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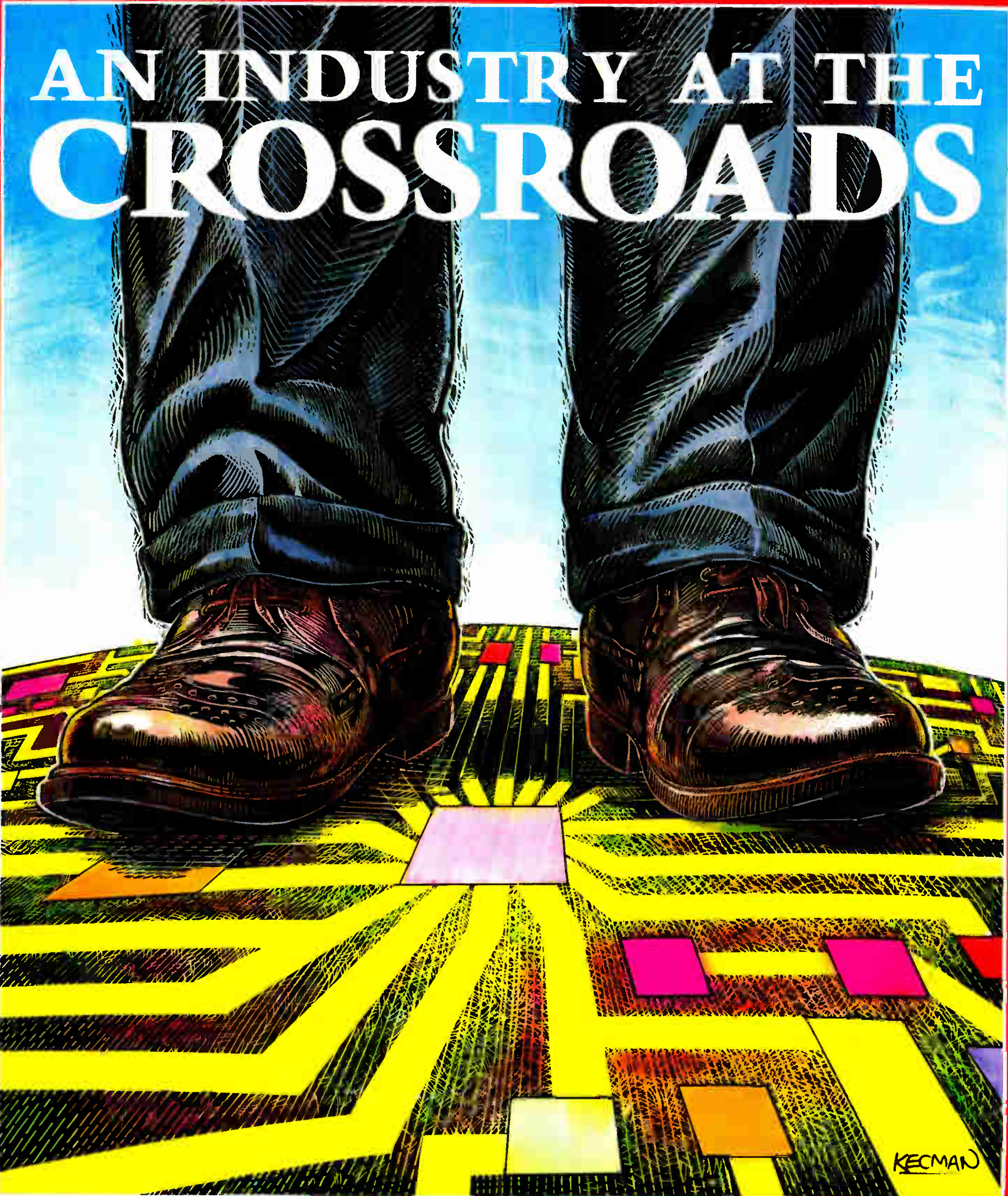
Electronics®

FIRST MAGAZINE OF GLOBAL ELECTRONICS MANAGEMENT

AN INDUSTRY AT THE CROSSROADS



HOW A STRATEGIC PARTNERSHIP WROTE A NEW CHAPTER ON SYSTEM PERFORMANCE:

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Achieving 24.2 MIPS at 25 MHz was no small task. Even for Digital.

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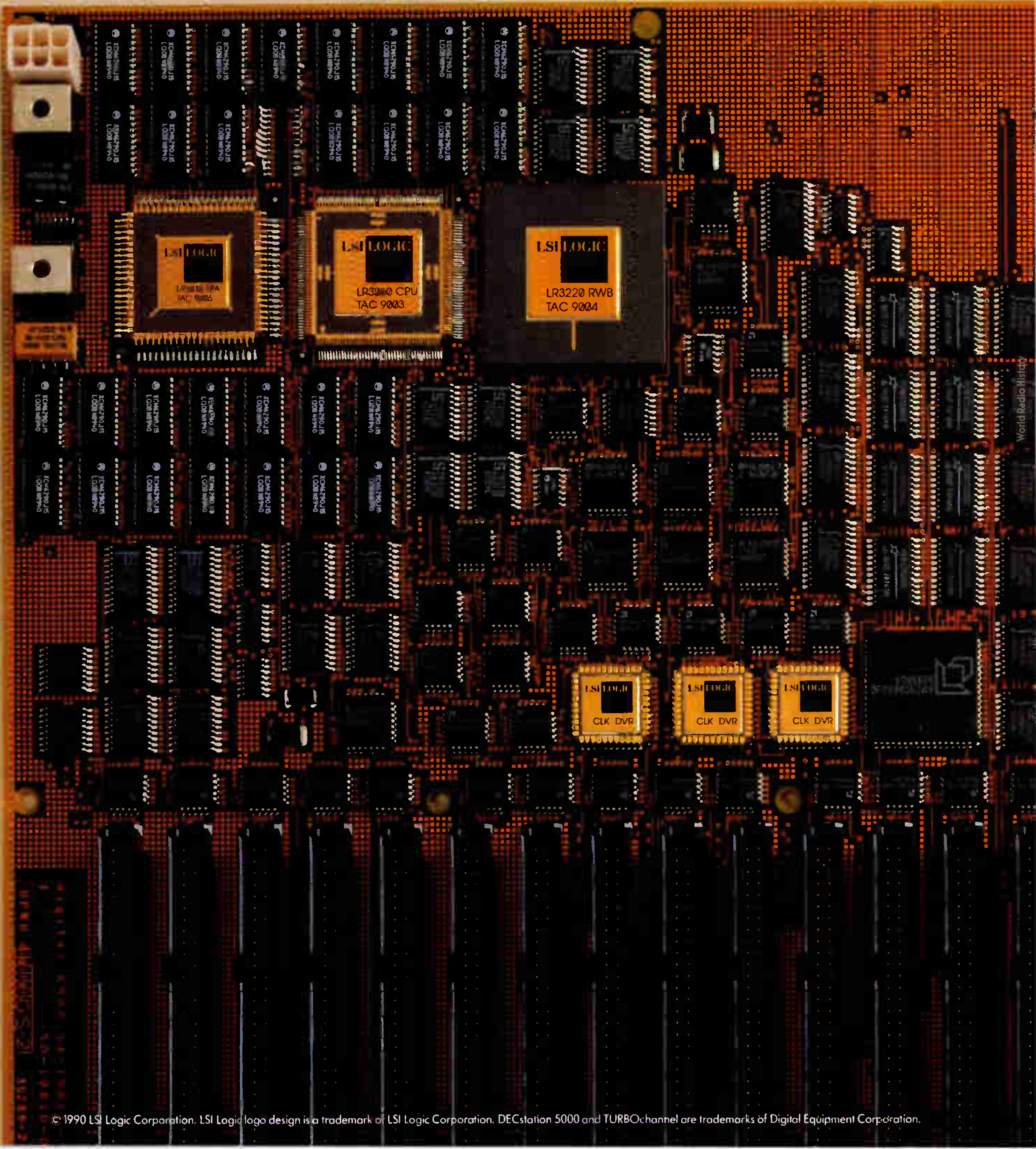

reality. In less than 11 months.

LSI's proprietary LR3220 read-write buffer performs memory write operations at the CPU clock rate, practically eliminating the bottleneck between the CPU and main memory. Boosting the processing power of the DECstation 5000 workstation to the limits of the price performance curve. A novel idea that delivers 120 Mbytes of main memory, dazzling high-end graphics and the new TURBOchannel I/O interconnect to the desktop, for under $15,000.

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ACROSS THE BOARD

According to Tom Furlong, Manager of Digital Equipment Corporation's RISC Workstation Group, "The level of performance achieved on the DECstation 5000 workstation simply wouldn't have been possible without LSI's ASIC methodology and their MIPS microprocessor expertise."

For the whole story call 408.433.7556, or write for a free white paper, "Writing a new chapter in workstation performance: DECstation 5000," LSI Logic, 1551 McCarthy Blvd, MS D102, Milpitas, CA 95035.

CIRCLE 176

Electronics

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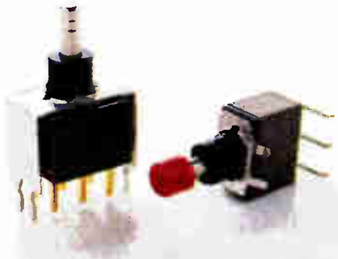


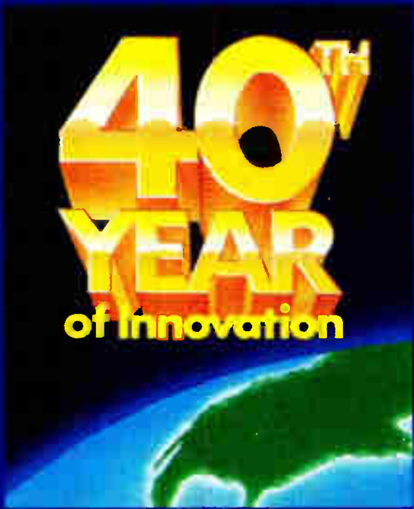
Washable M2B subminiature pushbuttons feature very-light-touch, snap-acting contacts. Straight, right angle, vertical PC terminals.

