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# COMPUTERS AND TECHNOLOGY—WHERE ARE WE HEADED?

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How will computers impact the environment in which actuaries conduct business?

Changes in technology which could feasibly be implemented over the next 10 years are explored from the perspective of

- Internal environment
  - Actuarial Tools
  - Office Administration
  - Product and service distribution
- External environment
  - Consumer Expectation and information
  - Regulation
  - Other financial institutions

MR. A. ANTHONY AUTIN, JR.: I would like to welcome you all to Open Forum Number 15 on the subject of Computers and Technology - Where are we headed? My name is Tony Autin. I am Vice-President with the Pan American Life in New Orleans and Chairman of the Council for the Futurism section. With the directions to be given by our speakers this afternoon, and with your gracious support in the audience, we will attempt to identify the impact of computers and technology on actuaries.

Certainly, actuaries are no strangers to computers or should I say computers are no strangers to actuaries. I suppose both of those statements are correct. At any rate, over the last twenty to twenty-five years or so, actuaries have used computers to perform more quickly and hopefully, with fewer errors, that which we did manually prior to computers. We are currently in an era of broad and rapid change, some would say a period of revolution in computer capabilities. But, few would argue that it is at least a period of rapid evolution. This change is indeed influencing how we perform the services we render. But, it is also changing the services we provide and the needs, as well as the desires, of those we serve. In this session, we will attempt to describe these changes as we see them impacting upon our internal and our external environments.

Our first speaker is Josiah Lynch. Joe has been working with computers for twenty years. He has programmed in Fortran and Cobol on mainframe computers, and is currently working in Fortran, Basic, Pascal and "C"-Basic on micro-computers. He is president of his own firm, Lynchval Systems, Inc.

in McLean, Virginia. His firm is six years old and most of his staff use microcomputers as well as mainframe computers every day. He spent his first eight years in actuarial work with an insurance company and the most recent seventeen years in pension computing. His background positions him well for his remarks to us this afternoon.

MR. JOSIAH LYNCH: Thank you, Tony. Time magazine has never named a Mainframe Computer as Man of the Year, but it has named a Micro. Why? The answer is universality, and affordability. Micro is really becoming ubiquitous. I am going to talk about some of the technological changes we can expect to see from micros over the next few years, and perhaps a bit beyond that.

First, of all, what is a microcomputer? Part of it is hardware, part of it is an input device, part of it is some type of output mechanism, part of it is storage, and part of it is communications and, of course, software. Concerning the central processors, there are a variety of chips in use right now, and some dramatic changes are being planned for the not too distant future. The Motorola 6800 chip appears to be one of the most popular new chips. It was introduced a few years ago and the software is only now beginning to catch up. The IBM Personal Computer has gone from nowhere to taking 23% of the market in its first year with the 8088 chip. IBM has done wonders with a rather inferior chip, but they have some improvements in mind. Memories associated with these chips addressable by the various microprocessors, vary from 16K up to a couple of million now. Let me point out that the "K" of course, is two to the tenth power or 1,024.

The input device for micros that you see commonly is the keyboard. The typical microcomputer with a keyboard has the so-called "Qwerty" keyboard with the letters "Q-w-e-r-t-y" in the upper left. This is an interesting anachronism. The Qwerty keyboard was designed a long time ago to maximize the amount of time it could take to type consecutive letters. It is a deliberate effort to slow down the typing rate because the early typewriters had keys that would jam quite easily if you struck them too quickly. A new keyboard was designed a few years back, called the Dvorak keyboard, which is getting into more and more use. Now it is possible to switch from the Qwerty keyboard to the Dvorak keyboard and back just by using a function key, or software control. This can be useful in offices where there are no trained typists. If you are going to train someone to type, why not train them on a more efficient keyboard? In a recent study of the difference between the two, it was found that during the period of time when a typist's fingers would move 16 miles on the Qwerty keyboard, they moved one mile with the same material on the Dvorak keyboard.

Another input device that is getting more prominent is the "Mouse." The Mouse, called that because of its size, fits in the hand, and is connected with the computer. The Mouse is the device that rolls back and forth - roll to the left, the cursor jumps to the left, to the right, etc. The value of using the Mouse is that the cursor can move much more rapidly. If you have used a microcomputer, or a word processor, you have probably had the experience of holding down the cursor and watching the cursor slowly trace across the screen. With the Mouse you can jump back and forth. Apple has recently introduced a computer in which the Mouse must be used for certain features. There is no way to get those features on the keyboard.

Other input devices that are currently being offered are digitizers, which let you enter digital data by moving something with cross hairs. Another

way of entering data is by using a touch panel in front of the T.V. screen. You might have seen some of these in convention centers where you touch something to indicate your response to a menued question. Last year I saw a display by the Pentel Company, that showed a form that was attached to the micro, where you simply touched various things with a stylus and what it touched was under software control, so you could touch a command, such as "print." These can be custom made for people who do not want to use keyboards at all.

The output for micros will have some dramatic changes in the future. The conventional printers in the past had a 64 character set, which included 26 capital letters, 10 digits and some other characters. Many of those machines are still in use. With the microcomputers, the two major kinds of output devices currently are the "dot matrix printer", which can have 5 x 7 or 9 x 9 or some other combination of dots making up a letter, and the "letter quality" printer. The dot matrix printer can print up to 180 CPS. The letter printers run around 40 to 45 characters per second. The letter printers have the advantage of looking beautiful. The output looks as if it was freshly typed by human hands on a Qwerty keyboard. The limitations are slow speed, and lack of flexibility. It is very hard to try to draw a graph or to try to change the type face or introduce characters that are not on the typewriter print mechanism. The dot matrix printer has much more flexibility, but the correspondence does not look as good as that which was printed on the typewriter. An ink jet printer is in the process of being introduced. A low cost ink jet printer that will have a modest speed but will have better looking letters than the dot matrix.

