your premise that you haven't benefited from it improved technology. The problem is that nobody has gone back and figured out where we would be today if we didn't have it. So the premise is one that I don't accept. Second, I just flew from Atlanta to Los Angeles and back from San Francisco for $318.00. I flew on Eastern. I didn't fly on American. What I said earlier was that because Braniff had decided not to invest in technology in the correct arena, it became a disadvantage to them. It was not American Airlines' responsibility to provide them with equal access to American Airlines' system. Braniff made a conscious decision to use American's system. Now there is a competing system called APOLLO, which is run by United. And Delta and Transamerica just went together to form a system. I said that you're at a disadvantage if you don't have access to the points.

Think of universal life. If technology weren't here, if the banks were still where they were and they took regulation Q off, which was the one that restricted interest, and if you didn't have technology, the insurance industry would be selling term today. There would be nothing left. This is just a hypothesis -- a creative actuary would have done something else. I'm just saying that the money would have flowed.

As for the question of whether or not society is benefiting from it, I don't know. If you didn't have television, if you didn't have microwaves, and if your car didn't talk to you, would you be worse off or better off? I'm not too sure. But my general premise is that for the most part, the forms of technology that are offensive to society tend to phase out. In general, there are some abuses, but the competitive use of technology is, I think, generally good -- if it's controlled. Regulated too much, maybe it's bad. But over any period of time most of us can get out of the way of it if we don't like it.

MR. BALEDES: I remember over 30 years ago when I was younger and I was driving in my 1951 Ford with hydraulic brakes, AM radio, and manual gearshift. It was really great, and I wish I could have those days back again. But then when I get into my car today with the computer-assisted automatic drive, cruise

control, and temperature control, I sometimes feel I've spoiled myself, but I think I've benefited from that technology.

As an actuary there's nothing more cleansing to my mind than to think that we could all go back in time to the simplicity of developing rates for single premium life or ordinary life. Think of today's equity-based products, like universal life without automation: the overhead charges would be enormous. Stop and think about group health claims processing and dental claims processing without computers. Do you think that the employees or the employers could have afforded the escalating human resource cost over the last 20 years? I doubt it. Again, this relates to changing to the knowledge work force. Stop and think back to how health claims were processed 20 years ago, to the Explanation of Benefits, which was somehow being transcribed -- by, hand maybe? Think about the person, the health claim processor in those days, making $3,500 a year. Today's cost for a health claim processor has quintupled. I don't think the cost of processing claims this year has quintupled over what it was 20 years ago. At The Travelers it has declined, because we have very effectively automated our claim processing system. The number of claim processors per claims processed has dropped enormously. But what's coming up on the other side is patient advocacy. We started a couple of years ago with 25 nurses helping indemnity plan employers to manage the surgical portion of their benefits. Employees call and have a nurse act as their advocate, making sure that procedures are being applied in the most cost effective manner. Right now we're expecting those 25 of a few years ago to increase to 2,500 nurses across this country, acting as patient advocates for our indemnity group health plans. So that's the increase of knowledge workers. I think that the American public would benefit from a patient advocate. As for using technology, expert systems will support these nurses. I think there have been a lot of benefits from technology.

MR. BLACKWELL: Both gentlemen mentioned the upside of being able to sell universal life and variable life. Maybe you're viewing it from the downside. At our company we've had to spend an enormous amount of effort supporting universal life and variable life. We've also spent an enormous amount trying to support universal life reserve calculations, Section 7702, and annuity tax regulations. I agree that's the downside, but I think it's our own fault for letting the

regulators force us down that path. So I agree that technology has been mostly beneficial.

MR. DAVID P. ROSENBERG: In our firm we use a mainframe computer and we use microcomputers as input devices, that is, micro-to-mainframe transmissions, in order to run large calculation programs. We're in the process now of introducing LANs and we're very much interested in the notion of taking some of the programs that run on the mainframe and downloading them to the micro. We believe this will offer significant savings in computer charges. This is money that's going to stay in the local operating unit, so it's a subject that's dear to the hearts of many of my colleagues.