ULTRA-MINI

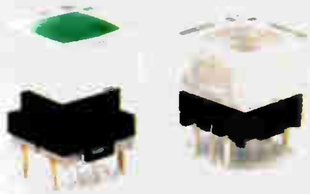
New ND switch is half the size of ordinary binary coded DIP rotaries. Washable and universal footprint pattern.

LEGENDARY

New compact, industrial-grade NB snap-in LED pushbutton with split legend up to 4 ways. Built-in resistor. Numerous options.

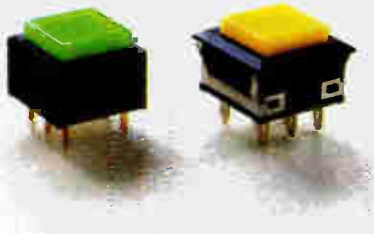


WORTH A MILLION



Million operations from unique LED illuminated JB keypad switch. Red, green or yellow LED options.

DOUBLE DUTY



Logic-level for PCB or power rating for snap-in panel mounting, from very low-profile UB pushbuttons with full-face LED illumination.

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Washable Binary Coded DIP rotary DR-A switch can be PC or panel mounted. Crisp operation. Right angle or straight terminals.

100,000 CHOICES

YB pushbutton yields literally 100,000+ part numbers with variations in mounting, illumination, circuitry and color.

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UP

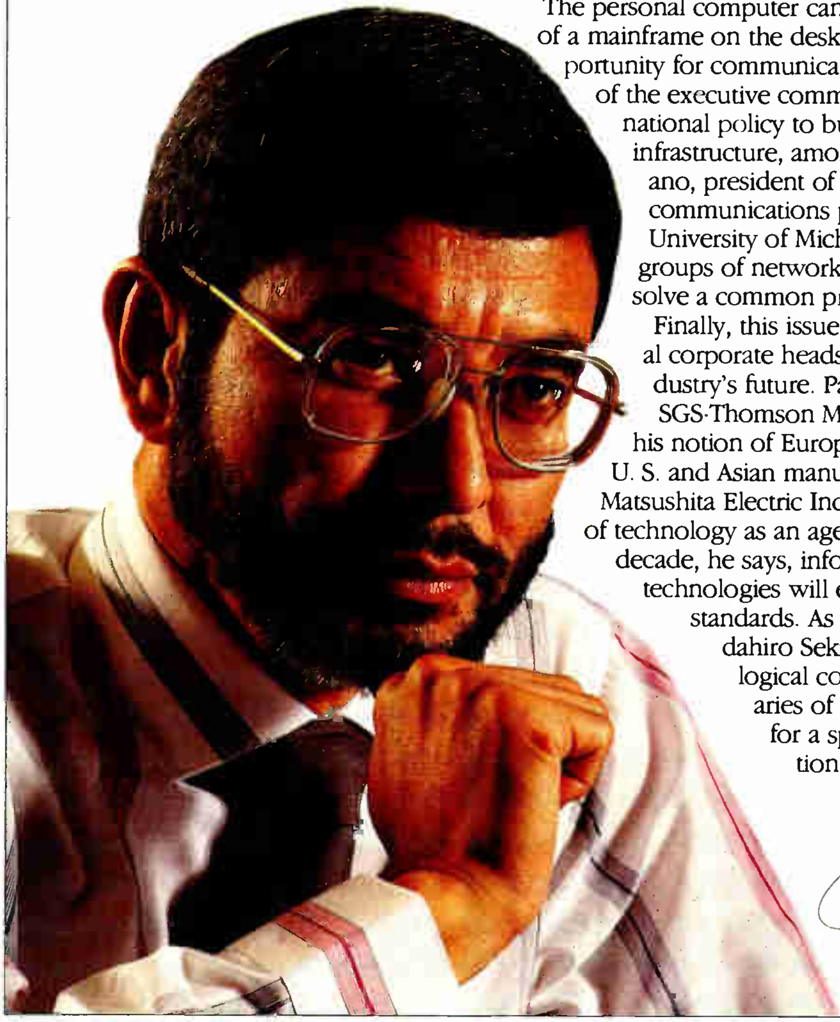
FRONT

AT 60, A LOOK AHEAD

Electronics turns 60 this year, and this issue celebrates the magazine's anniversary. The last decade has been a tumultuous period for the electronics industry. Time to market and market windows shrunk from years to months as the swifter-turning treadmill propelled new technology development faster than at any time in history. On the business front, courts became an integral part of company operations as corporations husbanded their intellectual property like a miser his money. Venture capital, once as plentiful as neon in Las Vegas, sought to light other industries. And corporations became world citizens.

In this issue of *Electronics*, we have invited the heads of major U. S. and international corporations along with leaders in law, finance, government, and international affairs to look back at the electronics industry over the past 10 years and forward to the decade that lies ahead. Charlie Sporck, president of National Semiconductor Corp., exhorts U. S. companies to make manufacturing a first priority and asks for a government industrial policy to help them do so. T. J. Rodgers, president of Cypress Semiconductor Corp., disagrees, favoring market competition.

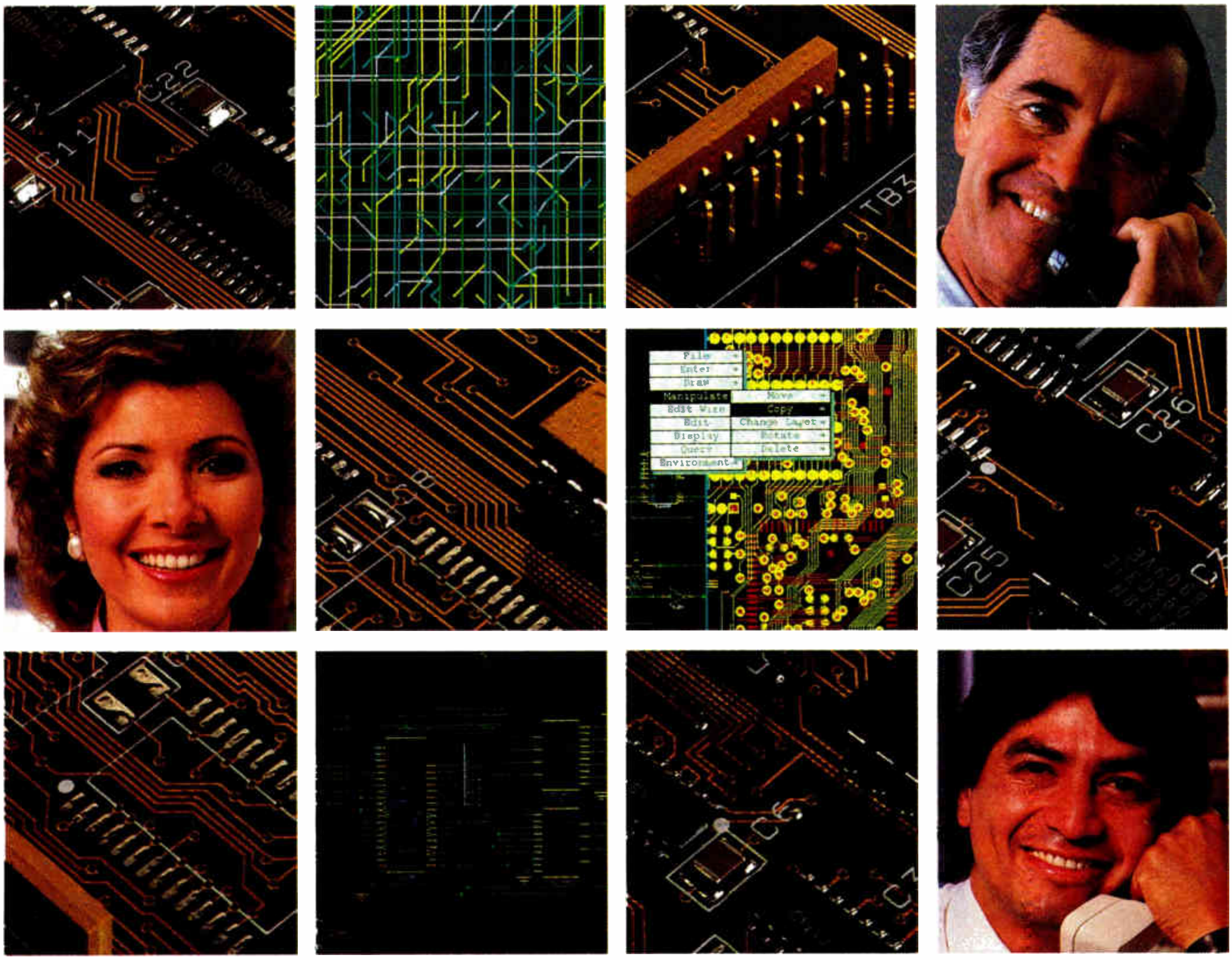
An advocate of government laissez-faire toward business, William Baxter, former U. S. assistant attorney-general in the Reagan Administration, reviews the change in antitrust enforcement policy that occurred during the 1980s in the context of the AT&T Co. divestiture and the dismissal of the government's long-standing case against IBM Corp. An expert in intellectual property, attorney Esther Schachter, weighs the role of patents and copyrights. Tom Dunlap, chief counsel for Intel Corp., discusses the importance of the Intel vs. NEC Corp. case. Rich Belgard, a frequent expert witness in intellectual property cases, outlines the operating principles of "clean room" development of software.



