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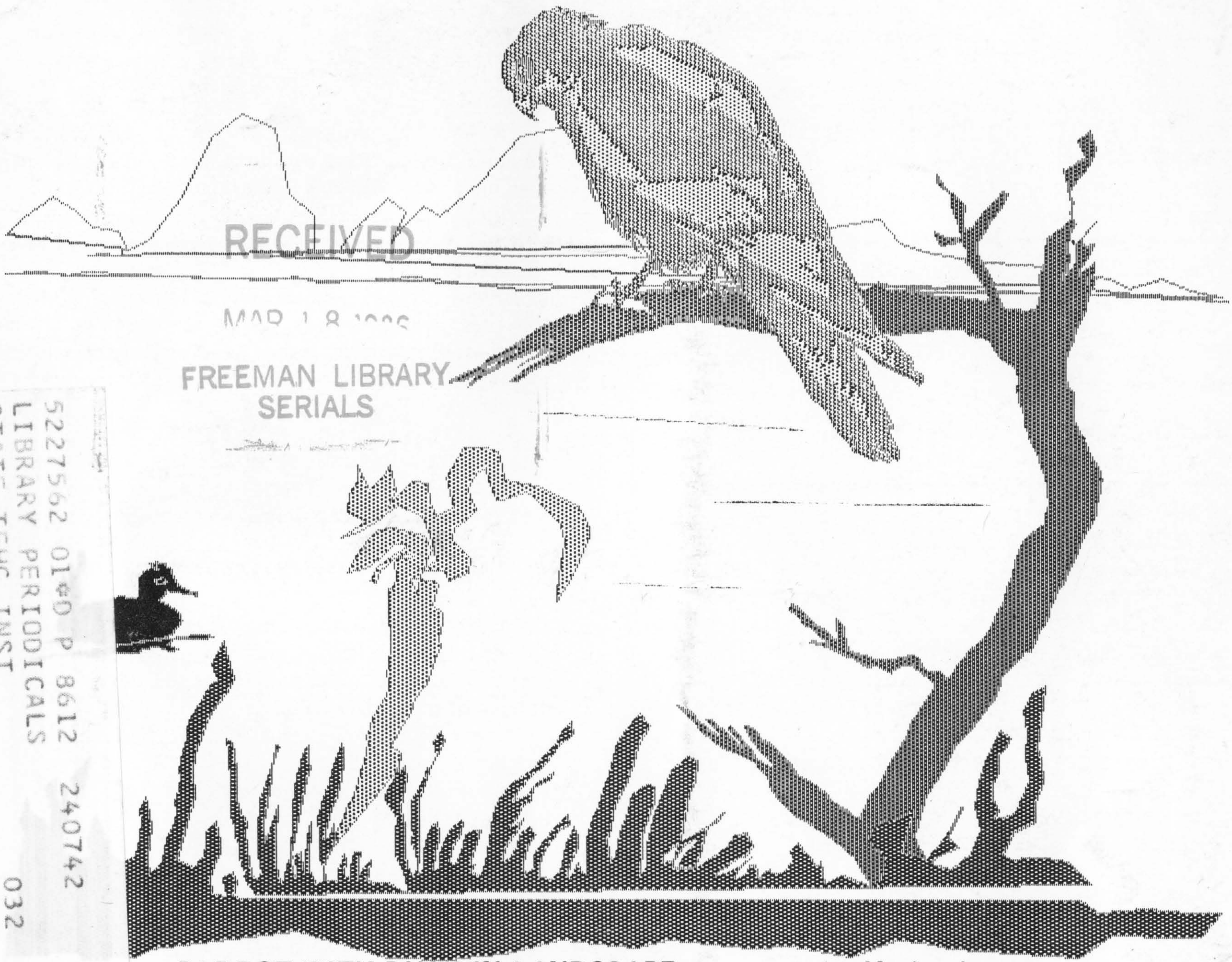

PARROT WITH DUCK IN LANDSCAPE *by Meelan Leong*

The Computer Almanac and Computer Book of Lists – Instalment 46

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Computing and Data Processing Newsletter

IMAGING OF ELECTROMAGNETIC DISCHARGE TO PRODUCE QUALITY INSPECTION WITHOUT DESTRUCTION

William Johnson
Office of Public Information
Lehigh University
436 Brodhead Ave.
Bethlehem, PA 18015

Researchers at Lehigh University are using an old photography technique to develop a portable non-destructive testing method for structures ranging from very large, like skyscrapers, to very small, like integrated circuits on silicon chips.

This technique is "Kirlian" photography, which is named after two Soviet inventors, Semyon Kirlian and Valentina Kirlian. They discovered this process in 1939. An image is obtained on photographic film by applying a high-frequency, high-voltage electric field to an object, causing the object to radiate a pattern of light onto the film.

The Kirlians studied these images to diagnose changes in living biological subjects. But Lehigh researchers Dr. George C. Sih and Dr. John G. Michopoulos are using the technique to develop a method to detect flaws in metal alloys and composite materials used in a variety of structures and products.

The Kirlian-Lehigh method will be accurate, but perhaps as important, it will be portable. "There are other methods that combined can produce the same results," says Dr. Michopoulos. "But our method will produce results in the field, not only the laboratory."

For example, an airplane usually is taken out of service for non-destructive structural testing after a certain number of flight hours. Pieces of the plane are removed and taken to a lab for analysis. The K-L method can be used on the plane without taking it apart or out of service.

The K-L method, also called "electromagnetic discharge imaging" (EDI), will enhance quality control in manufacturing. For example, integrated circuits must be tested for defects before being placed into service. The EDI equipment needed -- a generator, amplifier, coil, electrode and film -- can be contained in a box about the size of a portable TV set, and will cost (by estimates) about $200, while bulky, sophisticated X-ray, ultrasound and other non-destructive testing equipment usually are stationary and cost thousands of dollars.

Moreover, Dr. Michopoulos says, many methods tell you that a defect exists, but don't tell you the shape, size, nor exact location of a defect in a material specimen, as the EDI technique will. This is critical information to understanding and predicting the damage potential of cooling-water pipes in a nuclear power plant or a steel girder in a bridge. "We are utilizing digital image processing," notes Dr. Sih, "which provides a high-resolution image and helps us quantify even more specifically the size, shape and location of defects." EDI also requires far less electric power than most other techniques.

Drs. Michopoulos and Sih now are developing EDI theory that would identify all the electromagnetic, moisture, temperature and mechanical deformation effects on a specimen. Once such a theory is developed into a computer software system, the EDI technique can be automated and applied in non-destructive testing and manufacturing quality control.

COMPUTERS OF DIFFERENT MAKES AND MODELS HAVE BEGUN TO TALK TO EACH OTHER

Based on a report in the "Montreal Gazette"
250 St. Antoine St.
Montreal, Quebec, Canada
December, 1985

A researcher at the University of British Columbia in Vancouver, B.C., Canada, Prof. Gerald Neufeld, began in 1981 to develop a software package which could be universally understood by computers, based on a universal message system called the X-400, derived from a United Nations committee.

The software package has been finished for many different makes and models to talk to each other.

The Sydcom Messenger 400, developed by the university and marketed by Sydney Development Corp., could be adapted for the home computer market if it proves popular with computer users.

"During the last few months, representatives of corporations from around the world came to Vancouver to see and negotiate contracts for the new system," Sydney's chairman Walter Steel said.

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computers and people formerly *Computers and Automation*
including *Computer Graphics and Art*

The magazine of the design, applications, and implications of information processing systems — and the pursuit of truth in input, output, and processing, for the benefit of people.

Front Cover Picture

The front cover picture shows a sample of art by Meelan Leong, a student from Hong Kong, in a computer-assisted art class at Calif. State Univ. - Chico, CA. This black and white illustration of an original color work was made by using a group of programming routines, called TARTLIB, to manipulate patterns, colors and textures. The system used was a HP3000 minicomputer connected to a Tektronix display terminal, with a choice of CRT photography or a colored printer for output.

Back Copies

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Key

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Editorial

The Word "Undermine" and Star Wars

Edmund C. Berkeley, Editor

In the "Defense Daily" of Dec. 5, 1985, published by Space Publications Inc., 1341 G St. N.W., Washington, DC, 20005, appears the extraordinary word "undermine", in regard to the Strategic Defense Initiative or Star Wars scheme of the Reagan administration. The two sentences that give the context are these:

"Addressing the one technology issue that critics think may convince Congress to UNDERMINE [emphasis added] the Strategic Defense Initiative (SDI), a top computing official for the SDI organization has told Congress that the computing requirements including software for the battle management system of the strategic defense system can be met.

"Danny Cohen, chairman of the SDIO Panel on Computing in Support of Battle Management and Command, Control and Communications (BM/C3) asserted that 'there is no fundamental principle that prevents meeting the BM/C3 requirements.'"

The word "undermine" according to the dictionary has among its meanings "to injure or destroy by secret means or in imperceptible stages." This implies that if the U.S. Congress comes to the conclusion that the proposed SDI or Star Wars system is a ridiculous and impossible structure of computer pseudoscience, and accordingly refuses to continue monetary support, then Congress has reprehensibly "undermined" Star Wars. However, it is not criticism but facts, the truth, which is defeating Star Wars.

Danny Cohen is wrong. There are at least three fundamental principles that prevent meeting the battle management and control requirements (BM/C3), the supposed leak-proof umbrella of defense, the Star Wars vision.