Attaching graphs to the micro computers is done regularly and they vary in sophistication, colors, etc. Voice output is something that is more and more commonly used. You might find yourself walking up to an exhibit in a display and it starts to talk to you. You touch something on the touch screen and it alters its text according to what you have asked for.

One exciting development that is available now and will be more available in the future is the laser printer. The laser printer is very much like a photocopy machine. In a photocopy machine, using the xerographic process, there is a three image approach. The original you put in is the first image. That image is transferred to the drum as the second image. The third image is the output that you get, the copy. Using the laser printer, the approach is to use a two image approach using software control. An image is put onto the drum directly and then that image is copied. The flexibility is quite great. In the first place, you do not need continuous form paper to get continuous output, you can use 8 1/2 x 11 paper. You can reduce the size of what you are printing. You can invent forms. You can have the standard forms under one kind of software control and the variable information under a different kind of software control and in effect, print out printed forms. The speed of a laser printer approaches that of a line printer, so that you can get a half dozen pages a minute. The greatest news in the Laser printers is cost of reduction and price. The latest I have heard is that there is a Japanese firm about to introduce one for $1200, but that sounds very unreliable. I hear there is a firm offering them in quantities of ten, at $7200 each. This is where the future of hardcopy output is moving.

In the storage medium, in order to use the computer properly, you must have your software and your data stored somewhere. The storage medium is where

there is some tremendous activity right now. The two kinds of storage are on-line storage and archiving. Right now the bulk of use of on-line storage is in the 5 1/4 inch and 8 inch diskette area. The 8 inch diskette is pretty much on the way out, although it happened to be one of my favorites. The 5 1/4 inch diskette has been described as "the worst 40 tracks of the 8 inch diskette." But the 5 1/4 diskette is the one that is the most popularly used right now. Unfortunately, there are four different modes and they are not standard. The 5 1/4 is on the way out too.

The Japanese have developed some small diskettes, about three inches. Normally the Japanese companies saturate the whole market, perfect a product, and then the winning product is supported by the Japanese trade industry in export to other countries. But the Japanese companies are very defensive in their marketing in the small diskette area. So, as a result, they have been rushing the small diskettes to the U.S. market before they are really ready. There is no standard for the small diskettes. The 3 1/2 inch one, developed by Sony, and pushed by Sony, was introduced to the American National Standards Institute to be used as a standard. Earlier this week the Institute rejected it and said they would not have a standard at this time for the very small diskette. There is a 3 inch diskette, a 3 1/2 inch diskette, and I believe, a 3 1/4 inch one, and I.B.M. is pushing a 3.9 inch one. Do not laugh at 3.9, that is a hundred millimeters. The Sony diskette has the advantage of having a hard shell. That is, the cover over it has a window that closes. As a result, you can blow cigar smoke at it without hurting it all that much. The 3 inch diskette has the same kind of soft envelope with the exposed diskette surface that the current diskettes have. That has the disadvantage of having the same vulnerability as the current diskettes. It has the advantage of being a proven technology. One of reasons why the ANSI people did not accept the 3 1/2 inch diskettee is that it is not known how the hard shell will work out over a long period of time.

Beyond the small diskettes, there is the new process called vertical magnetism. On the current diskettes, the magnetic particles are aligned in horizontal form like railroad cars, and under the vertical magnetic approach, they will be standing up on end. The vertical magnetic approach is about to be brought to the market. There is one company that is so sure that this will be very popular, they have spent a great deal of money on it and they are in the process of building a machine to make them. The machine is 50 feet long and weighs 35 tons. It is a very difficult process. The coating has to be put on very carefully. The advantage of the vertical magnetism is that it increases amount of material you can put on diskette by a factor of 10, so it is possible to get up to 5 megabytes on a single 5 1/4 inch diskette using vertical magnetism. The vertical magnetism, although it is a marvelous concept, is also on the way out.

In my opinion, the true wave of the future in the storage devices is the Laser Optical Devices. The Drexler Company has a facility to manufacturer cards the size of a credit card by the billions. They have developed a process that will coat a card similar to a credit card with a coating that will have little holes burned in it with a laser and can be read by other equipment. This card can hold 2 megabytes of data. It is not reusable, but for shipping software, for shipping files and for maintaining files that should not be changed, there is a fantastic potential. On the larger optical disks it is possible to get up to one gigabyte, or one thousand megabytes on a single disk. It would be erasable and updatable.

The greatest action in microcomputers in 1983 is going to be in the area of local area networks which, linking microcomputers and work stations with each other. On one desk in a network there may be nothing but a terminal, no storage medium at all. On another desk there may be a printer. On another desk there may be large, hard disk capable of storing 20 megabytes. Someplace else there may be a graphing machine and it will be possible to tap in at any point, and divert what you are sending to any point on that network, and have people send material to you. You can then have a large data storage area accessible by a large number of people, so that you have one single file that is always up to date. You do not have different people using different versions of the data in different parts of the company.

There are several protocols available right now. Under the base-band approach, like Ethernet, it is possible to send as fast as 10 million bits per second. At the rate of 10 million bits per second it is possible to send the entire King James Bible in 3 seconds. Under various other protocols, you have other features. For example, under the broad band approach you can have different channels, with different capacities. You may have closed circuit T.V. piped into it. But the Local Area Network, or LAN for short, is where the big action in 1983 is going to be. Another area which is getting more and more popular is communications between micros and mainframes. There is low speed and high speed access available. The future just boggles the mind.

MR. AUTIN: Thank you, Joe. We will have an opportunity to question Joe or to comment on his presentation during the second half of our session. Our next speaker is Matt Tucker, who is in charge of the computer development staff of Tillinghast, Nelson and Warren, in their Jacksonville, Florida office. This staff develops actuarial systems for the insurance and pension consulting staffs of the firm. Matt has been in actuarial and computing work for more than twenty years, having worked in insurance companies, for a software supplier, and in actuarial consulting. He is the current Chairman of the Computer Science Committee of the Society.