The personal computer can now give every user the power of a mainframe on the desktop. That has created a major opportunity for communications, so Robert Galvin, chairman of the executive committee of Motorola Inc., calls for a national policy to build a high-speed communications infrastructure, among other initiatives. Rocco Marano, president of Bellcore, calls for a national telecommunications policy. And Lynn Conway of the University of Michigan predicts a world in which groups of networked users compute together to solve a common problem.

Finally, this issue provides a forum for international corporate heads to share their forecasts of the industry's future. Pasquale Pistorio, president of the SGS-Thomson Microelectronics Group, proffers his notion of Europeans competing equally with U. S. and Asian manufacturers. Akio Tanii, president of Matsushita Electric Industrial Co., believes in the power of technology as an agent of social change. In the next decade, he says, information and communications technologies will enter the home to improve living standards. As technology advances, predicts Tadahiro Sekimoto, president of NEC, technological cooperation will transcend boundaries of companies and nations. He calls for a spirit of competition and cooperation. *Electronics* concurs. ■

JONAH McLEOD
EDITOR



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AUGUST 1990 VOLUME 63, NO. 8

Electronics

60 YEARS OF GLOBAL LEADERSHIP

COVER STORY PAGE 49
ILLUSTRATION: MILAN KECMAN

FEATURES

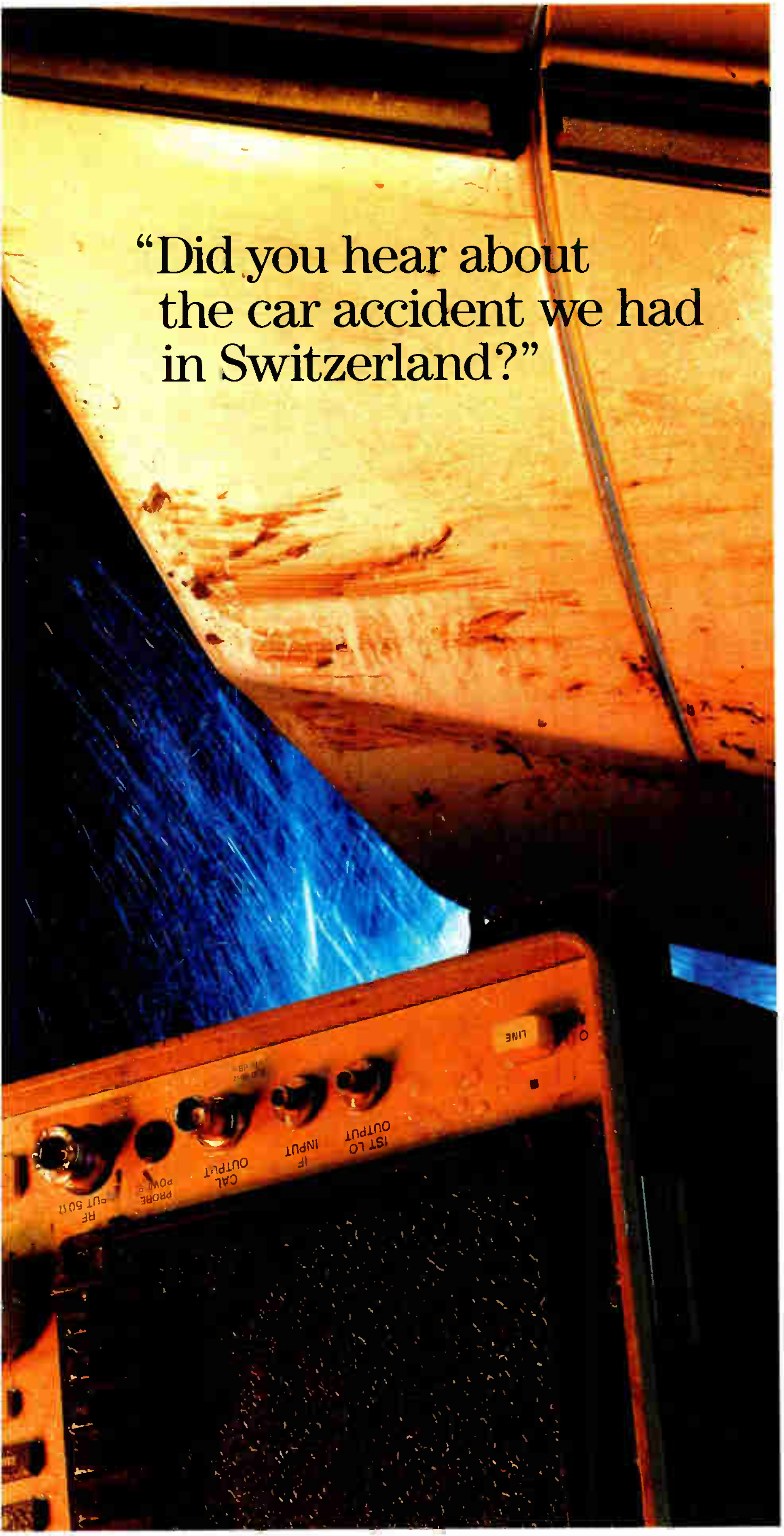
DEPARTMENTS

NEWS ROUNDUP

WORLDWIDE NEWS

SUPPLEMENT

Companies covered in this issue, indexed to the first page of the article in which each is mentioned.



There were no serious injuries.

Not long ago, an HP salesman turned a routine product demonstration into a crash course in reliability.

Our District Manager in Switzerland, Ueli Nussbaumer, had just given a demonstration of an HP spectrum analyzer. He set the analyzer down beside his car, intending to pack it last.

Well, there was a lot to pack. And when Ueli backed the car out, an ear-splitting screech of ripping metal made him hit the brakes. The analyzer!

It was trapped under the car. Ueli jacked up the car, yanked out the analyzer, and ran back to his customer's office to test its vital signs. The spectrum analyzer worked perfectly. The customer was incredulous.

Stories like this underscore why HP rates highest for reliability among engineering managers. And we're still not satisfied. In fact, in 1979 we started our Total Quality Control program to increase quality ten-fold in 10 years. A goal we'll reach this year.

It just goes to show that when design and manufacturing productivity are at stake, there is no reliable substitute for HP. Because you never know what you might run into.

CIRCLE 175

There is a better way.

HEWLETT PACKARD

National Semiconductor

“Everyone today is and digital on the same chip–but That's product, not promises.”

HOW NATIONAL SEMICONDUCTOR IS HELPING YOU MAKE SYSTEM-PERFORMANCE BREAKTHROUGHS IN THE 1990s.

Graham Baskerville, National Semiconductor's Vice President, Linear Product Development, and *Charlie Carinalli,* Vice President, Integrated Systems Group, talk about the challenges of mixed analog+digital technology.

Breaking the ISDN logjam at the U interface.

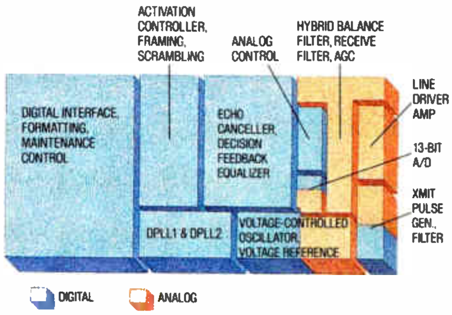
“This may be the most technically complex integrated-analog-and-digital device ever designed. It's our TP3410 U-interface transceiver for ISDN.”

“It's the missing link that allows the twisted-pair telephone network to carry simultaneous voice and high-speed data across the subscriber loop to the telco central office.”

“It's all CMOS, for high density, low power, and scalability— it's at 1.2μm, but we're already planning a shrink to 0.8μm.”

“And we can control that shrink because we designed the die in modules, separating the analog and digital functions. We even gave them their own power and ground supply pins to isolate the noisy rail-to-rail switching of the digital from the sensitive circuits of the analog.”

“Over 100K transistors with a single +5V supply, all in a 28-pin DIP that dissipates 300mW. Nobody else has a solution this advanced.”



Setting a new standard in A-to-D conversion.

“Our ADC1241 is another example of our unique strength in combining complex analog and digital functions on the same substrate.”

“It has an analog front end for data acquisition, but then we've implemented a powerful self-calibration function in digital. During each conversion, it performs a self-correction cycle, reducing nonlinearity errors to less than ±½ LSB.”

“So we get 12-bit-plus-sign resolution with an accuracy that's guaranteed over the full mil temp range. Nobody else can do this.”