These requirements are:

1) Locate, distinguish, and recognize 5000 or more hostile ballistic missiles and decoys traveling at an average of 5 miles per second
2) Execute a computer programming system needing 8 million or more coding lines
3) Aim and fire 5000 or more antiballistic missiles or similar weapons

All these actions would have to happen in less than some 12 minutes from the signal "go", and would have to happen correctly with no opportunity even once to test the entire system in real time.

First fundamental principle: In a chain of billions of links, some of those links are bound to fail. A complete umbrella is impossible. More than 1000 computer professionals have judged the Star Wars scheme and have asserted that it is impossible.

Second fundamental principle: The basic reason for the push to develop Star Wars is from the Pentagon, defense contractors, and certain sections of academia. Why? They see big money for themselves or their organizations. These are the people who sell a pair of pliers for $1500, a toilet seat for $640, and weapon systems that after half a dozen years and more than $1 billion spent are dropped as failures. With this kind of burglary record on the U.S. Treasury, we taxpayers should not believe what the burglars urge. They are selling snake oil.

Third fundamental principle: The only protection against nuclear war, nuclear holocaust, and nuclear winter is prevention. This is the prescription of the International Physicians for the Prevention of Nuclear War, the organization that won the Nobel Peace Prize in 1985. They have an enrollment of over 150,000 physicians in over 50 countries, all advocating the same prescription -- prevention.

President Reagan and Chairman Gorbachev stated jointly on Nov. 22, 1985, in Geneva:

"The sides having discussed key security issues, and conscious of the special responsibility of the USSR and the US for maintaining the peace, have agreed that a nuclear war cannot be won and must never be fought. ... They emphasized the importance of preventing any war between them, whether nuclear or conventional. They will not seek to achieve nuclear superiority." Ω

Surviving the Personal Computer Industry Downturn

John A. Young
President and Chief Executive Officer
Hewlett-Packard Co.
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Palo Alto, CA 94304

"Our ability to survive in the years ahead depends on pursuing these ideals ... with the relentless commitment and endurance of a marathon runner."

Based on his keynote address at the Comdex Show, Las Vegas, NV 89101, Fall, 1985.

I've been asked to give some insights on the very pertinent question of what we in the personal computer business can do to survive.

Not a Sprint But a Marathon

The first item I would place on our agenda for survival is this: We need to recognize what kind of race we're running. Survival isn't a sprint; it's more of a marathon.

The industry's so young -- and growth has come so rapidly -- that we've gone through a period of overabundant optimism. Not so long ago, venture capital was easy to get. All you needed was an idea and -- just maybe -- a marketing plan. Growth was so rapid that young companies doubled in size almost overnight. The industry developed its own raft of superstars, and software packages earned "top ten" ratings -- just like the hit parade. It was all very entertaining, exciting and effortless.

Personal Computers Shipped in 1984

Almost 7 million personal computers were shipped in 1984 alone. And now, all the easy sales have been made. Overabundant optimism has changed to questions about survival. Is the pessimism warranted? I think not. The "boom" times of 1983-84 just fooled us all a bit. Some people lost their long-term perspective. Some forgot that we're running a marathon.

Here's something that shouldn't be news to any of us: Business cycles have always existed in the electronics industry. This slowdown isn't just a computer phenomenon. The same thing's happening in components and instruments. It's all interconnected. Let's start by looking at what's going on in the electronics industry overall. We at Hewlett-Packard analyzed this business cycle to see how it compared to others in our history. Here's what we learned.

- In the U.S., purchases of electronic equipment have always correlated quite closely with capital spending by business. In fact, in the 1960s and 1970s, the growth rate of electronic shipments was just one percentage point higher than that for capital goods spending by business.

- But in the 1980s, electronic sales took off, and shipments grew more than twice as fast as capital goods. The results of that growth spurt are quite evident.

- Today, purchases of electronic equipment account for fully 40 percent of capital outlays by business. Five years ago, they represented just 27 percent.

Two Growth Rates

So for the past five years, the rapid growth in electronics really represented two trends -- first, the growth rate of our customer base, and second, the replacement of electro-mechanical equipment with electronics. Much of that replacement has already taken place -- witness the boom years of 1983 and 1984 and the millions of PCs shipped during that period. It's not that it can't continue, but I'd like to discuss what we need to make that happen later on in this report. Right now I just want to stress this: Because electronics purchases now represent such a major portion of capital spending, we're much more likely to feel the pinch when things slow down in the rest of the economy.

Capital spending grew a healthy 15 percent in 1984, and electronics had a good year. In 1985 it's slowed to just 3.7 percent, and we worry about overcapacity and survival. So our fates are much more closely coupled with those of our customers. The electronics industry will grow only if we provide real solutions to the business problems they face. Just selling them equipment doesn't meet that prescription. If business cycles and periods of slower growth are inevitable, then this reality demands a self-discipline that the PC industry hasn't needed before.

Catastrophic Mistakes

Four years ago, Chris Morgan, who was then editor-in-chief of "Byte" magazine, characterized in amazement the industry attitude of that time. He said, "You can make mistakes that would be catastrophic in any other business. And all you say is 'oops'." Nobody feels like that today. People have come to realize that the competitive race is a marathon. It requires stamina, and that only comes from self-discipline. We have to pay attention to business fundamentals that are less than glamorous -- things like asset management.

When financing was so easily available -- and when growth was so rapid -- it was seductively easy to forget basics like managing inventory and accounts receivable. I'm not going to hazard a guess as to whether we at HP would have been tempted to borrow money if we were starting out today. But I do know that our tradition of self-financing has forced us to focus on business basics. And during the past five years, we've renewed our efforts and used some new approaches to reduce our inventory and accounts receivable by $400 million. That's a non-trivial payback!

Process Technologies and Total Quality Control

Manufacturing is a second area where we need to pay attention to fundamentals. It does us little good to design state-of-the-art products if -- within months -- someone else can replicate and produce them for half the price. This is where Japan and its Pacific Rim neighbors excel. Too often, they've been able to manufacture products that are more attractive than our own -- both in price and quality. That's been the result of a heavy investment in process technologies and a relentless pursuit of total quality control. It's a lesson we should take to heart.

We've certainly done so at HP. We've learned that total quality control is the best way to reduce our costs. It's changed the way we design and manufacture products. Today, design engineers work closely with people from production and materials beginning on day one of a project. The result? Products that are easier and less costly to manufacture. For example, our Touchscreen II personal computer has only 400 parts, and the model that preceded it had 1,000. Our suppliers also have become part of the early team. We've worked closely with them to improve quality and on-time delivery. In fact, the relationship has become so close and harmonious that today we're able to use just-in-time delivery for our Vectra family of personal computers and many other product lines.

Why Customers Lack Confidence

So much for the first item on our agenda for survival: a long-term perspective and the attention to basics that comes with it. My next suggestion is that we should take that long-term view and apply it to our business dealings.

Building relationships -- building credibility -- is a second challenge our industry must address. Too often, the PC business has been characterized by:

- products introduced but never delivered,
- too much promised and unmet expectations,
- Chapter 11's and layoffs,
- fallings out, recriminations, and lawsuits.

And we wonder why customers lack confidence. Perhaps we've devoted too much innovation to our products, and not enough to our relationships.

To this audience I think it's appropriate to stress one vital relationship that needs much attention -- that between resellers and manufacturers. I think manufacturers have to view resellers as an extension of their own organizations. We -- and here I'm speaking as a manufacturer -- have to recognize that discounts don't take something away from our organizations. Instead, resellers add coverage by reaching a customer base that the manufacturer can't tap economically.

Now viewing the reseller as a complementary sales force -- and not as a customer -- results in some subtle but fundamental differences in mindset. When the reseller is seen as customer, the manufacturer's problems are over when he ships inventory. The customer -- the dealer or reseller -- issued an order, and the order was shipped. But filling up -- I'd say plugging up -- the distribution channel only solves the manfacturer's inventory problem. Tying up dealer capital with vast quantities of products that are then quickly rendered obsolete doesn't benefit anyone in the long term.

Sell-Through

No one benefits without sell-through. And while it's the reseller's role to take some inventory risk, manufacturers must seek ways to make that risk acceptable. I've said that manufacturers have to view resellers as members of their own team. But if resellers don't view themselves that way -- and if the manufacturer also has a direct sales force -- then the question arises of who should sell what to whom. The answer to that question is neither black nor white. Instead, there's a vast, foggy area of gray that takes patience and commitment to navigate.

One could argue that it would be easiest to draw a line and define the spheres of interest in terms of what products are sold. But with price/performance improvements and the need to network products into integrated systems, that line will need constant revision.

Defining Markets and Channels

A more understandable approach might be to divide the areas along the lines of markets served. Our industry has yet to tap the wealth of small and medium-sized businesses that could benefit from using PCs. There are more than 6 million business establishments in this country, and fully 95 percent of them have fewer than 50 employees. Only 14 percent of those establishments have purchased a personal computer. Vertical markets provide an opportunity for resellers to develop the special understanding and relationships that allow them to differentiate themselves. Both methods of defining channels -- along product lines and along market lines -- can work. But whatever the methodology, the line will get drawn, re-examined, and redrawn again and again. The technology and markets are changing too quickly for any one definition to last very long.

How can we best deal with all this uncertainty? By committing to the relationship first. Only within the context of commitment can we negotiate and build a mutually beneficial business relationship. Manufacturers must see resellers as part of their team, and that perspective must go both ways.