MR. MATT TUCKER: How will computers and the related technology affect the internal environment of the life insurance actuary in the environment of an insurance company? Within an organization that consults with insurance companies? Joe has touched on the computer hardware, so let me review very quickly what he has talked about.

Executive Work Station - This is a very powerful microcomputer sitting on your desk, which might have a touch sensitive screen, graphics tablets, a Mouse, and possibly even audio response units. These units will also have very powerful and fast communications capabilities.

Local Area Network (LAN) - This is a very high speed link for micros with access to telecommunications network with minicomputers, super minicomputers, mainframes, or even other local area networks with micros.

Word Processors - A look-alike of an Executive Work Station. The keyboard is a little different and the normal software is different. Many of these newer Word Processors have the capability of running Spread Sheet Analysis Programs, Business Graphics, and are able to fold that information directly into a Word Processing document.

Optical Disks - These are very large capacity laser encoded disks that store vast amount of information in a fairly small and inexpensive medium. The advantage to this over microfilm or microfiche is that it is readable by computer instead of just human eyes.

Well, all this hardware is nice and fancy but it seems new computers are announced every day, if not every minute. The real key is computer software. There are some newer programming languages like Pascal and Ada that some people think will replace all the current programming languages. Historically, this was said for COBOL, PLI and others!

Some new fourth generation languages allow you direct access to your data. These are relational data base systems. The network or hierarchical data bases have a much more rigid stucture and format. These fourth generation languages include Focus, Ramis II, Intellect, Ingress, and others.

General software support packages such as Visicalc or Multi-plan software are available for general use.

Several actuarial packages are available from time-sharing companies. Several are also available for purchase or lease on your inhouse mainframe or micro. In the pension area there are several packages available on micros and in the insurance area I expect there will be a great increase in the number of packages available, as micros become more powerful with greater calculation precision.

Traditionally, we have leaned very heavily on commutation functions. Commutation functions were developed when there were no micro, mini, or mainframe computers. The actuary was the computer. Commutation functions reduced the amount of time the actuary needed to develop the newer evolving plans, like whole life. With computers, we should look at the way we are really doing our work. While you might say, " a step forward," in another way, it is really a step backward.

Back to Basic Principles - Expressing actuarial calculations in the basic principles is often much easier to implement on a computer. It gives you a great deal of flexibility...but it sure makes it harder to check out.

The next logical step after back to basic principles is refinement of those calculations. Once you use a computer and the basic principle approach, people begin to ask you to make variations in every possible variable that you have in your program. That is easy enough to do, but even harder to check out.

The final step, which maybe has not happened that much yet, is an expansion of the methodology. Instead of using the mean expected value of the probability of dying as our basic underlying assumption, let us assume a distribution of that underlying assumption. To make it even more complicated, let us assume that the probability of withdrawal is distributed based upon size of policy, etc. If you think those other ones were hard to check, wait until you try to check this.

The office administration of the insurance company is changing also. Traditionally this is done on the large mainframe computers and it seems the Data Processing Department takes forever to make the system not do what we wanted it to do in the first place.

In the product distribution area, several things have come to live with us. Ten or fifteen years ago, proposals were rarely produced. If it took two weeks to produce a proposal that was expected. Now they are needed, at least according to the Agency force, for the sale of the product. This is at least partially true of the traditional product, but the newer products do make proposals a necessity.

Much disclosure information is needed, I expect that the amount will not diminish in the future, as I have not ever seen that happen in the case of the legal environment.

Servicing of the product by the agent and how he deals with his clients, as well as how he prospects for the new business is also changing. We in the Actuarial area are involved in this area much more often in today's environment.

As an example, I will go through the product implementation cycle of a new product. The first step in product implementation of a life insurance product is experimentation. Experimentation for a product would be done most probably on a powerful microcomputer, linked to a local area network. The microcomputer will be a fairly powerful one or our patience will be tested. The actuary doing this experimentation develops statutory cash values and reserves for this plan on either in-house developed software or software acquired from an outside firm. The product would be profit tested using either in-house developed software or out-house developed software. During the experimentation process on the microcomputer, it might well be that a composite or a limited model on the particular plan is run to see what effect it has on the profits of the company. Both the before tax and after tax profits are quite important. Finally, someone decrees, "Yes, this is a product that this company needs. It has appropriate profit margins. The commission scales are high enough. Expense margins are fine, and so forth, so on to development."

Next step is the development stage for this product. In the development stage, you run your final set of experimentation runs. You want to document exactly how the product is priced, and what was included in the product. Using your electronic mail system you send mail through the local area network to a word processing station. This electronic mail is read by the person on his word processor. You request that he retrieve a policy form that was done in the past and has been stored on an optical disk. You want to make minor changes in that document resulting in your new policy form. The person at the word processing station then calls up the policy form that you specified from the laser disk over their local area network, makes the changes and runs whatever other tests are necessary for the policy form, such as a Flesch test. When they finish with their work, they respond to your electronic mail message that the policy form is ready. You can review the policy form at the screen of your microcomputer or you can request it be printed on their printer. While this is going on, someone is assigned the task of calculating the necessary statutory cash values, reserves, gaap reserves, gross premiums, waiver of premium rates, ADB, etc., for every issue age that the company ever hopes to issue. You have now finished the product development stage.

Next is distribution. The actuary is likely to be involved in the distribution process at the initial stages. An actuary might be heavily involved

in the production of whatever proposals are necessary. For example, you may use a network with the agent dialing in, or a hand held computer with a plug in ROM (Read Only Memory). Or, you may use one of the new legal paper size computers that has a full keyboard, and up to eight or nine lines with fifty or sixty characters of display on the screen, a small graphics printer, and a microcassette unit, all for less than $1,000. The actuary is involved in all of those areas determining what type of proposals are needed in the distribution of this product. He will also be involved in the disclosure information.