ASIC D/A Converter

ISDN U Interface

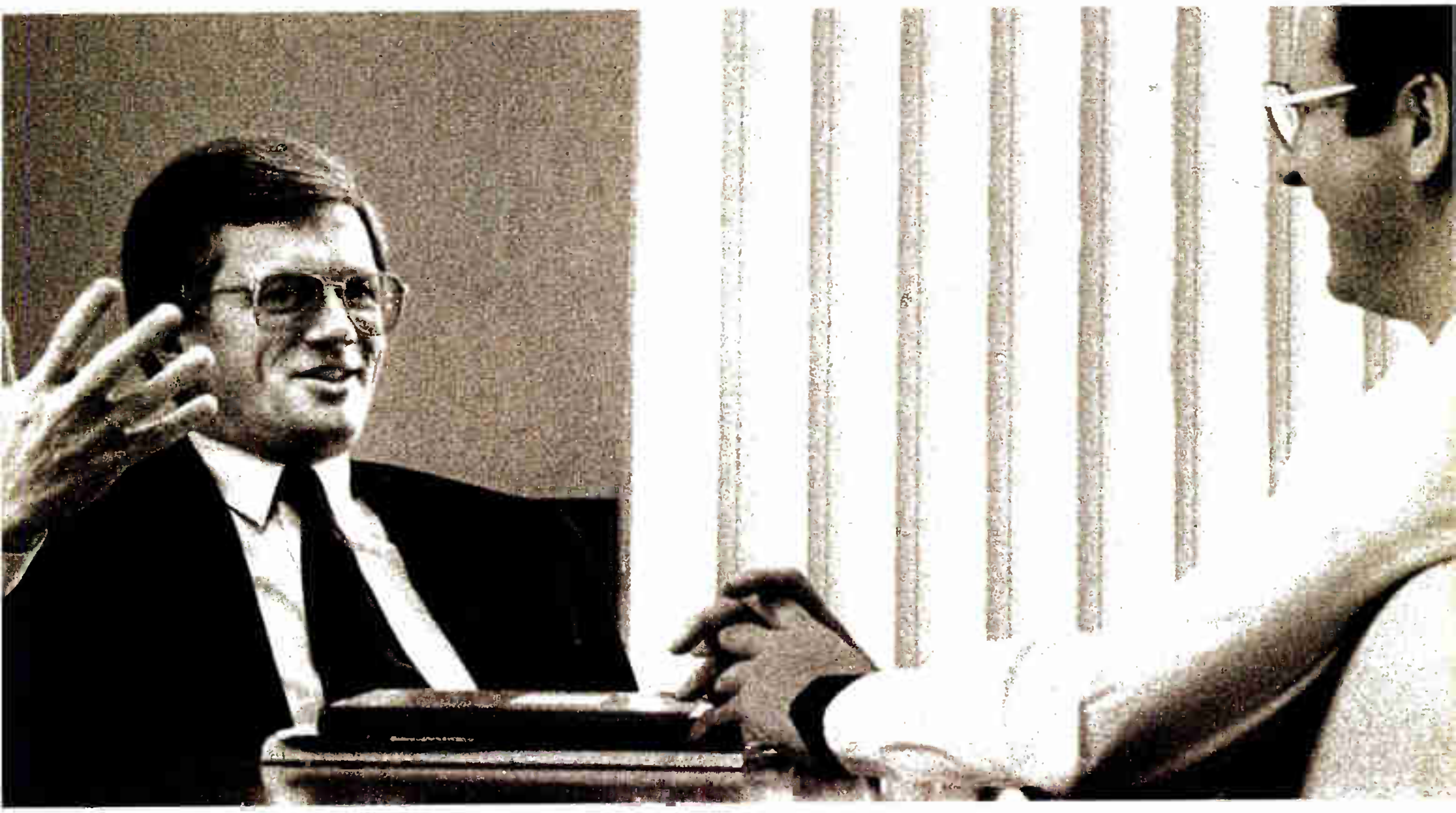
Super I/O

Hard Disk Synchronizer/ENDEC

Custom Linear ASICs

A/D Converter

talking about integrating analog we've been doing it for years.



Pushing the limits of PC integration.

"Here again, in our new Super I/O chip, PC87310, we've integrated analog and digital to a level that's never been achieved before."

"Industry-standard floppy-disk controller and UARTs, a parallel port, IDE hard-disk address decode,..."

"With analog PLLs in the floppy controller for pulse detection and data separation."

"All-digital is easier to build, but the performance suffers. And that's not a compromise we're willing to make."

Meeting our customer demand for mixed analog+digital ASICs.

"We call this CLASIC — Custom Linear ASIC. We use standard-cell methodology and optimized process technologies to offer high-performance VLSI solutions combining analog and digital functions."

"The CLASIC library right now has more than 500 analog cells and a good selection of digital building blocks."

"But again, it's not just functions, it's processes. We can fab in the process best suited to your design — linear bipolar, linear CMOS, BiCMOS."

"True customer focus."

continued next page

National Semiconductor

The challenge of integrating analog and digital functions onto the same chip.

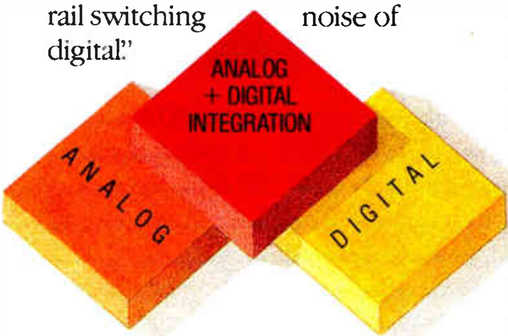
"The demand for mixed analog+digital really is customer-driven. Our customers need to build systems with higher performance because their customers are demanding it. Because their applications need it."

"And the way to achieve higher levels of performance is through higher levels of integration. Which, at the chip level, ultimately demands that analog and digital functions be pulled together onto the same substrate."

"And this is like trying to merge two incompatible universes."

"Digital's goal is smaller, faster, denser. The world turns on lithography. It lives for the shrink."

"Analog, on the other hand, is concerned with precision, linearity, dynamic range, bandwidth, phase shift, component matching, micro-voltage sensitivity. And it simply can't tolerate the clanging rail-to-rail switching noise of digital."



Meeting the challenge with world-class products.

"Our U interface is a perfect example of how difficult this really is. ISDN is digital, but it has to operate over the existing telephone wiring using analog signals. And there's only one twisted pair. So your transmit and receive signals appear on the same terminals. You send 160Kbits/sec digital pulses at 2.5V and it has to travel maybe three or four miles over the subscriber loop without repeaters or amplifiers. Over that distance, you're getting up to 40dB attenuation, so it arrives at about 25 *milli*volts. So the problem is, how do you pick that signal out of all the noise and the local transmit signal, which is 100 times more powerful?"

"You need low power, so if you tried to do it just with analog filters, it would be too complicated and too sensitive to process variations. But if you tried all-digital, it would be too complex to compensate for the limitations of the analog front end. So we combined analog filtering and a 13-bit A-to-D converter onto a single chip with dedicated DSP."

"The point is, we did it."

Meeting the challenge with world-class analog and digital designers.

"Building something like the U-interface transceiver demands some of the most sophisticated design techniques in the world."

"And not only are the individual analog and digital functions difficult to design, but then you have to integrate them onto the same chip."

"So you need world-class digital designers, world-class analog designers, and strategic partners who know how to work together."

"We've got them all. And they've been working on joint designs for many years."

"That's how we do it."

Meeting the challenge with world-class process technologies.

"Another problem for chip designers is that they are limited to the process technologies available to them."

"But, because of our heritage in both analog and digital, we've developed probably the broadest range of process technologies of any company in the industry, including bipolar, CMOS, and BiCMOS."

"We employ a 'core-process' concept. We have six basic core flows, then we add modules for specific functions."

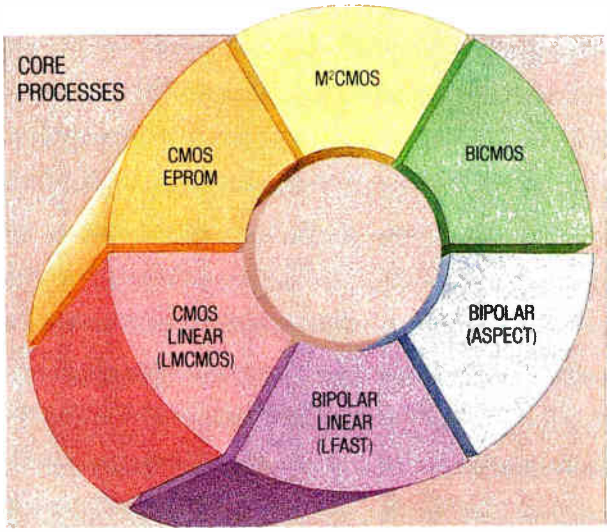
"We can take our advanced M²CMOS core, for example, and add a bipolar module. Or a linear capacitor module. Or EEPROM. Or we can do a bipolar core with a CMOS module. Or we can go to BiCMOS. Or LFAST or LMCMOS or DMOS or JDMOS."

"The key is, our designers have the freedom of selecting the best combination of processes for every analog and digital chip. The application drives the process choice. Not the other way around."

Meeting the challenge with world-class design tools.

"When you try to put analog and digital together, all the existing simulators, place-and-route CAD software, and behavioral models fall apart."

"So we've developed our own. And we're working closely with one of the world's leading CAD-tools companies to create a universal, end-to-end design environment."



"But already our ASIC Division has used our DA4 tools to introduce significant new standard cells, some of which allow high-voltage outputs to be combined with +5V CMOS to 30,000 gate densities."

"So now, for example, you can put logic, RAM, ROM, or EEPROM on the same chip with D-to-A converters and high-voltage drivers."

"No one has ever done this before."

"And it's only the beginning."

Putting the pride of National to work for you.

"The point is, our customers *need* mixed analog+digital capabilities. And we can offer that to them today. We can integrate a complete system solution for them. Or we can work with them at a particular phase in their design. We have the right products, the right processes, the right tools, the right people. And we're putting all of it just a simple phone call away."