So far I've talked about two items I believe necessary for survival -- first, the need for a long-term perspective on the race we're running, and second, the importance of building business relationships marked by credibility, shared understanding, and trust.

My third agenda item involves our customers, since our ability to maintain our growth momentum depends on satisfying their needs.

The Customer's Mindset

Customers don't want a PC. They want the gains in personal or organizational productivity that it makes possible. The PC isn't an end in itself; it's a means to an end. Our love affair with a little box -- or with making a quick sale -- shouldn't obscure that fact. Too often, people have introduced PCs into an organization without a clear information strategy. They've ended up creating isolated islands of information. By one estimate, only 4 percent of the millions of PCs installed today are linked into any kind of network. The rest are playing Lone Ranger.

There certainly is a role for standalone PCs. They've provided individual productivity gains for specialists -- so far, primarily word-processors and financial people.

But most "white collar" workers aren't specialists, and most people -- including specialists -- don't work alone. We did some research on how office workers behave. They spend fully two-thirds of their time communicating. People don't make decisions either immediately or in isolation. They ask for information, reflect on it, ask questions of their colleagues, and so forth. If the PC doesn't facilitate that process, then the machine falls short of its full potential.

And where is the information people need? One thing's certain: no one has it all on his or her PC. So the really useful workstation must make it possible to access internal data bases -- either at the departmental or corporate level -- as well as the growing number of public data bases available.

What must we provide our customers to meet these needs? First, a complete information distribution system -- one that integrates local area networks, wide area networks, and remote communications. A truly usable network doesn't just link PCs; it allows people to use the wealth of applications and information available both inside and outside the firm.

A Continuum of Products

Second, we must offer a continuum of products that begins with the personal workstation but doesn't end with it. We can't let our enthusiasm for desktop computing obscure the fact that individuals work in groups and that small businesses grow into large ones. We must see the PC as a part of a family and not as a maverick.

But purchasing the right products and networking them together solves only half the problem. The other half is having a strategy to use information effectively to manage your business. That means knowing what information is needed, how to develop it, and how to control the information architecture and data standards. Only then can you provide the right information infrastructure -- with the right matches between data bases, communications systems, and workstations.

World-Market Share

I think the pause we're seeing in the computer industry reflects our customers' uncertainty about what to do with the computing power available to them. We need to work with them to provide the real solutions they need. It's clear that we in the computer industry haven't yet provided the competitive advantage American industry needs. The recent expansion of our economy has been fueled by imports. And it's not just old-line manufacturing that's been affected. Fully seven out of ten U.S. high-technology sectors have lost world market share in the past 15 years.

The U.S. had a bilateral trade deficit with Japan in electronics last year of $15 billion. That's bigger than our deficit in passenger cars. Silicon Valley is not so far removed from Detroit.

I'm not here to explain why we're showing signs of weakness on the national level. The Commission on Industrial Competitiveness submitted a report to President Reagan that describes the variety of reasons, and I invite those interested to ask me for a copy.

"Neither a Lion nor a Computer Is Tame"

This discussion of the real business solutions our customers need leads me to the fourth challenge on the agenda for survival. We must make the personal computer truly easy to use. The phrase we hear so often -- "user friendly" -- reminds me of a question Abraham Lincoln once asked. "How many legs would a donkey have if you called its tail a leg?" "Five," came the reply. "Wrong," said Lincoln. "Calling a tail a leg doesn't make it a leg." Well, we in the industry have been trying to make a tail into a leg. One of our dealers summarized the industry's progress on user-friendliness this way: "I don't want people to have sweaty palms when they walk into my store."

Joel Birnbaurm, who is HP's vice president of R&D, says that the average person views working with a computer with about as much relish as walking into a lion's cage. Because neither the lion -- nor the computer -- is entirely tame. There are many signs of discontent out there. There's the Denver man who jokingly formed a Society for the Prevention of Cruelty to Computer Users -- and then found himself swamped by hundreds of phone calls from as far away as Australia. There's the book entitled "Your IBM PC Made Easy" that has 438 pages. There's Mayor Dianne Feinstein's much-reported comments about why the City of San Francisco won't be buying any more personal computers in the near future. And she's not alone. Recently one of the country's largest electronic facility managers privately told me that they were telling all their clients to stop buying PCs because they couldn't see the dollar payoff.

Arthur Clarke once said that if any technology was sufficiently advanced, it would be indistinguishable from magic. We've yet to make the internal workings of computers transparent to their users. We still need Doug Henning to stand over our shoulders and make the computer do its tricks. So the challenge remains for all of us to translate increasing hardware power into usability from the customer's point of view. It's a task of immense proportions.

Ease of "Useful" Use

The ideal goes beyond ease of use. The goal we must strive for is ease of useful use. This is the greatest promise of artificial intelligence. To help you understand our view for the future, let's start with where we are today. Today's personal computer is viewed as a tool, useful for solving specific kinds of problems. If a person wants to do financial analysis, he or she might pick up the appropriate tool, probably Lotus 1-2-3. Someone wanting to do word-processing probably selects something like Microsoft Word.

In short, a person today is much like a carpenter, and the PC is a workbench with a set of tools from which to choose. If someone wants to deal with the complexity of real applications, he must first understand what tool to use, and then develop the expertise to use it correctly. For many of us, that's an unreasonable expectation. We don't want to be experts; we want to be passably knowledgeable amateurs.

Passably Knowledgeable Amateurs

In just a few years, the computer user won't act like a carpenter, but like a general contractor. The computer won't contain a choice of tools, but instead a set of intelligent communicating assistants -- subcontractors you can call upon when you need them. These intelligent agents will understand the natural language you speak. Take, for example, this simple question: "Which secretaries work for department managers?"

Today's natural language system might be able to understand a simple query like that. But it couldn't adapt and understand if the user asked that same question in one of the many other possible ways:

- List each secretary working for department managers.
- Which of the secretaries report to department managers?
- List every secretary whose supervisor manages a department.

The possibilities are endless. Our researchers have identified 1,000 different logical ways that question could be asked.

We're working with other companies and universities to develop natural language systems that will be able to understand instructions that are far more complex than the secretary example I cited above.

Such systems will be both possible and cost-effective sometime within the next five years, and they enable computer users to access databases without knowing the arcane commands needed today.

Intelligence in a Computer

The intelligent computers of the future will also be able to make judgements that will reflect the rules of thumb you provide. For example, they'll be able to sort your electronic mail for you by putting notes from your boss on the top of the pile and by relegating "junk mail" to some sort of limbo where you can deal with it when you have time. Acting on your own instructions, these intelligent assistants will be able to search data bases while you're away on a trip, or at night when the communications costs aren't so high. They'll sort the data bases, link them sensibly, and move from one reference to another. The result will be a synopsis of some very real research that would take many hours to do alone.

Within HP, we're using several expert systems that make use of artificial intelligence. One captures the knowledge of experts in negative resist photolithograpy, and we use it to diagnose and treat wafer defects in one of our production facilities. Another is used by our Customer Response Centers to analyze equipment failures in the field. We've developed another AI tool that offers the promise of breaking the software bottleneck. We've used it to develop expert systems, as well as conventional applications in C, Pascal and Fortran. When personal computers acquire this much-needed intelligence, they'll become much more useful than the tools they are today. They won't be just replacements for capabilities we already have. The paperless office is not the ideal. They will be expansions of our own capabilities: our ability to remember, to reason, and to communicate.

Vast New Areas for Personal Computer Use

We in the industry still have much to accomplish in reaching that goal, but it's not so very far off in the distance. And when we attain it, we'll open vast new areas for personal computer use. And vast is certainly an appropriate description for the opportunities ahead. This nation has

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Bar-Code Scanning for Applications for Patents

Jeff Cochran, Director
Office of Systems Engineering and Telecommunications
U.S. Patent and Trademark Office
Crystal City, VA 24539

"The inputs come in on-line, are updated in the data base, and are immediately retrievable. Further, a lot of manual aids that were used to track paper were replaced by this system. The increase in productivity was obvious."

Based on a report *Applications for On-Line Bar-Code Scanning Use for Management and Control of the Patent Application Process* by Jeff Cochran, in *Recognition Technologies Today* for October, 1985, published by and copyright by the Recognition Technologies Users Association, P.O. Box 2016, Manchester Center, VT 05225, and reprinted with permission.

A successful Government application of on-line bar code scanning has been in place at the U.S. Patent and Trademark Office (PTO) since July of 1980, is still functioning, and the problems at present are those of the normal equipment reliability loss over 5 years of use. This application has been so beneficial in our patent program area that it also has been migrated into the trademark program area. The initial design has survived 5 years of requirement changes.

The Patent Office has the advantage of being totally located within Crystal City, Virginia, so that we were able to use a hard-wired local area network that has saved a substantial amount of cost over telecommunications. We have about 540 terminals connected through the local network at 9600 and 4800 bits per second.

The Patent Process

Before discussing the actual application, a short explanation of the patent process is in order. Patent applications are ideas that people put into legal and scientific terms to try to get protection in the commercial environment. A patent is a legal document that provides that protection. During the process of granting a patent, the Patent Office receives the applications in paper form, performs administrative processing, and subjects them to professional examiners who, by using legal precedents and technological material, try to decide whether this idea has merit. The applications go through many modifications, may be allowed, and if so go through the printing process. So, it is no small problem to deal with the paper files that we have in the office.