The final area of product implementation is administration, not only home office administration, but also field office administration. Microcomputers are likely to play a very large role in both home office administration and field administration. Some companies, probably some of the smaller ones, will explore the possibility of using the "cottage industry" approach for administration of insurance policies. The idea is to have several microcomputers tied together in a local area network and the responsibility of the group of people in this area would be to fully administer the policies belonging to a specific set of clients. It is very possible that this approach will be implemented in some companies, possibly on special products that are developed. One of the advantages that might come from this would be the feeling by the consumer that they are not dealing with a large insurance company but rather they are dealing with a much smaller unit, which they seem to relate to much better.

What about the external environment? Externally, sure enough, things are changing.

Consumers seem to expect much better information from us in the insurance industry, as well as from everyone else. They expect, and get, a much wider range of choices, sometimes more than probably is appropriate. I expect the micros or the availability of networks to increase this even more.

The regulatory environment has been relatively under control until recent years. Traditional products were relatively easy to regulate. With the newer products, the flexible products and Universal Life, the regulatory environment will need a much higher use of computers in doing their daily work. The Federal Income Tax area is a very important aspect to the entire operation of a profitable life insurance company.

Other financial institutions certainly have not been standing still as these microcomputers have come about. I expect much more competition from these financial institutions, and there are quite a few services already available. Most of these are dial-in services to get information. Tying into home computers is one of the steps that will be taken in the very near future and it is likely the cable TV outlets will begin having significantly more commercial channels. In home marketing you can dial into some of these networks for practically anything that can be sold that does not violate FCC rules.

MR. AUTIN: Thank you, Matt. Matt and Joe have shared with you their well-seasoned perspective, each having worked closely with computers and related technology in a hands-on mode. My role for the next few moments will be that of the futurist. I will try to bring us a bit further into the next ten years and perhaps also help to sharpen our focus on changes which have already been brought about by computers and technology, but have not yet been recognized by the profession.

How would a futurist look at this question of the impact of computers and technology on actuaries? To answer this question we must understand something about the perspective of futurists. They would, to begin with, say that the future does not really exist, in a sense; it merely needs to be discovered. Rather, the future is in the continual process of being invented. It will be the result of actions taken by people and institutions, by governments, and by loosely associated networks of persons.

In the short term, much of what will determine the future has already occurred or been decided. This provides opportunities for the typically extrapolative tools and methods of actuaries. The further we go out in time, the more that future events and decisions will be the major forces on the future, the less predictable are the outcomes, and the wider is the spectrum of events and people which will impact upon the specific future which we are examining. This speaks of the clear need to supplement traditional actuarial skills and schools with judgment, with opinions from relevant experts and with new tools capable of dealing with uncertainty.

Here are some of the things experts are currently saying about computer trends.

> There is a general concensus that price/performance ratios of computers will continue to improve at the rate of 22% to 25% through the 1980's, with an even faster rate in the late '80's for the cost of communications.
>
> It is estimated that 60% of the U.S. white collar work force will be direct users of information systems costing less than $10,000 by 1990.
>
> It is said that it is much more important for us to begin the work of discovering the information most useful to important classes of users than it is to understand those parts of a professional's current job that can be automated.
>
> While we will see first generation voice and image recognition technology in the 1980's, their application is unlikely to approach the discretionary cost threshold level until well in the 1990's. What this means is that we will still have to have people programming those machines. We will not be able to talk to them and ask them to do something for us.
>
> By 1990 the banking industry has predicted more than 90% of their transactions will be carried out electronically, as opposed to 3% in 1980. Banks will be delivering a service to our customers, placing a demand upon us for similar services.
>
> A second generation of computerization is now in a test phase in New Jersey, under the acronym C.A.A.P. (Computer Assisted Approvals Process), with the objective of improving the speed and quality of the review of life and health insurance policy forms and rates.
>
> Here is a note from a newspaper article: "A computer has come to the aid of the personal injury lawyer, helping quickly to resolve settlement disputes that might have dragged on for weeks, months and even years. The computer is operated by a new company called "Telephone

> Economics" which can tell attorneys, within minutes or at least within hours, the value of a client's loss in personal injury and wrongful death cases, by sorting out the complex inter-relationship of such factors as economic trends, wages, life expectancy." Nowhere in the article does it suggest that this was being done by actuaries.

This preceding collections of notes was compiled from recent industry publications and news articles about our industry. What then can we say about possible futures for actuaries in the balance of the 1980's. I believe such possibilities include the following:

> 1. State filings of forms and rates via telecommunication links between your computers and those in state insurance departments. Certainly our current flurry of product development activity is pressure enough to do something like this.
>
> 2. Transmittal of sales disclosure or sales promotional data directly to an applicant's mini or micro computer, where analysis or competitive comparisons could be done using rented, commercially available software.
>
> In the last 30 days, I have received notices of two college-level training seminars on the popular spreadsheet software programs, notably Visicalc and Multi-Plan. Such programs can be used by the computer literate, if not necessarily computer skilled applicant, to compare products. Might we not see enterprising Actuaries writing and marketing such software for the applicants use?
>
> I know of one company whose Actuaries were faced with the job of supporting Universal Life, as many of us are currently, while waiting for their mainframe computers to be brought up. They used Visicalc to let their clerical force do cash value and death benefit calculations on such policies, thereby relieving the actuary of the need to do those calculations themselves.
>
> 3. Rate book printing may give way to the burning in of ROM chips.

One reality in the 1980's is uncertainty. As a recently retired staff futurist of Sperry Univac, Earl Joseph has said, "The only certainty for the 1980's may be uncertainty." This is reflected in the high level of recent change in our products, economics, customer expectations, and no one is claiming to have seen the end of this change.