1-800-NAT-SEMI, Ext. 301

National Semiconductor

SOVIET COMPUTER MARKET IS HOT, BUT COMPLICATED BY CURRENCY LAG

PC PRICE TAG: LOTS OF RUBLE$

BY YURI A. KUZMIN AND STEPAN A. PACHIKOV

SOME OBSERVERS CALL THE Soviet Union's hunger for personal computers bottomless. Growth in the PC market, they say, is unlimited, to be measured not by years or days but by the hour. But the outlook is far from that simple. The lack of hard currency in the Soviet Union makes the price of high-end PCs virtually prohibitive, even though it's the high-end IBM-compatible machines that Soviet users now want.

What's more, the Soviet economy, and particularly the Soviet monetary system, are so muddled that translating into English such terms as "cash and clearing accounts," "cooperative," "joint enterprise," "government enterprise," and many other concepts must be accompanied by detailed explanations. All this makes marketing PCs the Western way a virtual impossibility in the USSR.

A PC costs 53,000 rubles in the Soviet Union today. That is the current price of what the Soviets call a gentleman's configuration: an AT-compatible computer with a 12-MHz processor, 1 Mbyte of memory, 40 Mbytes of fixed-disk storage, a CGA or VGA adapter and monitor, a 5.25-in. floppy-disk drive, a mouse, a wide-carriage printer with a color ribbon, and a box of diskettes. The price depends less on which kind of IBM clone is being purchased—a Compaq Computer Corp. machine or a lesser-known European or Thai brand—than it does on upgrading a cheap (by Western standards) wide-carriage printer to an expensive one with a normal-width carriage.

And just how does 53,000 rubles translate into dollars? At the official commercial exchange rate, it amounts to an astonishing $88,000. At the official Western tourist exchange rate, the price dips to $8,800. However, at black-market rates, 53,000 rubles is somewhere between $3,000 and $4,000. By way of comparison, though, the average monthly wage in the Soviet Union is 250 rubles, so even at black-market prices the tab amounts to the equivalent of a year's salary—virtually out of reach for almost everyone.

Such a configuration costs roughly $1,300 at wholesale, but despite the relatively reasonable price tag, setting up a profitable PC business is not so easy in the Soviet Union. Importing computers into the USSR is complicated. Just determining which import regulations apply is difficult enough, and the regulations are subject to frequent and unpredictable changes.

Still, with all the caveats, it's clear that a market for computers exists in the Soviet Union and that it's growing. There are two basic components: the minuscule home computer market, where machines considered dinosaurs in the West are the most common, and the government-enterprise and institutional market.

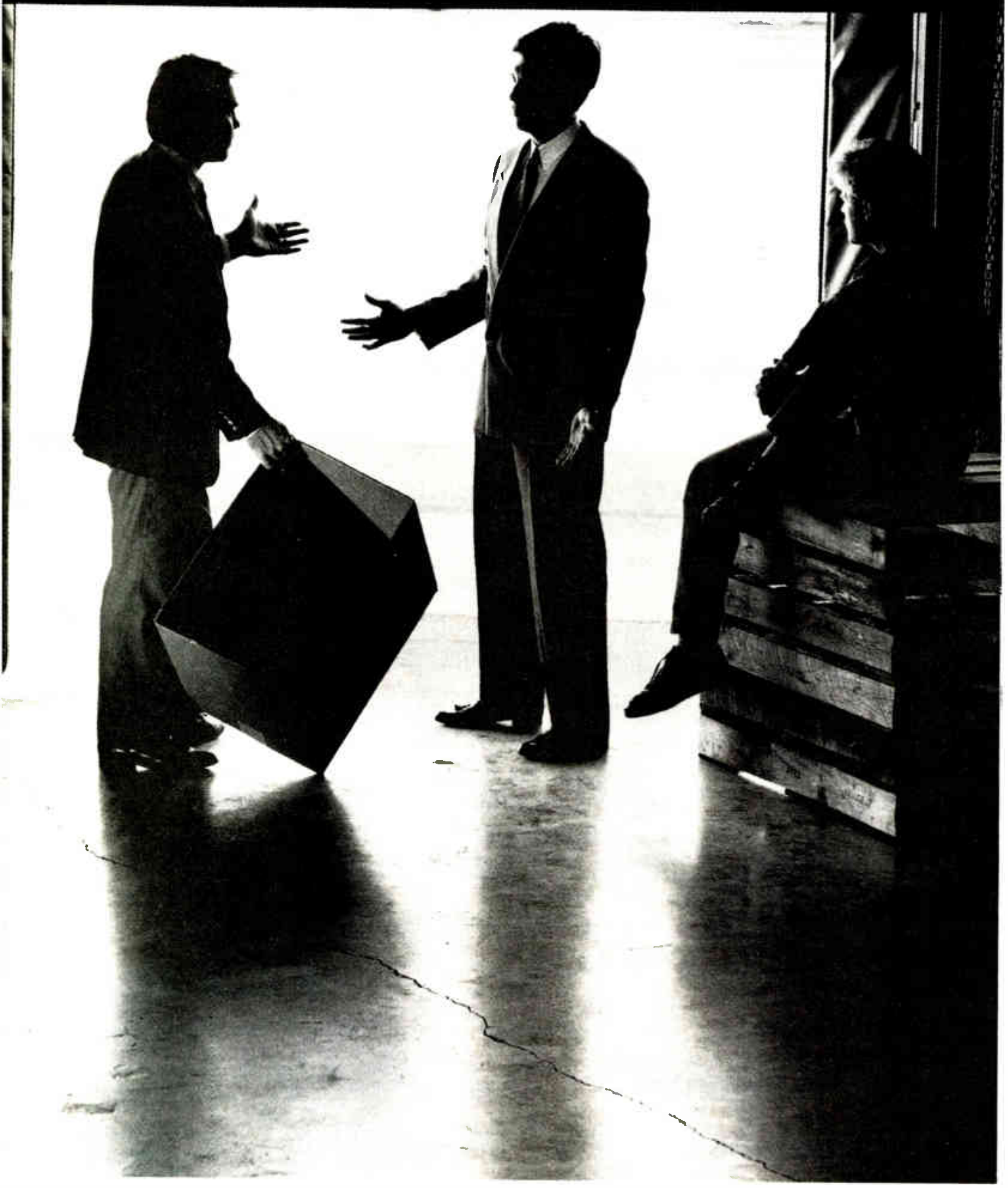
There are almost certainly no more than 20,000 home computers in use in the Soviet Union today, including domestic brands, which probably account for half that number. The 10,000 imported machines are mostly 8-bit computers such as the Atari 600, 800, 65, and 130 (with 6502 processors) and the more powerful Atari ST, which is quite popular; the Sinclair-Spectrum; and the Amstrad 64, 6128, and MSX machines, with Z80 processors.

Bringing up the rear is Apple Computer Inc.'s Macintosh and IBM Corp. PCs and compatibles. There are perhaps several hundred Macs, equipped with Motorola 68000 chips, in home use in the Soviet Union, and an equivalent number of IBM-compatible machines. The IBM units start at a steep 25,000 rubles, depending on configuration. The 8-bit machines range widely in price, from 7,000 rubles for an Atari 130 with floppy-disk drive and color monitor all the way up to 25,000 rubles for the Atari ST1040 with a fixed-disk drive and a monochrome monitor.

The demand for home computers is, of course, extremely sensitive to price. Hard-currency sales approach zero: perhaps several hundred units a year. The market for ruble sales would be practically unlimited if the price did not exceed the average yearly wage of 3,000 rubles. If the machines were to come down to even 10,000 rubles, the market for them would be enormous. But at today's prices, having a computer at home is just a pipe dream for the vast majority of Soviet citizens.

This leaves state institutions as the highest-volume purchasers of PCs, both for hard currency and for rubles. The institutions market in hard currency comprises three categories: centralized purchases by ministries and departments; independent purchases by state enterprises and institutions; and purchases by cooperatives and joint enterprises for resale in

Sittin' on the dock of the bay.



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rubles to state agencies.

The volume in institutional sales is apparently around 10,000 units per month. The market for ruble sales is practically unlimited for machines costing 15,000 to 20,000 rubles. But at today's price of 50,000 rubles for a typical high-end configuration, the market is close to saturation. Though there is no data on the value of single-unit purchases by state-owned enterprises and institutions, the total could scarcely exceed $50 million to $70 million.

IN THE USSR, MANAGERS CHOOSE THEIR EQUIPMENT CONSERVATIVELY, TO MINIMIZE THE RISK OF MAKING AN INCORRECT DECISION

Soviet managers are extremely conservative in choosing computing equipment, and with good reason. They prefer to purchase computers and configurations that decrease the risk of being punished for an incorrect decision. The underlying reason for this is the basic style of decision making by the Soviet bureaucrat, which follows the principle of minimization of risk: it is always safest to buy the same systems as acquired by one's neighbor.

As recently as 1987 or 1988, Soviet computer purchasers were relatively unsophisticated, but in the last few years they have become more discriminating and better informed, both about world prices and about prices on the home market. They are becoming increasingly discerning about technical specifications such as fixed-disk access time, coprocessors, and the preference for 3.5-in. diskettes.

Except for educational purposes, Soviet buyers have practically ceased acquisition of XT compatibles, opting instead for ATs. Increasingly frequently, Soviet buyers try to acquire turnkey systems, local-area networks, and appropriate software along with the hardware.

UNDOUBTEDLY, THE VERY near future will see an increasing demand for completely integrated desktop publishing systems—systems including a laser printer, a high-quality monitor, a scanner, appropriate software, fonts, and Russifiers.