Volume

We have approximately 110,000 new applications each year which stay in the office for an 18 to 36 month period depending on the technological field of the application. There are approximately 260,000-300,000 applications in progress at any time in the office. There are 15 examining groups and 900-1,200 examiners. In addition, when an application is judged not worthy of becoming a patent, it becomes abandoned. There are 650,000 abandoned files also retained. There are 4.5 million U.S. Patents and 9 million foreign patents in the files. Before we implemented this bar code scanning application, finding an application took 1 hour to 3 weeks. The PTO occupies 3 full buildings of 11 floors, 20,000 square feet each, and 8 partial buildings with a total of over 500 different work areas.

Controlling All This Paper

It is a major administrative problem to control all this paper. The evolution of the PALM3 (Patent Application Location Monitoring 3) system, which is what our bar code application system is called, began in 1972 when every time a case went from one location to another, an individual punch card was sent to the data processing organization. This card was sent out to a contractor to be punched and then input to a small computer system. There were very few on-line terminals; so it was a very limited capability and, of course, cards got lost, folded, spindled, and mutilated. In 1975 the system was expanded to include management production reports and pendency reports. Pendency is a measure of how long it takes an applicant to obtain a patent.

The project goals for PALM3 included better control of the paper flow, reduction in administrative costs, and greater accuracy in management reporting on the location and status of patent applications.

Development

PALM3 development included installation of a large mainframe computer, data base, and a network of approximately 280 bar code readers, CRTs, and printers in an on-line environment. This development took from February 1978 to July 1980 when PALM3 became fully operational. It was a very fast project.

The bar code reader equipment is manufactured by Control Module Inc. It has some unusual features that required reprogramming inside the decoder. For example, we had some special displays created. The green light tells the operator that the bar code reader is functional and ready to input; the blue light is for display of power on; a yellow light indicates an input error by the operator. The input error could be a line error or, more likely, an error on the format or the information that came in on the transaction. One of the design decisions we made was that the users were limited to a single transaction at a time and must wait for a logical acknowledgement of the transaction.

We also had some function keys installed. One is RECEIVED because the highest volume transaction is receiving a case at a location. There is also a CHARGE TO EXAMINER transaction key. The other two are used in the trademark area. If a function key is not used, the keyboard is. The transactions input are all 4 digit codes followed by variable information, and lastly by a scan of the bar code label.

The system is configured such that the scanning of an 8 digit bar code label causes transmission to occur. The only way to enter transactions from a bar code reader is by scanning a label.

Never a Wrong Reading of a Bar-Code

To my knowledge there has never been a problem with the labels in terms of reading the wrong number, neither has there been a transposition problem. During the procurement of the equipment, we required the specifications for the labels in the RFP (Request For Proposal) to be used to acquire the label printers.

The transactions input at a bar code reader include application dispatching and docketing information. There is information similar to a court docket that indicates which cases require action and what dates are required. Papers that we receive from the applicant are also recorded. There are approximately 400 different types of application related papers that an applicant can send to the office. Further, whenever an examiner takes an action on a case that information is recorded.

There are two other types of equipment in this network. One is a CRT (Cathode Ray Terminal). Most are Hazeltine Mod 1s which are now out of production. One of the future steps we are taking is to attempt to replace these terminals. The other type of equipment is Centronix printers with sheet feeders.

Timeliness

PALM3 improves the timeliness of the data. The inputs come in on-line, are updated in the data base, and are immediately retrievable. Further, a lot of manual aids that were used to track paper were replaced by this system. The increase in productivity was obvious.

We print our own labels at the office using MARKEM label printers from SCANMARK. The printer uses a heat transfer head so that as it prints the label, it burns the bar code on. We also use a laminate to cover the labels. These machines have just been replaced after 4 years of operation. The label is printed using a medium density code 39 with no check digit, and the label printers are off-the-shelf with no programming modifications. The patent application number is created by using a two digit series code followed by a 6 digit sequential number. The human readable number is printed below the bar code in each case. There is a required realignment of the label printer on a regular basis, but we are achieving very good first read rates.

Lamination is used to improve the system life of the label. A standard mat finish adhesive tape is used as a laminate on top of a red label stock which was tested to prevent duplication of the label on duplicating machines that permeated the office. The intent was to preclude entry of data using duplicated labels. We affix the label on the back of a three part folder and enclose all the application papers inside.

Patent Files

Bar code labelling is used for the patent files also, but a different label printer is used. The patent label printer prints two lines. It prints an OCR (Optical Character Recognition) readable patent number on the upper portion, and below that, a high density code 39 representation of the patent number. The label is split in the center so that the bar code can be placed on the file and the upper numbers can be placed on separate related papers that do not need the bar code.

The printer was modified by special programming so that the upper number is locked into the lower number and so that it prints three identical labels at a time (which is what we needed for our application). The patent label uses a regular white paper stock and no lamination. By contrast, the patent application label uses an acrylic-based glue that will self-destruct the label if it is removed from a case.

"Natural Language"

We display the information from a case on the CRT screen in standard words as well as in coding. Some examples are filing date, the applicant's name, and application location. The location is coded and is loaded by the bar code reader hardware address. The application information is available to the examiners, clerks, and the management. Also displayed is other bibliographic type information. As the system has grown the data base has been expanded.

The printer application involves preprinted forms. The forms are inserted in the printers and certain information is printed by the system on the form. This saves typing and improves the accuracy of the output. To get a print accomplished, the clerk takes the sheet of paper, inserts it in the sheet feeder, and scans the label of the case using a bar code reader. A print automatically occurs with the paper ejecting. Some of these papers are sent by themselves; some are added as cover sheets to other documents. The printers are distributed throughout the user areas.

All of these devices are cabled through multiplexers to the mainframe. We have approximately 130,000 feet of cable running through Crystal City.

The Application Flow

The best way to describe PALM3 is to describe the application flow and how the system interacts with it. In the mailroom we receive from 450 to 1,350 applications per day. In the earlier system when a folder was being built, 10 blank punch cards were inserted. Today the bar code label is affixed for later scanning. The data base already has records established and a scan activates that record in the system.

The application folders are then grouped into batches where they go through administrative processing and capture bibliographic information. All through the process of moving cases and changing status, bar code transactions are entered. As soon as the case enters the office, information can be displayed. An examination group can look at data on cases that are in administrative processing even though they don't have the physical folder. After administrative processing, the case moves to the examination area.

The case is logged into the examination area using the bar code reader. At the time that it is logged in, it is also assigned to the examiner's docket through some other transactions. Examiners can later retrieve the file, charge it to themselves, and begin the actual legal examination of the application.

The Examination Process

From this point, the examination process today is all manual. It involves the examiner's going to and looking at paper copies of documents, using his prior experience of what things have been patented earlier, looking at any new legal precedents that have come out, and deciding whether this application is patentable. It is rare that a case becomes a patent exactly as it is submitted the first time. So even if the idea is patentable, the examiner will write guidance to the applicant as to those things about the application which are not patentable. That becomes an office action. The examiner takes preprinted forms, makes notes on them, and sends them to typing where they are scanned again to indicate they are in typing. Then the actions are created on off-line word processing equipment. When finished, the action goes back to the examiner for signature, the cover sheet is generated from the printer, and the action is mailed out to the applicant. Then the application is rescanned and refiled. This process is repeated every time the case moves or an action is taken.

Simple Transactions

In the most simple of the transactions, the bar code reader sends in a transaction, it is validated for certain edit checks, and it updates the file. Another type of transaction occurs when a CRT retrieval is required that is restricted to certain individuals. In that event, the bar code reader is used to initiate the transaction, it is validated against the data base, and then the formatted output is sent to a printer or CRT. A third transaction type is an update to bibliographic information or prosecution information. When that is required, to insure that the individual has the case, it is scanned with the bar code reader and a password. This password is a bar code label generated for each person in which the human readable characters have been cut off the bottom and the characters building the password are non-displayable on the bar code reader. The user does not know what the password is. The transaction goes through validation and retrieval and sends out data to the CRT screen. From that point on, the CRT screen is used to complete the update.

Menus

As the system has evolved we have made some additional uses of bar code labels. One of the things that we found very useful are menus. A lot of the common transaction codes have been put into a book. The clerk can use the book to pick the labels that are appropriate for the data that needs to be entered. The bar code reader will accept a scan or key entry for any data field. We found this very useful because it saves the extra key strokes and increases productivity.

Extensions of the System

We also produce labels for all Government owned equipment. These are used to perform inventories of Government owned equipment such as desks, cabinets, calculators, and lamps.

The scope of the application system has also been expanded. In what we call Phase III of PALM3, we implemented an examiner reporting system. We also added the Board of Appeals system to track cases that are appealed, and a Cash Receipts system to help our financial management.

Current Systems Network

Year	Avg. Trans./Mo.	Total Transactions
1980*	405,625	2,028,129
1981	475,118	5,701,420
1982	576,539	6,918,468
1983	978,371	11,740,454
1984	1,333,487	16,001,848
1985**	1,677,865	10,067,194

*August-December only
**January-June only

Figure 1

Figure 1 illustrates the growth of the system. The users, in defining requirements, estimated a maximum peak volume on the system of 10,000 transactions a day. The second full day of operation the volume was 11,000 and that was before about 3/4 of the software had been implemented. The system has been steadily growing. The mainframe computer has been upgraded 4 times to handle the load which is now approximately 80,000 transactions a day from 540 terminals. It has been very successful.