Matt and Joe have described the hardware and the software which can provide flexibility to manage change. I would like to add that this flexibility is emerging in the form of do it yourself reporting and management information systems. These systems will require actuaries and other users to master the use of the new report generating tools. All of a sudden, you and I are a part of the data processing department.

Can we say goodbye to commutation columns, unit cash values, reserves, dividends, rate books, policy anniversaries, hard copy output, typewriters, keyboards?

Perhaps at the risk of raising the old familiar "which came first" questions, computers are fostering the new products with flexible premiums and benefits,

and these are in turn adding to the uncertainty of what our policyholder experience will be. Actuaries will use computers to their fullest, in performing sensitivity testing, or "what if" analyses. Less able to price products on a "best estimate" basis, we will need to develop products which are appropriately indifferent to varying mixtures of results.

We hope that we have stimulated your thinking and raised some questions, surfaced some issues, and hope that you are now anxious to get to the microphone in the center aisle, and ask a question or make a comment.

MR. THOMAS K. GROSS: Both Matt and Joe discussed local area networks as the wave of the near future. It seems to me, with the local area network, we are headed towards the same direction as we have had with our mainframes for some time, where we have had terminals and have been able to use APL, Fortran, or BASIC, or whatever language that we have on the mainframe. Do they feel that we are headed that way? What are the advantages of using micros over mainframes as terminals?

MR. LYNCH: The advantage of using the micros is primarily cost. The communications on the mainframe can slow down the mainframe. The software on the mainframe is not as "friendly" as the software on the micros. Now really, you can do a lot more on the micros. It is great to be able to do some work off-line, using the microcomputer, text editing, spreadsheets, and graphing capabilities. Get the data from someplace else. Send the data to someplace else. What is on the mainframe that you need, you can tap into, but it is not a good idea to use it as a bus. To give you an idea about the cost element using the LAN (Local Area Network), I mentioned the idea of ten million bytes per second on the base band approach. Ethernet would be an example of that approach. It has a tremendous speed, but one drawback is cost. It costs about $1,000 to tie in each unit. There are slower networks, and one example would be CP Net. CP Net only runs about 300,000 bytes per second, but only costs about $100 to tie in each unit. But, why use the mainframe, when you can use the micropower? By the way, I will throw in a gratuitous definition. Someone asked me, "What is the difference between a mini and a micro?" I said, "If you can buy the software from anyone but the vendor, it is a micro."

MR. ALBERT K. CHRISTIANS: I would like to say that you painted a picture of a world of not too much change, and that the technology already here is very likely to produce extremely drastic changes for the way we do our work. You were talking about different ways of doing the same things, and it seems to me very likely that this technology could turn our entire world upside-down. For example, how many of your companies are prepared to provide, if it was legislated as mandatory, security of all your data files, such as cryptographic techniques, so that people could not get at data they were not authorized to get about your policyholders? Suppose you had to let every policyholder know every record you kept on him in your company and give him access to correct it if required, or give him the option of having you delete it if he was no longer an active policyholder? How many of you people can respond to the need for electronic money? If the banks are going to be doing 90% of their transactions by electronic money, so would the insurance companies that are going to survive. How many of you know anything about electronic money?

One thing that you also did not mention is artifical intelligence. Right now the first expert systems are being created. The actuarial field seems

to be a good one to apply expert systems. Tony mentioned this about the life expectancy and wrongful death cases. There are just not enough of us to make it economical at the present time, but within a few years there will be expert system generating systems which would be economical to use to generate an actuarial expert system. This is something every actuary would like to have to help him out, but I expect that the people who develop these are not going to sell them to experts, they are going to sell them to insurance company presidents instead. It is really going to put us into an entirely different world.

My last suggestion about what is going to happen in the future, is that by an extrapolation of simple trends, we can see that within a very few years, the microprocessor will cost less than we now spend on printing policy forms. You would be able to include economically, a microprocessor as part of every insurance policy. This microprocessor, along with one of these Optical Cards, would be the policy. The paper, if you bought it to produce it all, would be superfluous. The policyholder could insert the card in the machine, do all his policy service functions himself, he could eliminate a Policy Service Department. The policyholder could sit home with his microcomputer you gave him, ask for cash value quotes, loan quotes, any kind of quote he wanted. When he wanted to actually produce a transaction, of course, all the money that would change hands would change electronically, you would not have to do any mailing or collection. It could really change the environment the actuary is operating in and I do not think there is very much preparation for it.

MR. AUTIN: From the perspective of a futurist, it is important to realize the distinction between what is possible, what is probable, and what is desirable. Technicians, I will include actuaries in that category, computer designers, software designers...can help us visualize what is possible. They can help evaluate the extent to which it might be feasible financially and administratively, to implement something. But when you get to the point of deciding which of these technologies we will apply, then you get beyond the realm of the technicians and you get into the politicians, the public-sphere, you get into value-judgments. I certainly think that it is our responsibility as actuaries to identify what are the consequences of some of these applications. But the decisions are not going to be made by us. If in fact lawyers take on and adopt this software, they can get answers to the question of how much is it worth to compensate their client for their loss of earnings. If they can do so for $100, they are not going to be looking to employ an actuary to give expert witness for $1,000. I would by no means make the judgment that this is an expert system, but it might be viewed by lawyers as an expert system. Actuaries should be letting themselves be heard on this point.

MR. LYNCH: Let me respond a little bit further on that. One, the phrase "artificial intelligence" is a psychologically loaded phrase. Not too many years back, the word "robot" was a psychologically loaded word but now you hear about robotics and see it everywhere, and there is nothing magic about it, it is just mechanized pincers that are under process or control. Well, the same way with artifical intelligence. Primarily, it is having a modular kind of solving process. The chief example currently would be medical diagnosis, where certain questions are asked and answers are given. Those very answers then generate the asking of additional questions. So, the artificial intelligence is already here. You are really talking about the sophistication of software. The other point I wanted to

make was in connection with the plastic card which stores two megabytes, I forgot to tell you one of the most charming features of it. Whereas to read a diskette you must use a reader costing about $700, the reader to read one of these cards only costs about $100.