The market for graphics workstations, now in its infancy, has great potential. Inexpensive graphics stations have the greatest chance of succeeding: types such as ATW, Acorn-Archimedis, the Next machine, the Macintosh II, and the newer, low-end models of the Sun Microsystems workstations. Longstanding restrictions on the import of Sun and Hewlett-Packard Co. Apollo workstations have created a pent-up demand for these products.

Soviet engineers are expressing a greater interest in Inmos Ltd.'s Transputer microprocessors, which up to very recently have been on the restricted list. Now that many restrictions have been lifted, Transputer-based systems will be welcome arrivals in the USSR. Recently a Soviet Transputer Association, whose goal is the widespread introduction of such systems, was organized.

LANs are also on the Soviet computer user's mind. On the one hand, demand for LANs is rising dramatically—large consumers now prefer to order not individual PCs but complete systems and networks. On the other hand, the shortage of hard currency means they are practically unobtainable. At present, the number of installed networks is in the hundreds, and their growth is not rapid. Besides the cash crunch, another reason for the lag is the lack of coordinated policy in many state enterprises; some government departments prefer to work "independently" and are resistant to linking with others.

As for wide-area networks, one cannot expect any significant progress in the near future. The basic reason for this is the USSR's catastrophically antiquated telephone system. The second obstacle is the super-monopoly on communications by the Ministry of Communications. The pace of rebuilding Soviet telecommunications networks will depend largely on how fast, and whether, this monopoly can be dismantled. ■

Yuri A. Kuzmin is editor-in-chief of "PC World USSR"; Stepan A. Pachikov is general director of JV ParaGraph publishers.

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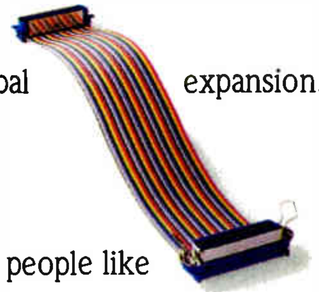
Some big names in electronics are  making big plans for global  expansion.

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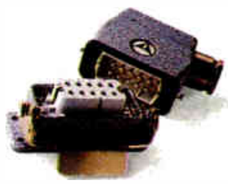
Spain, and  soon in Thailand, Korea and Australia.

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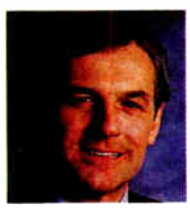
makes us a world class connector  manufacturer, and second to none when it comes

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CIRCLE 215

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CAE Technology Report

August 1990
Vol. 2 No. 6

Key Engineering Challenges of the 90's

Recently, key executives from leading U.S. companies shared their views on CAE technology through media surveys. The most critical engineering concerns of the 90's were: top-down system design as opposed to traditional bottom-up design, a higher standard of product quality, and shorter product development cycles. Since all three require greater use of CAE tools, engineers should become adept with the new technology as soon as possible, starting with basic tools like schematic capture and simulation. A huge savings in time as well as considerable improvements in design quality are already available with today's CAE tools.

Electronic Breadboarding Works Like the Real Thing

The new CAE tools, based on incremental compilation, look more like an electronic breadboard rather than traditional simulation tools. An excellent example is the SUSIE™* logic simulator from ALDEC, Inc. (Newbury Park, CA). SUSIE can convert any netlist into an exact electronic breadboard. Additionally, SUSIE allows concurrent design changes and simulation of the new ICs, wiring, propagation delays, etc. The simulator is fully interactive: you can toggle switches, move jumpers, load JEDEC fuse maps, etc., all within a split second. Prices for PC-based SUSIE start at $1,000 and delivery is from stock. Circle 102

High Quality Test Equipment Comes Free With Electronic Breadboarding

The new silicon technology puts a high demand on test equipment in terms of speed, loading factor, grounding, etc. Fortunately, electronic breadboards come with built-in test equipment that never breaks and costs nothing. For example, an advanced version of SUSIE ($2,490) is equivalent to a 1000-channel logic analyzer, and a 1000-channel signal generator, both with 100 GigaHertz clock speed. The probes do not inject any ground noise and they can be easily and instantly attached to any point in the electronic breadboard. What's more, the probes can be fed into any input and output without IC overload. Since ICs can be instantly replaced with min/max propagation delay parts, worst case conditions can be instantly tested with on-board instrumentation. Circle 103

PLD and PGA Users Save Time With Logic Simulators

Sales of simulators have been accelerated by the growth of PLDs and PGAs. With multiple PLDs, in particular, simulation is a *must* because it saves over 80% of engineering time in many cases. SUSIE/PGA ($1,995) from ALDEC allows designers to simulate the XILINX™ parts in a fully interactive mode: designers can redesign the CLB configuration and equations as well as emulate various layout effects. With SUSIE/PGA designers can isolate the problem of logical design or physical PGA layout. Circle 104

Racal-Redac Is Betting On SUSIE from ALDEC

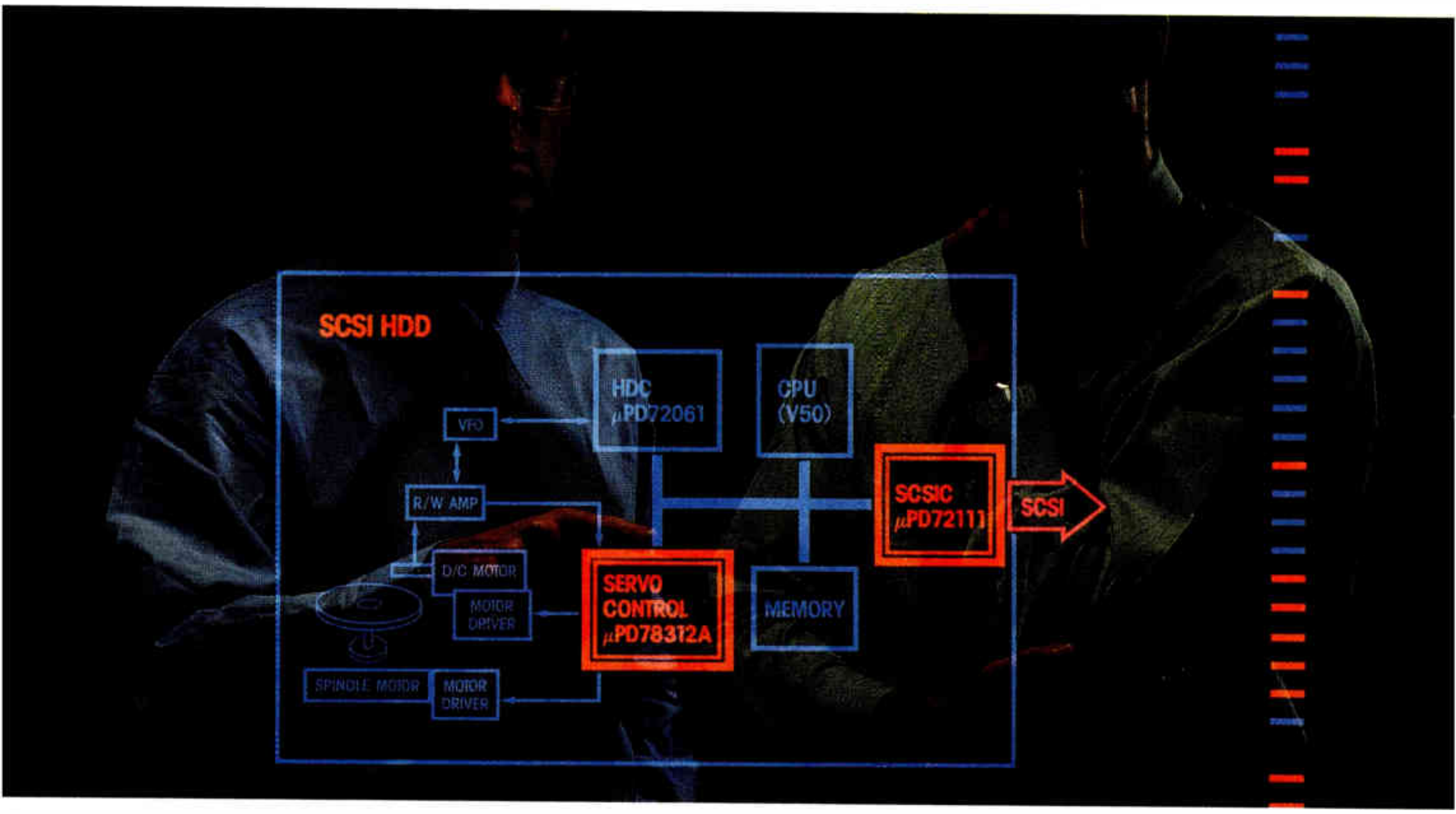
During the last two months, Racal-Redac has retrained its world-wide sales force to support the leading electronic breadboarding environment—the SUSIE logic simulator. SUSIE is already resold or recommended by over 17 major PC-based OEMs. Electronic breadboarding is seen by many CAE vendors as the biggest CAE growth area of the 90's.

** SUSIE is a trademark of ALDEC, Inc.*
Telephone: (805) 499-6867. Fax: (805)498-7945

CIRCLE 239

C&C Computers and Communications

The clear solution:



NEC's complete chip set for high-end SCSI hard disk drives.

Want to improve the performance of your hard disk drive while reducing size, weight and power consumption? Call NEC. We'll deliver everything you need for an advanced SCSI disk drive design, including servo controller, SCSI controller, CPU and associated chips.

Responsive, singlechip servo controller.

NEC's 16-bit singlechip microcontroller excels in interrupt response.
The µPD78312A incorporates 8-level priority interrupt. It also gives you two exclusive hardware interrupt handling features that reduce software overhead.