Getting Rid of the Paper Problem

Our real need is to get rid of the paper problem all together. We are currently developing an Automated Patent System to do just that. We are beginning to capture both text characters and images. These will be stored in a totally electronic form and accessed via a new local area network. The design is for distributed processing system and the first phase will become operational in the next year. We have approximately 32 terabytes of data in image form to store in the system. In the end the examiner, instead of walking to a bar code reader or CRT terminal, will have dual screen workstations, local storage, local printing, and a capacity to do a great number of functions such as word processing and full text and image searching of the data bases. The project is due to be completed about 1990.

We have been very fortunate with our bar code system, we have been very pleased with it, and it certainly met the objectives for which it was designed.

Ω

Daily Surveillance Sheet, 1987, from a Nationwide Data Bank

Dennie Van Tassel
Head Programmer
San Jose State College
125 S. 7th St.
San Jose, CA 95114

(This famous article on privacy by Dennie Van Tassel was printed first in "Computers and Automation", predecessor of "Computers and People", 17 years ago in October, 1969. Then it was printed for the second time in "Computers and People" 11 years ago in August, 1975. Now it is printed for the third time in "Computers and People" for March-April, 1986.)

The "Daily Surveillance Sheet" below is offered as some food for thought to anyone concerned about the establishment of an official or a de facto "National Data Bank." Hopefully, it will help illustrate that *everyone* should be concerned.

NATIONAL DATA BANK
DAILY SURVEILLANCE SHEET
CONFIDENTIAL
JULY 11, 1987

SUBJECT. DENNIE VAN TASSEL
SAN JOSE STATE COLLEGE
MALE
AGE 38
MARRIED
PROGRAMMER

PURCHASES.

WALL STREET JOURNAL	.10
BREAKFAST	1.65
GASOLINE	3.00
PHONE (328-1826)	.10
PHONE (308-7928)	.10
PHONE (421-1931)	.10
BANK (CASH WITHDRAWL)	(120.00)
LUNCH	2.00
COCKTAIL	1.00
LINGERIE	21.85
PHONE (369-2436)	.35
BOURBON	8.27
NEWSPAPER	8.10

** COMPUTER ANALYSIS **

OWNS STOCK (90 PER CENT PROBABILITY)

HEAVY STARCH BREAKFAST. PROBABLY OVERWEIGHT.

BOUGHT 3.00 DOLLARS GASOLINE. OWNS VW. SO FAR THIS WEEK HE HAS BOUGHT 12.00 DOLLARS WORTH OF GAS. OBVIOUSLY DOING SOMETHING ELSE BESIDES JUST DRIVING THE 9 MILES TO WORK.

BOUGHT GASOLINE AT 7.57. SAFE TO ASSUME HE WAS LATE TO WORK.

PHONE NO. 328-1826 BELONGS TO SHADY LANE - SHADY WAS ARRESTED FOR BOOKMAKING IN 1972.

PHONE NO. 308-7928. EXPENSIVE MEN,S BARBER - SPECIALIZES IN BALD MEN OR HAIR STYLING.

PHONE NO. 421-1931. RESERVATIONS FOR LAS VEGAS (WITHOUT WIFE). THIRD TRIP THIS YEAR TO LAS VEGAS (WITHOUT WIFE). WILL SCAN FILE TO SEE IF ANYONE ELSE HAS GONE TO LAS VEGAS AT THE SAME TIME AND COMPARE TO HIS PHONE CALL NUMBERS.

WITHDREW 120.00 DOLLARS CASH. VERY UNUSUAL SINCE ALL LEGAL PURCHASES CAN BE MADE USING THE NATIONAL SOCIAL SECURITY CREDIT CARD. CASH USUALLY ONLY USED FOR ILLEGAL PURCHASES. IT WAS PREVIOUSLY RECOMMENDED THAT ALL CASH BE OUTLAWED AS SOON AS IT BECOMES POLITICALLY POSSIBLE.

DRINKS DURING HIS LUNCH.

BOUGHT VERY EXPENSIVE LINGERIE. NOT HIS WIFE,S SIZE.

PHONE NO. 369-2436. MISS SWEET LOCKS.

PURCHASED EXPENSIVE BOTTLE OF BOURBON. HE HAS PURCHASED 5 BOTTLES OF BOURBON IN THE LAST 30 DAYS. EITHER HEAVY DRINKER OR MUCH ENTERTAINING.

*** OVERALL ANALYSIS ***

LEFT WORK AT 4.00, SINCE HE PURCHASED THE BOURBON 1 MILE FROM HIS JOB AT 4.10. (OPPOSITE DIRECTION FROM HIS HOUSE.)

BOUGHT NEWSPAPER AT 6.30 NEAR HIS HOUSE. UNACCOUNTABLE 2 1/2 HOURS. MADE 3 PURCHASES TODAY FROM YOUNG BLONDES. (STATISTICAL 1 CHANCE IN 78.) THEREFORE PROBABLY HAS WEAKNESS FOR YOUNG BLONDES.

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Newsletter – *Continued from page 3*

Within the past year, Sydney has licensed for sales AT&T Information Systems in the U.S., British Telecom in Britain, Canada's AES Data Inc., Siemens AG and Nixdorf, both of West Germany, and the Olivetti Corp. of Italy. AT&T has already sold one package for $45 million to the U.S. Customs Service.

Paul Gilmore, who co-ordinates government grants for computer research at the university, said for now the software package is aimed at large computer users. Within a year or two, once large users are established in a network, the software may be made available to home computer users, he said.

Until now, different brands and makes of computers couldn't communicate with each other electronically without cumbersome program packages.

Using grants from the federal government's Natural Sciences and Engineering Research Council, Neufeld finished his work and handed it to Sydney for marketing in 1985. Ω

CACBOL – *Continued from page 2*

Barry Trager, IBM Thomas Watson Research Center, Yorktown Heights, New York, USA
Hans van Hulzen, Twente University of Technology, Enschede, The Netherlands
Volker Weispfenning, Universitat Heidelberg, FRG
Hans Zassenhaus, Ohio State University, Columbus, Ohio, USA
Horst Gunter Zimmer, Universitat des Saarlandes, Saarbrucken, FRG

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6 APHORISMS OR QUOTATIONS (List 860302)

To hear is one thing; to know is another.
- the Jackal

When the Jackal admits he is gray, how black must the Jackal be!
- the Adjutant-Bird

Flattery is the best way of getting things to eat.
- the Jackal

(please turn to page 20)

Technological Surveillance: 1985 in the U.S.A.

Ross Gelbspan, Staff Reporter
The "Boston Globe"
135 Morrissey Blvd.
Boston, MA 02107

"The National Crime Information Center's responses include at least 12,000 invalid or inaccurate personal records each day."

Based on *Technology Brings Fears of an Era of Big Brother* by Ross Gelbspan, published by and copyright 1985 by the *Boston Globe*, Dec. 5, 1985, and reprinted with permission.

"He knew that for seven years the Thought Police had watched him like a beetle under a magnifying glass. There was no physical act, no word spoken aloud, that they had not noticed, no train of thought that they had not been able to infer." -- George Orwell, in the novel "1984"

In conferences and publications in 1984, Americans celebrated the fact that the United States had not succumbed by 1984 to the pervasive state surveillance that George Orwell had detailed in 1949 when his book was published.

But today a growing number of commentators say that a technologically driven explosion of space-age surveillance devices may be bringing a similar scenario much closer to reality than most people believe.

Technical Innovations in Surveillance

"Technical innovations [in surveillance] have ... become penetrating and intrusive in ways that previously were imagined only in science fiction," notes sociology professor Gary T. Marx of MIT's urban studies department.

Just 10 years ago, most surveillance consisted of court-approved wiretaps, video cameras in sensitive areas and airport metal detectors.

By contrast, a survey last month of 35 federal agencies by the Congressional Office of Technology Assessment found that government officials are currently using or planning to use such surveillance devices as:

- Massive computerized databases capable of tracking individuals' transactions and activities.
- "Starlight scope" systems to watch people at night.
- Helicopter and satellite cameras to identify people in crowds and track individuals.
- A profusion of remote listening and recording devices, such as miniaturized bugs and remote parabolic microphones, which often eliminate the need for court-approved wiretaps.
- Closed circuit television cameras for visual surveillance.
- Automatic telephone switching equipment that records the time, length, origin and destination of telephone calls.
- Electronic beepers to track automobiles.
- Urine tests which detect past or current drug use.
- More lie detectors to assess employee honesty and discourage unauthorized leaks of information.
- Devices to monitor and intercept electronic mail.

Computerized Record Systems of Federal Agencies

The most alarming of the new surveillance technologies to privacy advocates lies in the computerized record systems of federal agencies.

The massive databases either contain or can acquire a person's medical and job histories, educational background, credit card purchases, bank transactions, tax payments, automobile records, applications for government aid, contributions to charity, subscriptions to publications and even library withdrawal records, among other things.

Electronic Trails

"Agencies can compile an electronic trail of where someone has been and what he has done," said professor George B. Trubow of the Center for Information Technology at John Marshall School of Law in Chicago. "The average person doesn't have the slightest idea what is happening in the development of computer surveillance technology. In pursuing efficiency, agencies are putting things in place that have potential for enormous invasions of individual privacy," he added.