MR. DAVID J. FISHBAUM: It was a very interesting discussion by both of you. We, as actuaries, are at the basics of information. This is not the computer age, it is the information age. I work for a life insurance company and I would not want programmers setting up systems. What the actuary should be doing is setting up the informational requirements. Let me take the example of Universal Life. I happen to work in the Systems Department right now. We had four sets of information coming out of Universal Life. One was the annual statement information, one was the history information, one was the actuarial statistics, and one was the government statistics. Now, all those things are lying around your company and if you do not work in the systems department, you do not know that they are there. People are trying to do persistency studies. How are you going to do persistency studies if you do not know what information is around? You have to sit down and say, "What are our informational requirements?" From there, all the needs you have can be answered because your going to have machines that will do anything you want, as long as you know that the basics of the whole company is information. Remember, when you are selling life insurance, you are not selling anything else but an inch of computer tape. We have to understand that it is just information that we are selling.

MR. TUCKER: Mainframe computers store information in one central place. Traditionally, central systems stored and retrieved the information stored there. Even with this natural concentration of information, often the left hand knew not of the right hand. Microcomputers can make this problem much worse unless the organization has a definite plan for integrating the micros into the work place and information structure.

MR. STEVEN R. LINNEY: As follow up to that other question, most of us in the room are probably old enough to have been trained without computers. As the new people come along they get addicted to the computer, and they tend to look more at what the computer can do as opposed to understand the concept behind it. Visicalc is really just doing what a human being can do and doing it a little faster and in a more organized manner. But a real debate we have in our company is, "Should you program something that you literally cannot check by hand?" In a sense, you are not just trying to take what a human being can do and just do it on a machine faster. If you cannot check it, what is the worth of it?

MR. AUTIN: I would like to comment on your last point. Those of us who have indeed been around, and were not trained for the first computers to come out, were trained to do things by hand. When the semi-mechanical electrical adding machines or calculators were introduced, there is no doubt that somebody checked them by hand to make sure the machines really were operational. We got over that stage and when computers came along, we would program them and go back to our calculators and see that the computers were, in fact, working. We will go through the same stage. Right now we use commutation columns because we do not trust computers yet. We are going back to basic principles and using the principles with which we are all very familiar, but we want to make sure that we have learned how to use the tool and the power of the new computer. We do that by going back and

checking that which we are very familiar and which we have accepted. We will get over this need to go back to the old technology, the old methods, and as each new development comes along in computer capacity, we will be using the prior one to judge the accuracy of the new one.

MR. LYNCH: I would like to follow on that. At our shop, we routinely do calculations on the computer that are literally uncheckable because of the magnitude of them. These would involve, on large pension plans, actuarial gain and loss by source together with the interjection of new entrants in a forecast. But there are benchmarks on checks. There are sample lives where reasonableness checks can be inserted at various points. On the gain and loss by source, for example, the theory indicates the nature of each particular gain or loss and then the arithmatic sum and difference of those, together at the beginning of your information and end of your information, should add to zero. If it is not zero then there is something wrong with the calculations. That is an independent check, not actually checking the formulas or what the computer does, but simply checking that the answers behave in the proper pattern.

MR. AUTIN: What is going to be increasingly necessary and important for actuaries will be to develop those skills and techniques which allow us to decide whether these increasingly complex systems and tools are working properly. I do not see the president of my company buying a piece of software and running it and saying "Yes, I will accept that number." He is going to say "I do not understand that funny looking result. Actuary, will you please tell me, is it right? Did I make a mistake putting input in? Did we program it wrong?" Actuaries are still going to have a lot of work to do, even if computers can apply the techniques. Someone needs to determine that they are being applied properly.

MR. RALPH P. WALKER: I have a little different perspective on this checking business, because I went back to first principles and started working up some values. Let us just take a basic values table. Now with commutation columns, it is impossible to check all those values in the book because of limitation of the number of places in the commutation column. You can take an identity formula and try to apply that with some of your values in the basic tables and it just will not work. But if you go back to first principles, it does. Also, if you take the mortality rate right out of a table and use those to compute nonforfeiture values and reserves, you come out with different values than those in published tables. But if you divided d by 1 to produce q, and use that, then you can reproduce the published values. So, to my way of thinking, it is more accurate to use the first principles, rather than commutation columns.

MR. AUTIN: I would like to ask for some feedback, either from the audience or the panel on the question of computational accuracy. I have an Apple Home Computer, and I am warned in the manuals that you have only have a certain degree of accuracy. How much of an issue is that?

MR. LINNEY: As a follow-up, I also have an Apple Computer, and I do not know if you happened to read recently, but the random function in that machine is incorrect. I wanted to do some Monte Carlo simulations, and I just happened to stumble across a book that says the random function that Apple built into their computer is incorrect. You have faith that Apple computer says their random function RND is right; you start running the

models; you come up with a result, and discover that it is totally wrong. So, I guess I am still very skeptical that the process in the computer is way ahead of the understanding and the following up.

MR. LYNCH: The precision in calculations is a function of the language you are using. One of the criticisms I have had of IBM for one period of time, is that IBM says that the single precision in IBM Fortran is accurate to seven places, but it falls to six, then five, very rapidly. You must use double precision routinely. Now, one of the criticisms I have had of certain software on the micros is lack of precision. I have tried a number of different operating systems and a number of different languages. If we take the basic language, for example, that comes with Radio Shack's Trisdos package and if you calculate a double dot upper 12 angle ten at 7%, in double precision, you are off by a very large order of magnitude. The correct answer is 7.287140 and I use that as a benchmark when I am just testing a language. There are some languages that have a large amount of precision built in, and there are some that have declarable precisions. Fortran, if it is based on an 8 bit byte will, in its single precision, not have sufficient accuracy. You must use double precision on anything that is going to be recursive or is checkable, such as a payroll total. A language such as Cobol, lets you declare the precision attribute. PLI lets you declare the precision attribute. Basic is atrocious in this regard. Some of the spread sheets are atrocious in this regard. Some of the data base management routines are atrocious in this regard. For example, dBaseII is a wonderful data base routine for everything except calculations.