- ☐ Macro Service provides high-speed data transfer between memory and a special function register. No software intervention required.
- ☐ Context Switching selects a new register bank for each interrupt request and eliminates the need for additional software to save current register contents.

The µPD78312A offers all basic peripheral functions on-chip to simplify your design and minimize circuit board size.

- ☐ 2-channel, 16-bit up/down counter.
- ☐ 2-channel, 16-bit timers.
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- ☐ 8-bit programmable real-time output ports.
- ☐ EPROM version available.

Versatile, high-speed SCSI controller.
Our SCSI controller gives you a competitive edge with features like high-speed sequence control. Overhead is minimized because high-level commands drive an on-chip, hard-wired sequencer.

The versatile µPD72111 interfaces with the 8- or 16-bit data bus of any CPU. It executes high-speed asynchronous data transfer at speeds up to 5M bytes/sec. And it enhances bus utilization by providing both an 8-byte FIFO for the SCSI bus, and an 8-word FIFO for the CPU bus.

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CIRCLE 197

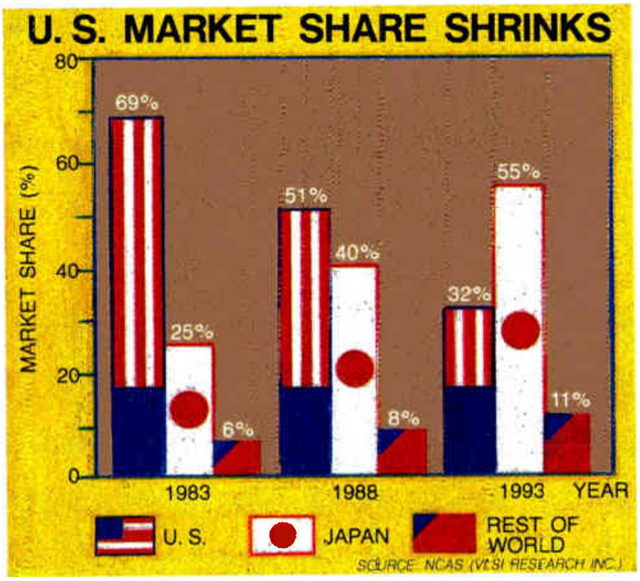
HOW TO SAVE AN INDUSTRY

A capital infusion of $1.2 billion for R&D over the next three years will be required to reverse the declining fortunes of the U. S. semiconductor materials and equipment industry. That was one of the conclusions of a report of the National Advisory Committee on Semiconductors released last month. Calling the industry critical to the health of the U. S. semiconductor and electronics industries, the report indicates that it is headed for serious trouble, with declining market share in many critical areas and an almost complete loss in some.

A major problem is the cost of capital in the U. S., according to Ian M. Ross, president of AT&T Bell Laboratories and chairman of NACS. This prevents U. S. companies from making the needed R&D investment to keep up with technological advances.

The report follows up a preliminary one issued in November, in which the committee requested an additional $100 million for Sematech, the manufacturing research consortium, a request to which the Bush Administration has been noticeably cool. There is little reason to expect a positive response to the latest proposals.

These include 50% investment tax credits on new equipment purchases in the first year after introduction, liberalized depreciation rules, permanent R&D tax credits based on total annual R&D expenditures, a revision of antitrust statutes to enable and encourage joint manufacturing consortia, and basing future antitrust decisions on worldwide market and competitive considerations. Also, the report urges encouraging (or forcing) foreign companies participating in U. S. markets to establish complete businesses in the U. S., including R&D, and establishing a national goal of achieving commercially and technically viable capability in all basic elements of the equipment industry by 1995. ■



U. S. companies will have just a third of the market for semiconductor fabrication equipment.

MENTOR STUMBLES ON THE WAY TO THE BANK

No one was more surprised than Mentor Graphics Corp. at its poor second-quarter earnings performance. For the period ending June 30, preliminary estimates were for revenues of $100 million to $103 million, compared with $106 million for 1989's second quarter.

What happened? The Beaverton, Ore., company was late to market with its System 8.0 tool release, says Robert Herwick, senior technology analyst at Hambrecht & Quist Inc. in San Francisco. The products were scheduled to appear in the third quarter but have been delayed to the fourth.

"It is a classic case of pre-empting sales of existing product with the announcement of next-generation products before they were ready to ship," says Joe Prang, vice president of marketing at competitor Valid Logic Systems Inc. in San Jose, Calif. Prang expects Mentor to spend the better part of the next year digesting Silicon Compiler Systems Corp., which it purchased in February, and delivering on all the products introduced the past year.

But don't count Mentor out of the game. System 8.0 should bring earnings back on track in the second or third quarter of next year, Herwick says. The question is how much ground it will have lost in the meantime. ■

1-0 ON THE YEAR, LOTUS GOES TO THE MOUND AGAIN

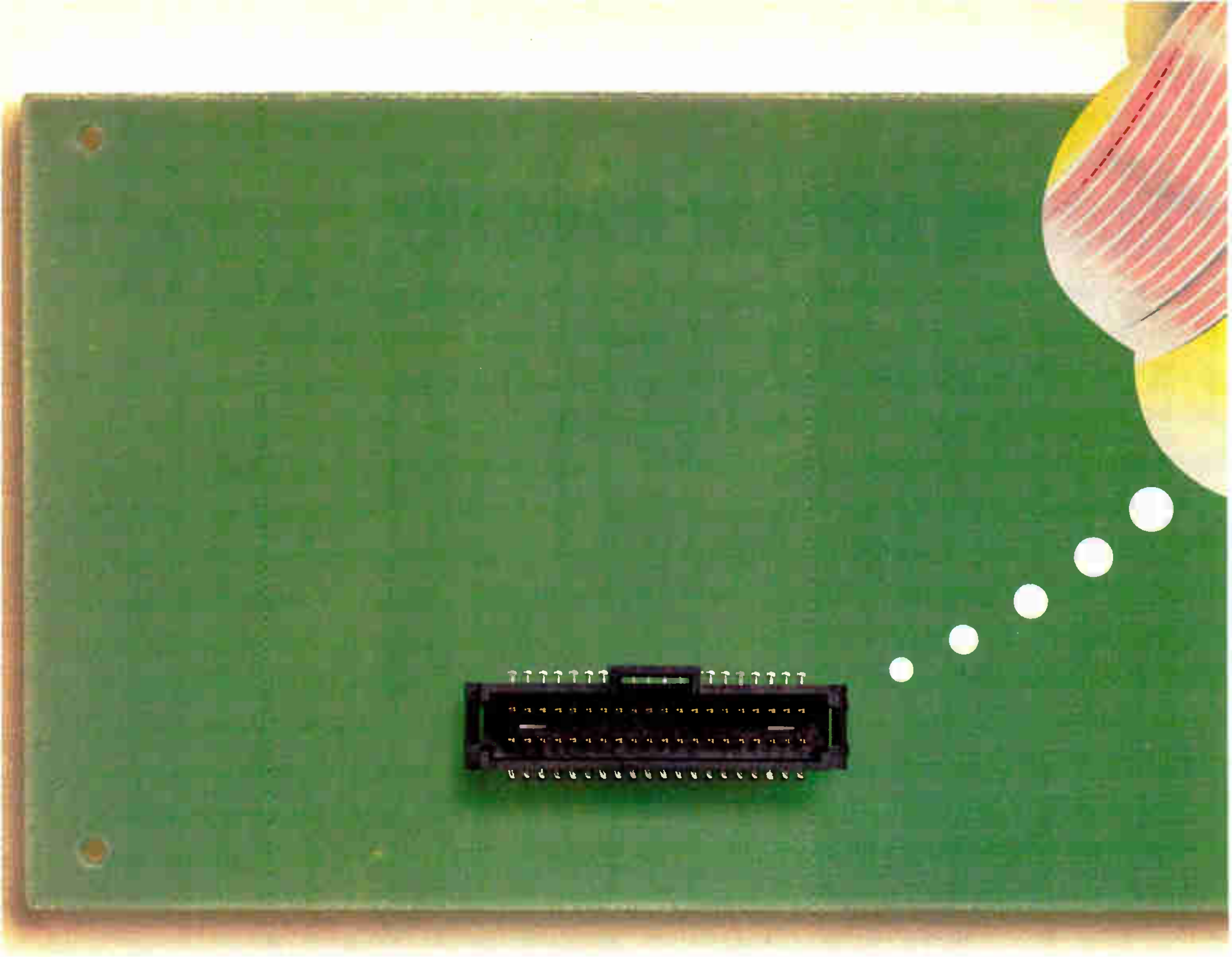
Software developers have been alerted that the innovation embodied in a program's user interface—the way the program is presented on the screen—is protected by copyright law, and that Lotus Development Corp., for one, will fight to maintain that protection. Those are the salient points that surfaced in the wake of a Boston U. S. District Court ruling that favored the Cambridge, Mass., developer of the 1-2-3 spreadsheet, and Lotus's filing of two more suits last month after that ruling.

Lotus has sued Borland International Inc., Scotts Valley, Calif., and The Santa Cruz Organization Inc., Santa Cruz, Calif., saying Borland's Quattro and Quattro Pro and SCO's SCO Professional violate copyrights covering 1-2-3's user interface.

In light of the Boston decision, it would appear that Lotus has a strong case. Federal Judge Robert Keeton said that "the user interface of 1-2-3 is its most unique [sic] element, and is the aspect that has made 1-2-3 so popular."

Judge Keeton served notice that software developers must consider the innovation expressed in a user interface, including its structure and sequence, and organization of the program's menus.