While MIT's Marx is concerned about a widespread "climate of suspiciousness," others fear that an outbreak of serious social or economic disruption could lead the government to mobilize the surveillance apparatus against dissident segments of society.

Civil Liberties

"That's not just idle speculation," said Jerry Berman, legislative counsel of the American Civil Liberties Union. "The technology is on line. The government can link its record systems together whenever it wants -- whether to combat terrorism, subversion or even social deviance."

Most computerized record systems reside with agencies such as Health and Human Services, Social Security and Medicaid which deal with clients, as well as state and local governments.

Fraud Detection and Law Enforcement

Government officials say computerized records enable them to better audit agency performance and to detect fraud by aid recipients. But critics say that, by comparing one agency's records against those of another -- or against private records -- agencies can use records for purposes other than auditing.

A growing number of databases are also used by law enforcement agencies. Last week, for example, defense officials attributed their success in arresting 13 Americans on espionage charges this year to the dramatic expansion of domestic surveillance.

According to the recent Office of Technology Assessment report, 85 computerized record systems used for law enforcement, investigative or intelligence purposes currently contain 288 million records on 114 million people. That represents half the population of the United States. And the figure does not include data held by the Central Intelligence, Defense Intelligence and National Security Agencies.

Inaccurate Output

The FBI's National Crime Information Center is used by federal, state and local police nearly 400,000 times a day to check people stopped for traffic violations, as well as those suspected of serious crimes. It contains records on some 9 million people.

Yet, despite an FBI audit showing that the NCIC computer's responses include at least 12,000 invalid or inaccurate personal records each day, officials are currently proposing to expand those records to include files on white collar and organized crime and to use data from such quasi enforcement groups as campus and railroad police.

"No one slice hurts, but suddenly the whole sausage is gone."

That steady growth in the gathering and exchanging of data is "like the salami technique," said Trubow of the Marshall Law School. "No one slice hurts. But suddenly the whole sausage is gone. People can be kept under surveillance constantly by computers. It's a scenario for a very scary environment."

National Data Bank

During the Carter administration, a proposal for a national database had to be withdrawn after intense opposition from critics concerned about the specter of "Big Brother."

But Mary Gerwin, an aide to Sen. William Cohen (R-Maine), noted that the current system of links between computerized files of federal, state and private agencies "presents the same kind of national databank that was opposed in the 1970s."

Gerwin is concerned about an administration proposal that would provide taxpayers' IRS records on unearned income to agencies which administer veterans' benefits, Pell college grants, guaranteed student loans, low-income housing aid, black lung benefits and federal employee benefits -- programs that serve millions of citizens. The same proposal would also permit agencies to check the private individual and company-sponsored insurance records of all citizens.

"This isn't an infringement, and we are asking for very little in the way of records," Office of Management and Budget spokesman Steve Tupper said. "We're just asking for the states to do a little more checking because we're losing $300 million a year that's going out to the wrong people."

Personal Dossier

But the ACLU's Berman said the proposal "will result in a de facto national data center in which government agencies will be able to reach into hundreds of different computerized files and build a personal dossier on any man, woman or child who has been selected for examination."

In the last few years, critics have focused on such procedural remedies as due process for people identified by computers as, say, welfare cheats. Others want to amend the Privacy Act to limit Congressional authorization of computer matches.

"Congress only responds to a clearly identified abuse."

But a recent ACLU position paper, citing the limitations of such piecemeal solutions, concluded that "we must change the terms of the debate to include these larger concerns about the society we are creating."

"Unfortunately," concluded Trubow, "Congress only repsonds to a clearly identified abuse. We don't have that right now. We're just laying the foundation for it.

"But when the abuse begins taking place, it's going to be too late to stop it," he said.

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CACBOL – *Continued from page 17*

He who watches long shall at last have his reward.
- the Crocodile

A little thought is like salt upon rice.
- the Crocodile

Adding the tail to the trunk, I make up the whole elephant.
- the Crocodile

(Source: from "The Undertakers" in "The Second Jungle Book" by Rudyard Kipling, Charles Scribner's Sons, 1899, 228 pp; slightly edited)

Ω

Young – *Continued from page 11*

some 60 million knowledge workers. Only about 10 to 15 percent of those have PCs. There's not only room for us to grow; there's plenty of reason to.

We in the U.S. are part of an interdependent and highly competitive global economy. We're competing against nations where people get paid a whole lot less than we do -- no matter what their job classification.

There's only one way to keep the high standard of living that we've come to expect: We have to add more value. We have to work more productively and more creatively than our competitors. Information technology is what makes it possible for us to do that. It's our strongest competitive advantage.

Preparing for the Marathon

So we in the personal computer industry still have many contributions to make. Our industry has only paused, and it will regain its momentum. Let's make use of that pause to prepare ourselves for the marathon race. We will survive, we will thrive:

- if we acquire the self-discipline in business fundamentals needed to succeed in the long-haul;
- if we build business relationships based on mutual benefits, trust, and integrity;
- if we remember that the PC is only a means to an end, and that the end is to help people work more effectively;
- and if we accept the challenge of taming the computer and making its magic useful to the millions of people who need to tap its power.

That's my agenda for survival. And I'm the first to admit it's an unfinished one. I can't say that Hewlett-Packard has completed any of those four items. No company has, and no one ever will.

Our ability to survive in the years ahead doesn't depend on scratching these challenges off our list as completed. Rather, success depends on pursuing these ideals with the relentless commitment and endurance of a marathon runner.

Ω

Knowledge Processing and Conventional Data Processing: The Differences

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"Conventional computer systems aren't stupid . . . but they are ignorant: they don't know how to interrelate data to produce knowledge."

Based on an account in the *Artificial Intelligence Letter* of Texas Instruments, for January, 1986; no copyright; reprinted with permission.

Machines That Reason

Computer scientists have at last produced machines that reason -- but they look just like the familiar old computers we're used to. So where's the excitement?

The excitement isn't in what knowledge-based systems look like; it's in what they do -- and what they'll be able to do.

There's no big difference yet in the hardware. Indeed, a few of the older knowledge-based systems still run on the same computers that have been used for years to calculate things like payrolls. Newer systems are both developed and delivered on conventional personal computers. The personal computers (PCs) need to have a lot of additional random-access memory (RAM), and it's organized and controlled in a radically different way, but the chips haven't changed.

Even LISP machines, the powerful computers designed expressly to facilitate the development of knowledge-based systems, are not remarkably different in the hardware they use. One system, for example, employs a variant of the LISP language, and the organization and control of its memory are entirely different from those of a conventional computer, but the hardware is much the same. The big differences are in the software.

Knowledge-Based Systems Manipulate Knowledge

There are three essential differences between data processing and knowledge processing software:

Difference #1: Conventional software represents and manipulates data, but knowledge-based systems represent and manipulate knowledge. This distinction isn't very helpful unless you recognize the difference between "data" and "knowledge." The dividing line is fuzzy, but for our purpose, data are isolated bits of information whose relationships to each other and to the real world are not known. Knowledge is facts related to each other and the real world well enough to serve as a basis for intelligent action.

Imprecise definitions like those deserve a vivid example: You're a supervisor of a natural-gas pumping station, and notice that the special pipeline to the nearby copper smelter shows a flow of 12,000 cubic feet per minute. That's data. An isolated bit of information. It has no useful meaning until it's related to the other data on flow rates in that line, and to an interpretation of what an abnormally high rate might mean in the real world.

You've watched that pipeline for a year, and you've never seen a flow rate over 11,000 even with the smelter going full blast. Now, you've related that single datum to all the other data. You call the smelter manager, and he reports that his gas pressure has dropped. Now, you've related the datum to the real world. You can now infer new knowledge by correctly combining just a few facts.

Swiftly, you close the cutoff valve to that line, dispatch your emergency crew, call out the nearest fire department, and hope to hear sirens instead of a big bang.

Conventional computer systems aren't stupid. Anything that can perform differential calculus in seconds shouldn't be called stupid. But conventional computer systems are ignorant. They don't know how to interrelate data to produce knowledge, because we haven't been able to tell them how to do it, until now.

Knowledge-Based Systems Use Rules from Experience

Difference #2: Conventional software can use only algorithms, but knowledge-based (KB) software can use both algorithms and heuristics. Folks who use jargon like that earn a lot of money, but if you're content to think of algorithms as equations, and heuristics as rules-of-thumb, you won't be far off the mark.

Typical algorithm: The number of gallons of gasoline you buy, multiplied by the price per gallon, equals the total price you pay. Every time. Rain or shine. Cold weather or hot. Precisely. Put the same numbers in; get the same number out. Conventional data processing software can calculate it flawlessly, several thousand times a second.

Typical heuristic: It's the first really cold day of winter, and snow is falling as you walk to your car after work. It absolutely won't start. When the tow truck finally arrives, the driver pulls up nose-to-nose with your car, pops open his hood, and walks toward you with jumper cables in his hand. He hasn't talked to you or examined your car, but he's prepared to give you a jump start. Why? Heuristic knowledge. He knows from experience that there's a 94% probability a jump start will get you on the road again. Other things could be wrong, of course. You can insist that he begin with first principles and make a thorough, methodical examination of your car's systems before beginning a systematic diagnosis. But you'll get home late, cold, and impoverished, bereft of one mechanic friend. Without our frequent use of heuristics, everyday life would be unendurable, and science and engineering would be virtually undoable.