MR. CHRISTIANS: This problem of precision is one where computer arithmetic does not match arithmetic as we are taught in school. You can determine the precision with which your machine does calculations by finding out the amounts by which it differs. That is, if you add a number, and then subtract it, you do not always get zero, if you multiply by a number and then divide, you do not always get one. You may code and test a program and find that for your test cases it works perfectly well, but, in particular when interest rates get high, or you are doing accumulations and withdrawal rates get high, the thing just explodes. When you carry it out for more years, maybe you hand check one for ten years and then you run it for thirty, all of a sudden the truncation error in the calculation becomes larger, If you have confidence in the program that you have obtained from checking one case, maybe it does not always apply to the others.

There was an article in the paper this morning on a parallel subject in another profession. It said that a study of autopsies has revealed that a significant cause of misdiagnosis in medicine is over reliance on high technology diagnostic tools. The doctors tend to believe their tools, and in the cases where they are wrong, they do not know that they are wrong in every case. This is now a large proportion of their errors.

I wonder what actuarial standards are going to be the actuary's responsibility of checking the reliability of such things? The Academy guidelines say the actuary should only rely on reliable data. Is the random numbers generated and supplied by Apple reliable, or is it not, or should he test it before he decides? Is the program that he wrote himself and tested reliable or not? Is the program that somebody else wrote for him reliable or not? I am curious about what people think the guidelines for these kind of things ought to be.

MR. AUTIN: I certainly concur with what you are saying and that one of the responsibilities of a professional, whether actuarial or otherwise, is to make sure that the tools that they are using are reliable and that you know the capabilities of those tools. We certainly have been faced with this same issue in using large mainframes now for twentyfive years. The power of these minis has started off well below the mainframes, but it is rapidly approaching that which we were accustomed to having available on mainframes ten years ago or five years ago. So, if we were satisfied five years ago with the mainframe, certainly we can anticipate that we are going to be satisfied with the minis and with the micros in the next five years.

MR. GOTTFRIED BURGER*: I would like to make three different remarks. One, we must always keep separate the hardware which was built into the micros and the operating system, in the matter of precision. There is a series of three basic books on the computer science by Dick Strauser. One half of one book just deals with random generators. The books are very famous and they use them in the context of HB 35's, in the early days. You cannot blame the micro for the random generator. Nor can you blame APL. Most of the implementations are deficient.

Second, I want to talk briefly about one thing I found extremely bothersome with the development of microsensors. Computers are my hobby, and APL in particular. I started to write all the actuarial packages for our company fifteen years ago. Now I am transporting it for the fourth time. I started on a time sharing service, then I transported them to an IBM 5110, then I transported it to a small micro, now I am transporting it to a super micro, which is based on the Motorola 68000 chip. Much more attention must be given to transportability of languages, and anything which helps to generate standards is most useful. But, so far, I have talked as somebody who loves computers as a hobby. I am also a company president, and I am sorry to say we have two big mainframe computers. I wish I could throw them away. We have one big IBM and a Hewlett Packard 3000 which do not talk to each other. Our company is notorious for lousy service in premium billing, and we are working on that. Four years ago we started a big program to move manual coding sheets to computer terminals. In that time, we have doubled the number of clerks who do the input. We have, in addition, hired computer programmers, and we are not close to the end of the project. We now have in the first consultant to tell us what we did wrong. And everyone explains to me, "You did nothing wrong, you are just experiencing what everybody does and you have to expect it." Micros are wonderful, but to program boring things, like sending out premium bills or calculating reserves or producing annual statements, you need an army of programmers. By the time you tell them what you want, unfortunately the situation has changed. What we need is a computer device which writes computer code. I think what we are suffering from is development which is so fast that our mainframe just cannot keep up with it.

MR. AUTIN: I certainly concur with the majority of what you said. We all know that one of the biggest problems that the computer industry has is the shortage of programmers, and there appears to be no end to that. We users would like very much to have program generating programs, where we

*Mr. Burger, not a member of the Society, is the president of Cologne Life Reinsurance Co., Stamford, CT.

could ideally talk to the computer and it would generate a program that would deliver what we want. I am confident that there are some geniuses around who someday will deliver something like that. But in the meanwhile, we have got to struggle without it.

You have raised some very serious issues, such as the matter of compatibility, of being able to interface between one type of computer and another. Those of us who are in Actuarial departments are frequently asked to give an opinion as to whether we ought to acquire a certain piece of hardware, a certain software package, or a certain language facility.

We would like to play with new programming language but we need to be concerned that our computer output can be effectively transmitted to the other computers that have got to deal with it. Those of you who are trying to do product development work and need to take the output and get it into computers or software programs that do proposals for your field, or product administration, or underwriting and issue, or your ongoing billing and collection functions, probably have already run into these compatability problems. It is awfully discouraging to use these minicomputers or even microcomputers to calculate reams of numbers and then need to have somebody input them by hand at a terminal because you cannot have the minicomputer talking to the mainframe.

MR. LYNCH: I have no idea of the volumes you are talking about but I can give you a suggestion for research about how to get programs written without writing programs. On the microcomputer, it is possible to use an advanced, inexpensive data base language for modest volume situations. The one I use is dBaseII by Ashton-Tate. It retails for $700 but actually sells for a little over $400 as a package. An intelligent person who is reasonably technically oriented, can learn to write "programs" in the language. It can be used without doing any programming. It is a data base manipulation language that can be used directly to shuffle information. It can be used for data entry. The information can be manipulated as if it were being programmed with reasonably simple commands. It is slow in operation. It is not useful for high volumes of data, but it is wonderful for having unique situations manipulated by people who are not experienced programmers.