MR. BALEDES: Ignoring the political aspects, there are currently two schools of thought concerning computer technology. There is the advocate of the two-tier system and the advocate of the three-tier system. In a two-tier system, the intelligent work station on a knowledge worker's desk is one tier of information processing and the mainframe is the second tier. The three-tier people believe in the departmental computers -- the minicomputer acting as a middle tier between the mainframes managing large data bases. Departmental computers support the applications and requirements of a subgroup of people within an enterprise, and the intelligent work station at a desk supports the applications of the individual. We at The Travelers believe in the two-tier approach. We believe that the intelligent work station on the knowledge worker's desk has now, and will continue to have, increasingly the power of mainframes. Also, the LAN will allow communications among groups of people who have good reason to communicate with each other. Within those intelligent work stations will be applications that make better sense in that processing environment than in the mainframe environment. Downstream, the mainframe environment is going to be basically managing data, providing data and providing power resources. Most of the application processing, I believe, will be in the knowledge worker's mainframe on his desk.

MR. BLACKWELL: We purchased the asset liability system we have from a consulting firm that was using it in a time-share environment. We have since rewritten it into a micro-based version. We're getting a tremendous amount of interest from that same consulting firm to move the diskettes to their local shops. Of course, we are having some political problems because they have a

service organization. Our experience has been that we end up selling the systems through the data processing people with advice from the chief executive officer. Only if we force the issue do we manage to get professionals in on the decision. Hence, the data processing professionals are controlling the decision, and most of them want to have a mainframe shop. Right now it's a very political issue.

DR. BRINK: If the question were to be stated, "Are the personal computers increasing in power and are things running on the mainframe today that can be offloaded to the personal computers on a more effective and efficient basis, cutting down on line costs or giving better access and better response time," the answer is definitely "Yes." If the question is, "Can you take a bunch of personal computers and connect them by a local area network and effectively eliminate the need for the large computers," in general the answer is that you can do it, but you had better have some rocket scientists working on it. Second, once you get finished with this thing, it's liable to look like a spaghetti throw, because most people don't understand where they're going architecturally. They develop one thing and then another thing, and then they want the two things to talk together. The next thing they want to do is to put in some exotic machine which doesn't fit with what they're doing. The Travelers is a bastion of technology on the North American continent. They are really elegant in their use of technology, investing heavily in it and in people who spend a lot of time researching where it's going so that they don't buy themselves into a corner. Putting together LANs in today's arena takes rocket scientists. Connecting them is easy. Making them work, doing the work, sharing information, sharing data, sharing scarce resources, and putting communications on is nontrivial.

MR. CHRISTIANS: Most of what was discussed here was oriented toward the future. I have a specific question for Dr. Brink. His company does not comment on future products. How can we plan for the future with the largest supplier of technology not telling us what's coming?

DR. BRINK: Part of the problem is that in many instances, technology moves too quickly. If I discuss specific products with you, you invest rather heavily in them, and then those products don't come out the door because they've been

made obsolete by competing products within the IBM Corporation, then you feel disadvantaged and we end up getting sued.

Beginning this year, we have had a series of conferences and institutes at which time frames have been divulged and functionality has been divulged. I don't believe anybody has committed to cost structures, because prices on products are set by the IBM Corporation within a very few hours of the product being announced. Costs are a function of where we're going and what we expect in the forecast, competition, and everything else. We are in a more competitive market than earlier. I think the generic reason is partly why I'm here today, attempting to say "Here's where it's going." Any company that is an IBM customer can, through its IBM representative, request briefings on technology. You can visit the plants. One of the things that Mr. Brophy does on a regular basis is visit the technologists of the corporations, not only IBM, but also AT&T. We wish he would only come to IBM, but that's not the reality of things. I think the vendors would be willing to share with you, in essence, their directional statements. They won't tell you color, size, or exact dollars, but they will give you enough direction to help your planning process. I think that since we are no longer as big as we once were in relation to the size of the pie, we can go ahead and open the doors. You will find that more of that is done.

Second, there are a large number of services in the United States that do nothing but watch IBM -- the Yankee group, the Gardner group, and many others. You don't have to necessarily be that intense -- sometimes we wished they'd be a little bit more kind to us. We're just trying to struggle along, just like the rest of the world. But you are right about the problem. What we find is that too often the client, YOU, are not willing to invest your time to understand where the industry is going. The IBM representative in the field has access to a large venue of information to help you understand where the industry is going in relationship to who you are and what you want to do. So I think the information for planning for the future is available. It's getting to be a more open arena, and if you read *Computer World* or any of the other publications, they know in advance what's happening. In fact, there are an awful lot of IBMers who, if somebody found out where the information came from, would be destroyed.