So knowledge-based systems use algorithms wherever they're available, to make the knowledge precise. But they also use heuristics where the knowledge cannot be made precise and certain -- or where it's not economical to be precise. Because heuristics "play the odds," most KB systems assign certainty factors to inferences drawn with the use of heuristic knowledge at some point. For example, the KB system would report your gasoline bill "with a certainty of 1.0," but its recommendation to try a jump start first, "with a certainty of 0.94."

Whether you're the least bit interested in KB systems or not, it's a sheer delight to see a formerly arrogant and overbearing computer imply, for the first time ever, "I may be wrong, but ..."

Knowledge-Based Systems Use Reasoning Processes

Difference #3: Conventional software uses repetitive processes, but KB software uses inferential processes. The hallmark of conventional software is the totally reliable and accurate repeating of the same routine throughout a particular job. If you have dividend checks to prepare for a million stockholders, and your board has declared a dividend of 25¢ a share, you want the precise algorithm applied repeatedly, to the penny. It's not up to the computer to decide that paying 20¢ a share will save earnings to plow back into the growth of the business, or that paying 30¢ a share will impress the security analysts.

But it is a responsibility of the board to make such determinations, based on hundreds of factors -- only a few of which can be neatly reduced to equations. A simple KB system might help make this decision process more effective -- not faster, but better. Because KB systems can draw inferences. That is, they can take facts, relate them in logical ways, and thereby produce new facts.

To accomplish this, KB software is constructed to carry out "symbolic reasoning." "Symbolic," because both the facts and the way they're related are put into the computer, and are reported out of the computer, not as numbers but largely in human words (a system of symbols we've developed over the last million years or so), having been manipulated according to strict rules of logic (which philosophers have developed over the last 2500 years or so). "Reasoning," because that's the word we use for the process of drawing inferences or conclusions from facts known or assumed.

Reasoning, as defined, may clearly be done in a machine or in a human brain, just as arithmetic may be done in a calculator or in the brain. Whether any of this is "thinking" need not divert us here -- though it does make a diverting debate.

The three essentials of a KB system, then, are: Ability to manipulate knowledge; ability to handle both algorithms and heuristics; and ability to make inferences.

If one of those three essentials is missing, whatever you have, it's not a KB system. But in addition, most KB systems have a number of characteristics in common to a greater or less degree. We can touch on them only lightly here, but the usefulness and acceptance of KB systems will depend heavily on their development:

An Explanation Facility

Unlike conventional data processing systems, most KB systems are able to explain how they arrived at their conclusions and recommendations. Some can display the chain of inferences they used. Others can cite particular rules they used at each point in the chain. Others can do both. This capability is vitally important because: it permits the human experts to correct most faults they've built into the system; it makes clear to the user what shaky assumptions or uncertainties had to be used to arrive at the conclusion; and it gives users a greater confidence in the results if they understand the rationale underlying each recommendation.

Metaknowledge is knowledge a system has about its own knowledge. Explanation facilities are one kind of metaknowledge, because they show that the system knows how it used its knowledge to arrive at the conclusion. Other metaknowledge abilities just now being developed will help KB systems adjust their explanations to the interest or level of knowledge of the user, or to correct their rules as more is discovered or learned, or to "rank" explanations according to plausibility when more than one diagnosis fits all facts.

Asking the "Right" Questions

Any high school student can work out the value of "e" in the equation $e=mc^2$. It's a simple matter of "turning the mathematical crank," knowing m and c. But formulating the equation required an Einstein. Much of the work and value of human experts lies in their ability to help clients "ask the right questions."

In a knowledge-based system designed to help decision-makers minimize business taxes, for example, a "depreciation choices" subprogram might lead the user through a series of questions about the type of asset, its service life and scrap value, as well as tax-law constraints, thereby helping the user to choose among straight-line, declining balance, and sum-of-the-years-digits methods of calculating depreciation. With that selection made, and the few variables plugged into the appropriate equation, the problem is essentially solved. All that remains is to press a key that turns the mathematical crank.

Looking up Knowledge

Some of today's KB systems are still being designed to run in isolation, without being able to "look up" reference knowledge beyond what's incorporated in the KB software itself. But it's a rare human expert that can work this way. Medical specialists require frequent access to the literature and medical statistics. Lawyers must search for and review precedent. Engineers must refer to extensive reference tables. And business consultants cannot function without flexible access to company records as diverse as quality control statistics and return on investment.

Such access will also contribute greatly to the "depth" of KB systems -- their ability to help solve very complex problems in their specific domains. And it will contribute to their "breadth" or "robustness" -- by bolstering their ability to suggest alternate valid problem-solving approaches when faced with incorrect data in carrying out an initial approach, say, or when the rules governing another approach are incomplete. A human expert easily adapts the approach to the kinds and quality of data available. KB systems will be able to make such preliminary surveys of the data available -- but only if they have ready access to the data bases.

In contrast, nearly all conventional data processing programs do little of this, with the exception of champion game-playing programs as in checkers and backgammon, and almost-champion chess-playing programs. Locked into their algorithms and their need for complete and almost precise data, and limited to using only the body of data prescribed for them, they are super-efficient giant calculators -- but they are not necessarily effective problem-solving assistants.

Artificial Intelligence technologies -- and in particular today, knowledge-based systems -- represent a giant step toward man's full realization of the power of computers.

Reference

If a reader is interested in more information about these ideas and more examples, we suggest that he or she take a look at the TI Explorer™ system and the form of LISP language called COMMON LISP™ .

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Annual Index

for "Computers and People", 1985, Volume 34

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The Computer Almanac and Computer Book of Lists (CACBOL)

Games and Puzzles for Nimble Minds and Computers

Military Control of Over Half of Computer Science Research is Excessive

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"To the extent that academic research is correlated with military objectives, academic freedom suffers. . . . Academic research and development thrives on openness."

Computer science is not a branch of military science.

But the Department of Defense (DoD) now directs over half of academic research in computer science. This is too much.

Civilian applications are suffering because of excessive military spending on research and development (R&D). For example, the people of the United States are unable to take full scientific and commercial advantage from the research sponsored by the DoD on the communication network of the Advanced Research Projects Agency (known as the ARPANET). For the past five years, most federal funding for networking has gone into transforming the concepts of the ARPANET into a military product, called MILNET. Civilian networking has therefore become a low funding priority, despite the great advantages that would accrue to industry and science.

Lacking strong federal support, the development of a national network will be left to private industry. Most likely, we'll endure a tower of Babel: VAXes running UNIX that can't talk to PC/XTs running PC/DOS, and much more. The National Science Foundation (NSF) or the National Bureau of Standards (NBS) would have to spend hundreds of millions of dollars to hire the talent necessary to prevent this. But only military R&D projects command major federal attention these days.

In scientific terms alone, there would be more payoff from a national network development project than from several Star Wars. All scientists and engineers could be in immediate contact with each other. We could circulate our manuscripts and journals on-line. (This is already starting to happen in computer science, but we are hampered by the lack of a standard typesetting language.) With sufficient funding, all scientists might even get convenient access to on-line libraries.

Instead of working toward civilian or broad scientific goals, most of our academic software experts work on projects of military need. In the recent past, their talents were devoted to a crash program to develop the Ada language. In the immediate future, this expertise will be mobilized to work on the Strategic Defense Initiative. There will be little beneficial "fallout" to civilians from these projects, especially in view of the inability to transform ARPANET into a civilian product.

Statistical Evidence of Military Dominance

Comparing the academic R&D computer funding situation of today to that of a decade ago, civilian applications are lagging. In 1976, most basic research in academic computer science was funded by NSF, 69%. In 1985, NSF's funding share was about 31%, significantly less than DoD's. When applied research money is added in, DoD's preeminence is even more marked. Allowing $25 million for industrial, state, institutional, and other academic computer science (CS) research support in 1985, most academic CS research is now directed by military agencies.

It's surprising that NSF has even 31% control over academic computer science research, when one considers how military R&D budgets have mushroomed over the last decade. In 1976, half ($10 billion) of all federal R&D funds were allocated to national defense. The proposed 1986 federal budget allocates almost three-quarters ($42 billion) of its R&D to military purposes.

The outlook for federally-funded R&D for civilian applications is poor by comparison. Federal military R&D will rise by $8 billion from 1985 to 1986. This single-year funding increment is more than five times NSF's total budget, $1.4 billion. Among other things, this means NSF will continue to lose control over academic CS research.

According to Dr. Leo Young of DoD, his agency will spend 25% of its 1985 R&D budget on electronics and computer science. DoD's $10.5 billion on electronics and computers R&D in 1985 is comparable to the combined $10.8 billion spent by the "information technology" industry in 1983. Assuming a 20% growth rate for industrial R&D expenditures, these figures indicate that DoD now supplies about 40% of all computer-related R&D funds in the nation. When one considers that a significant fraction of industrially-funded R&D is aimed at the military market, it is safe to conclude that well over half of all computer-related R&D in the United States is directed toward military goals.

Effects of Military Control of Academic CS R&D

The harmful effects of military control of academic computer science research are as follows: it exacerbates a shortage of trained personnel; it has a chilling effect on academic freedom; it threatens the development of our scientific foundations; and it does not serve the national interest. Similar concerns have been voiced by many persons.