MR. TUCKER: To continue on that, the relational data base type systems are exactly that type of language. They are non-procedural languages. They are not a programming language per se. You define what the data looks like and then you can manipulate it, add, subtract, multiply, divide, etc. Normally they have report generators included.

Much research has been done on how to write correct programs, or how to write a program that would check to see if your program is correct. I suspect it is a long way from being very useful at this point, it is just experimentation. It is similar to the artificial intelligence area which was touted ten to fifteen years ago as something which was going to be great, and yet it took long, hard development before anyone actually came up with knowledge-based or expert systems. We are really just getting started in the expert type of systems. What we really would like to have is a system that not only knows how to do the things that actuaries do, but also can learn from us individuals about the things that we do that are unique.

In most programming departments people are not taught to write correct programs. After all, the first thing they do is look for bugs in a program,

as if the bug crawled in. Of course it did not crawl in, the programmer put it there. No one wants to admit an error, so it is called a bug. Emphasis on writing correct programs is something which we, as actuaries, in our contacts with programming could benefit. Certainly there are many things such as the modular type of programming that can help improve the correctness of the first version of a program.

MR. LYNCH: There is a display at the Smithsonian of the first computer bug. Captain Grace Harper of the U.S. Navy described it on Sixty Minutes a few weeks ago. Grace Harper is a marvelous woman in her early seventies, who invented the Cobol language. On Sixty Minutes she described the first computer bug, which was a moth which was found in the wires of an early computer.

I would like to address one more item to Mr. Berger. It is possible without writing IBM programs, to bring data in small quantities from the IBM mainframe to the micro.

MR. BURGER: I realize that. The core of the problem is the very expensive data base management system which we bought from IBM. As an example, suppose you perform a lapse study, with a data base of 200,000 policies, and you want to study the lapses on females within the last ten years for a special plan. From any outside language, you just do not know how to access this data base. You have to be familiar with the IBM intricacies of this particular data base to be able to access it. There are problems which have to do with the data base management system.

MR. LYNCH: A great deal of attention was given to that recently by the Cullenette Corporation which has just released an interface with the IBM mainframe to the IBM data base management system and the Cullenette data base management system on a large micro. They are terribly expensive though, about $65,000. It sounds like that was the kind of a problem they were trying to address.

MR. DENNIS K. PETERSON: We have a number of microcomputers in our Actuarial department and we have found them to be very helpful. For example, we have been able to throw away all of our columnar work pads. We are starting to be concerned with things that we addressed on the mainframe a number of years ago, such as standards and backups. I am curious how other people are addressing these problems. But in relation to that, I also heard a very curious comment yesterday in a seminar on Management Information. One gentlemen said that two large insurance companies have recently banned microcomputers from their home office, namely Metropolitan and E. F. Hutton. I am curious to find out any specifics about that and the reasons for it.

MR. TUCKER: Quite naturally the Data Processing Departments of many large companies feel rather intimidated by the microcomputers. After all, they have been dealing with computers for a long time and all of a sudden their job is in jeopardy. There are some real problems installing an army of micros. Control is an important part of a large organization. There must be a mechanism to control this information and make sure that they do not end up recording almost the same information in many different places.

MR. AUTIN: You could have a need for both the mini or the micro and the mainframe, and the needs are in fact different. A lot of what actuaries do is one shot and it is just not effective to do that on the mainframe

because of the difficulty of standing in line for mainframe resources. It is too easy to program something on the mini or on the micro and then realize that you have tied up your whole mini or micro to do one function, whether it is proposal processing or something else. They tend to be much more effective, at least in today's state of development, to do ad hoc vs. ongoing processing functions.

MR. CHRISTIANS: Our company has already encountered this problem of one application. We had a Marketing Division that wanted sales information and they figured that using a micro was the fastest way, so they bought a Tandy 10. They talked somebody into programming it for them and they started putting out their sales information. Somebody left the company, and the hardware proved to be not reliable. We had a microcomputer Basic program that, all of a sudden, needed to be converted to something else. The Data Processing Department inherited it and did not know how to make heads or tails of it. We should think in terms, not of microcomputers, but of personal computers, where the word personal is very important. If it is your personal computer, you use it to do your personal work and it is your personal decision to use it. But, if you use it to do the company's work, then it is the company's business to dictate how you do it, because they are going to have to use it when you are gone.

The company has a great deal to say about whether or not employees should be using a personal computer, and if so, what kind of compatibility standards and programming standards are used?

MR. LYNCH: It is not uncommon for the data processing people to refuse to have anything to do with the integration of micros into the company. It is fairly common in such a situation for whatever computer the president gets at home to become the company standard. I always wait to hear about the first one that goes to the Sinclair Timex.

MR. WALKER: I write Cobol programs on a micro and then I have a modem hooked up to my former office where I can hook into the mainframe to do the compiling on the mainframe. The text editor and materials that you get with that CP/M system that is used in my micro are tremendously powerful.

MR. TUCKER: My firm has a pair of non-IBM time sharing computers. Many of the features that I see on micros, such as software, have a vague resemblence to the software we have been using for the last seven or eight years. Much of this software has existed, but, not generally on IBM equipment. In my environment I really do not have much need for a micro since I can write programs that are 1.2 megabytes in size and run 200 to 400 times faster than on any of the micros we have tested. Many of the user friendly features of micros have been available for quite some time but have simply been secrets.

MR. LYNCH: In response to Mr. Walker, I can second his liking for that approach. We have switched entirely to that approach at our office. All of our set-up work is done on micros, such as the text editing, the manipulation of programming material. The actual running of them is done on a high-speed Control Data computer that crunches numbers at a rate we could not dream of doing on a micro. But the combination of the two is just stunning compared to what we did in the past when it was strictly punch cards and mag tape.