Personnel Shortage

The current shortage of computer scientists is widely felt. The Association for Computing Machinery (ACM) lists hundreds of unfilled academic positions. According to Jack McCredie of DEC, industrial R&D projects are limited by personnel, and not by internal R&D funds. Meanwhile, DARPA is sewing up the academic R&D market. According to a recent brochure, "the number of graduate students and faculty working in [Strategic Computing] has increased. The number of graduate students working on DARPA research projects in each of the next two fiscal years [1986 and 1987] is expected to double."

Academic Freedom

To the extent that academic research is correlated with military objectives, academic freedom suffers. It's not hard to find the reason why. Academic R&D thrives on openness, but militarily-sensitive data must be withheld from the enemy.

For academicians doing basic research with military implications, the price is clear. We are ordered not to divulge our results to colleagues overseas, especially if those colleagues happen to live in the Soviet Bloc. A case in point: a full professor refused to send a copy of his student's Ph.D. dissertation to my co-author on a recent research paper. His reason was that he didn't want to risk offending his military sponsor by sending a technical report to Czechoslovakia. Ironically, the report was classified "distribution unlimited".

Over the last few years, I have noticed other areas of friction. DoD keeps tightening the screws on pre-publication review clauses. These were enforced for the first time, as far as I know, in the Strategic Computing project. Papers must be submitted to one's funding agent thirty, sixty, or even ninety days in advance of publication, presumably to give DoD time to react to any disclosure of sensitive information. In August 1985, a tighter restriction was announced by the director of the Strategic Defense Initiative, Lt. General James A. Abrahamson. He stated that SDI researchers at universities may publish papers only after the subject matter passes "sensitivity checks" by SDI officials.

In 1981, DARPA asked the academic VLSI (very large scale integration) community to keep non-citizens (and especially one-year visiting faculty) away from our research equipment. CalTech agreed to do so, but fortunately the Berkeley, Stanford and MIT faculty refused to comply.

A final area of tension is that of technical conferences, the lifeblood of scientific communication. DoD (and NSA) reserve the right to cancel whole conferences on rare occasions, to "pull out" individual papers, and to require conference attendees to sign non-disclosure agreements. Again, concerted collective action has so far saved the day. The presidents of Institute of Electric and Electronic Engineers, American Physical Society, and ten other major technical organizations sent a letter to Caspar Weinberger that resulted in some reassurances. (It is humiliating to report that the ACM was not a signatory to this letter.)

To sum up, we are collectively holding the DoD at bay in its attack on academic freedom. It is possible to live with the duplicity of individuals who have informal, and ultimately unenforceable, understandings with their military patrons. My main worry is about the future. How long can our scientists and our organizations continue to resist the pressures that come with dependence on military funding?

Scientific Foundations

This year, most of the theoretical CS faculty here at Berkeley took a 15% cut in their NSF grant. I presume similar things happened across the nation. The message is clear: even theoretical researchers must apply for DoD grants. If individuals have to modify their research program somewhat, that's not so bad. If the whole field has to march to a military drum, that's a different matter altogether.

Because of the Mansfield amendment, if for no other reason, we cannot rely on the DoD to support basic science. The DoD's mission-oriented goals, and its boom-or-bust funding cycles, do not provide a good basis of support. A much more stable base could come from NSF's mechanism of peer review, if it were adequately funded.

Once upon a time, a DoD blanket grant could support a whole spectrum of academic activities, from artificial intelligence (AI) to hardware to software to theory. Now DoD's computer research is more closely directed. Strategic Computing couples AI to hardware, leaving traditional software in the lurch. Strategic Defense (Star Wars) may support software and a fragment of theory.

NSF has now been relegated to a role of "filling in the gaps" in DoD funding of academic computer science. It is not completely successful in this role, judging by the recent cuts in funding for CS theory.

The National Interest

Most scientists believe that their research is worthwhile, no matter who pays the bills. The fact that DoD currently pays the bills is usually viewed by academicians as a slightly unfortunate accident of history.

One problem with this state of affairs is that we are reluctant to criticize major R&D initiatives like Strategic Computing and Strategic Defense. To criticize one of these initiatives is, at least in the short run, destructive to our field of research. We're financially dependent on these major DoD initiatives.

As a result, we can rationally support any major R&D initiative. DoD's academic R&D initiatives are "blue sky" projects. Almost certainly, they won't deliver what was promised to Congress. They will, however, produce something: some scientific knowledge, some funding for us, some military payoffs, and perhaps even something of use to civilians.

Our support for military R&D initiatives is not in the national interest. Most of us realize we could do more for the nation if we spend less time on military projects. Too many of us are developing Ada and devising algorithms, software, and hardware for advanced radar systems. Not enough of us are worrying about what the nation should do to maintain its commercial strength in the fields of computer design and software engineering. Neither are we developing enough cross-disciplinary ties with other scientists and engineers. It's not entirely our fault: the funding just isn't there.

A Call for Change

We, as computer scientists, must prod our National Science Board out of its institutional lethargy. With our help, it could lobby Congress effectively for multi-billion dollar R&D projects of broad-based scientific and civilian interest.

We, as a nation, must somehow revitalize our Commerce Department. Our government's responsibility for promoting the nation's commerce is at present fulfilled only for the military-related industries. For example, Commerce should undertake a multi-billion dollar initiative in standardizing network protocols, operating system interfaces, and typesetting languages. It should also provide economical and efficient on-line access to the keywords, abstracts, and contents of all federally-funded technical reports and journal articles. With careful guidance from academics, the results would be beneficial to industry and the nation as a whole.

Finally we, as citizens, must prevail upon DoD to stop throwing our tax money at grandiose and impossible R&D initiatives. Our scientists and engineers do not have to be on a military dole; there is plenty of useful work for us to do.

References

For further information, more statistical evidence, and detailed references, please write to the author.

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Opportunities for Information Systems

COMPUTER-ASSISTED QUESTION-ANSWERER

Edmund C. Berkeley, Editor

How does a computer program do what it is supposed to do? How can we modify it?

If there is a corresponding written program in an understandable computer language including many short remarks well chosen by the original programmer, we have a good chance of determining the answer to any random question.

But if all that is available is a working binary program that operates correctly as of now, we have a very poor chance of knowing what is in the program and modifying it for some new function. The chance may be so close to zero that it is only sensible to write the program over again.

So let us have a COMPUTER-ASSISTED QUESTION-ANSWERER. For example, once I had a friend Lowell Hawkinson at the next desk, and I said to him "I can't make this sample symbolic program I have constructed assemble – what can I do?" He looked at my code, and then he said to me "Hm. Put a carriage return at the end of your symbolic program, and try that." I inserted one more symbol, and the program assembled. (In the Assembler Manual there was nothing whatever about Lowell's trick.)

On another occasion, I asked a friend Bob Froehlich, "How do I use the command TYPE in the CP/M operating system to type out a single line spaced file of a paragraph on the floppy disk in double line spacing? It ought to be something extremely simple, like moving the line spacing lever on my old typewriter." He said to me, "I know of no way you can do that with the command TYPE." Wow! I was so happy to know that my frustrating search was finished. Then he explained to me another way to get double line spacing using a different utility program.

A general question-answering program should be very easy to construct along the following rough scheme:

1. Make a list of a hundred or so topics in a field (usually, two or more syllable words).
2. Make a list of common ordinary ways in which common ordinary questions can be asked about topics (usually, one syllable words in patterns).
3. Seek to recognize the meaning of the question, no matter how it is worded.
4. Offer the meaning of the proposed question to the questioner.
5. If he says "yes," give him the answer.
6. If he says "no," try again.
7. Improve the question-answering system, through trials, errors, and feedback.

A market for this general question-answerer should be very large because it would help so many frustrated users of computers and other systems. Ω

Games and Puzzles for Nimble Minds and Computers

Neil Macdonald
Assistant Editor

NUMBLE

A "numble" is an arithmetical problem in which: digits have been replaced by capital letters; and there are two messages, one which can be read right away, and a second one in the digit cipher. The problem is to solve for the digits. Each capital letter in the arithmetical problem stands for just one digit 0 to 9. A digit may be represented by more than one letter. The second message, expressed in numerical digits, is to be translated using the same key, and possibly puns or other simple tricks.

NUMBLE 8603

```
      S L O W L Y
      *     R U N
  -------------
    R W N L D T S
  Y R T S O O U
W Y L D U Y D
---------------
= W S U W O S S U S
```

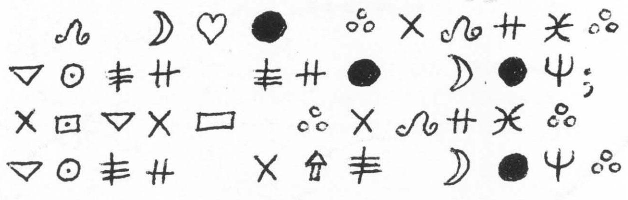
X9881 9108X X0117 119

Hint: X is a vowel.

MAXIMDIDGE

In this kind of puzzle, a maxim (common saying, proverb, some good advice, etc.) using 14 or fewer different letters is enciphered (using a simple substitution cipher) into the 10 decimal digits or equivalent signs, plus a few more signs. The spaces between words are kept. Puns or other simple tricks (like KS for X) may be used.

MAXIMDIDGE 8603



Our thanks to the following person for sending us solutions: Steven Schulman, Edison, NJ – Numble 8511, Naymandidge 8511, Maximdidge 8511.

SOLUTIONS

MAXIMDIDGE 8601: Times that are are better than times that were.

NUMBLE 8601: Closed fist gets closed eye.