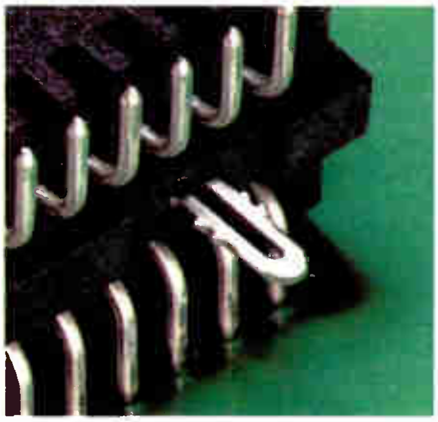
In concluding that the defendants infringed the copyright, Keeton added that "a menu command structure is capable of being expressed in many if not an unlimited number of ways, and that the command structure of 1-2-3 is an original and nonobvious way of expressing" that structure. ■



Think small. Think surface.

Our latest high-density surface-mount connectors offer a special design advantage — they bring you all the flexibility of the AMPMODU System 50 connector family.

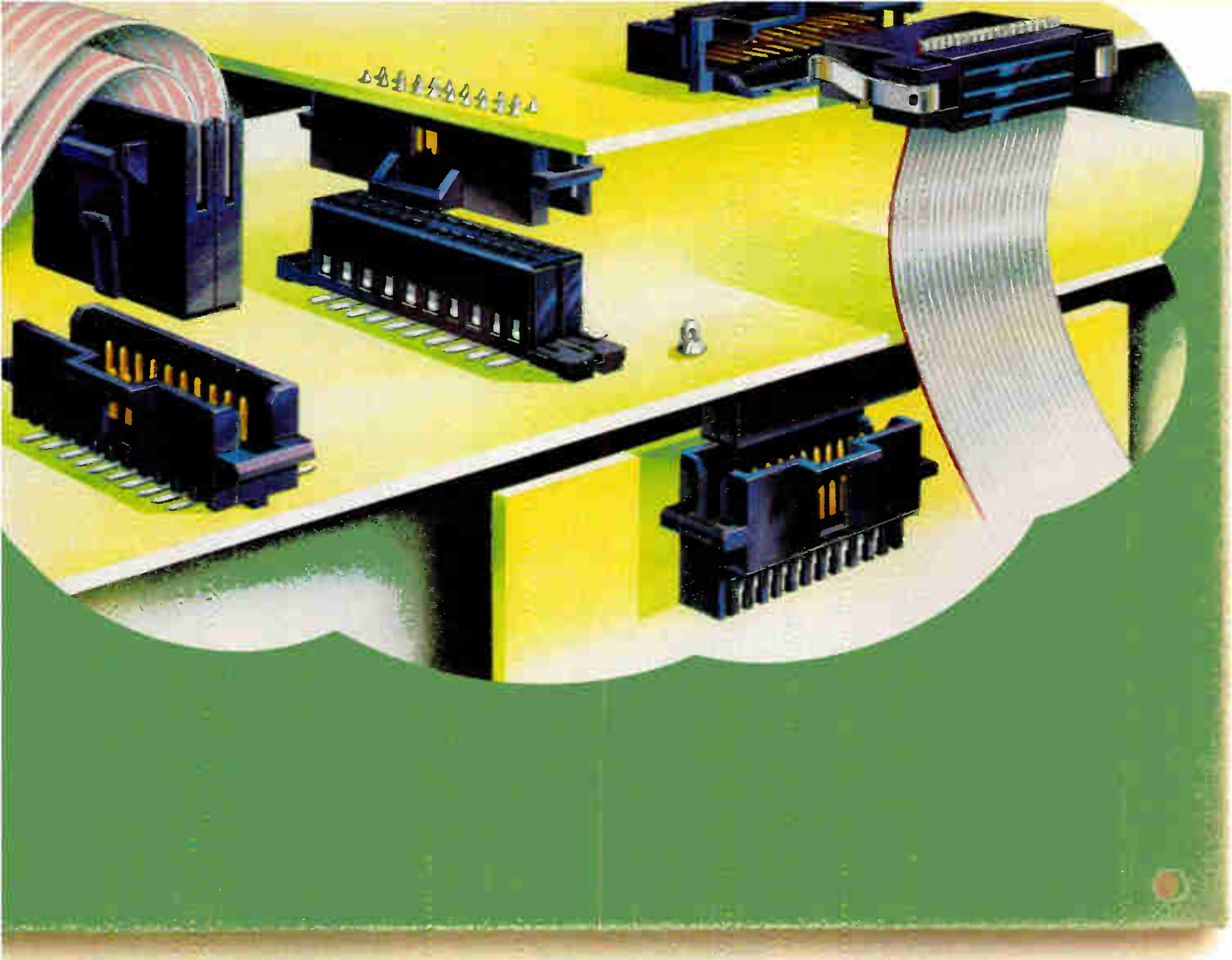
System 50 SMT receptacles and headers intermate with our complete .050" x .100" system, including cable-to-board types that expand your design thinking to include flat flex cable, .050" center flex etched circuitry, and .025" center ribbon cable.



Unique hold-down design requires only simple board support during placement. Design, materials are process-compatible.

Surface-mount versions are available in vertical, double-row versions, fully shrouded, in select sizes from 8 through 100 positions. Our compact design uses the same reliable System 50 interface, with dual-beam phosphor bronze receptacles plated gold-over-nickel on the mating end, tin-lead on the tail.

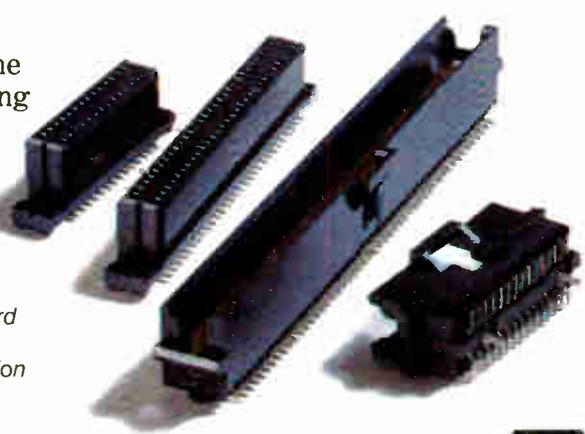
Dimensioning, tolerances, and positioning datums are engineered for robotic placement. A simple, low insertion



Think system.

force hold-down secures the connector during processing and provides long-term strain relief. 94V-0 housings are compatible with reflow soldering.

Intermate with the AMPMODU System 50 family for board-to-board stacking and mother/daughter configurations, and mass-termination cable-to-board interface.



Call the AMP Product Information Center at 1-800-522-6752 for more information on AMPMODU System 50 surface-mount connectors, and the System 50 family. AMP Incorporated, Harrisburg, PA 17105-3608.

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CIRCLE 188

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- VMERAM-EC1: Featuring Clearpoint's exclusive "extra bit" technology, 24- and 32-bit addressing, and 8-, 16-, and 32-bit data transfers, VMERAM-EC1 is available in 2 to 64 MB densities.
- VMERAM: The VMERAM is the low-cost alternative for EDC memory, with pricing comparable to parity memory. The VMERAM is available in 2 to 16 MB densities.
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The Clearpoint Difference

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GaAs EASES PC DESIGN

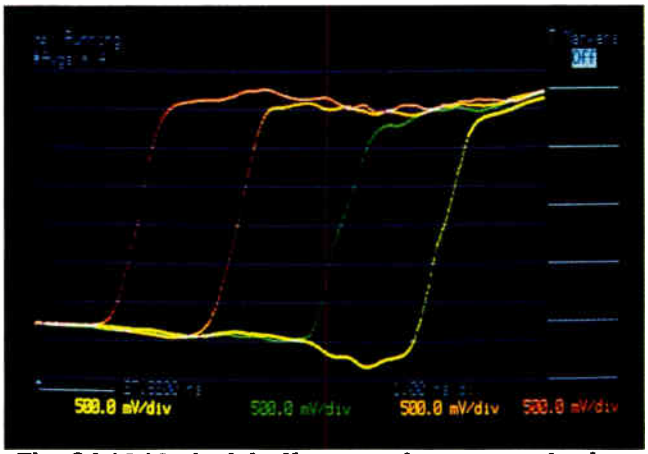
Two new GaAs chips from Gazelle Microcircuits Inc. of Santa Clara, Calif., will enable designers to use TTL design rules rather than more expensive emitter-coupled-logic implementations for high-speed PCs and workstations.

With the GA1110 multiphase clock generator and the GA1210 clock buffer, designers can use TTL design rules to build motherboards with components that run at up to 100 MHz, according to Gazelle.

Up to now, designers have had trouble stretching TTL beyond 30 MHz because of problems related to clock distribution on circuit boards.

Clock pulses distributed to different parts of a board can arrive at different times, depending upon the trace lengths. Adjustments to accommodate differences can result in performance penalties of up to 25%.

Gazelle says that its new clock buffer can advance or retard up to five individual clocks from a single clock input in increments of 2 ns. The clock generator can multiply an input frequency by 0.25 to 8 times. ∎



The GA1210 clock buffer can advance or retard up to five individual clocks in 2-ns increments.

NATIONAL TAKES A STEP FORWARD WITH NEW BiCMOS PROCESS

Building on its Aspect III bipolar process and its high-performance CMOS technology, National Semiconductor Corp. is moving into the next generation of biCMOS with a new process: the 0.8-μm ABiC IV. The Santa Clara, Calif., company claims the new process—its fourth-generation biCMOS technology—delivers more performance at lower power and higher integration levels than any other now available.

ABiC IV's core Aspect III bipolar technology incorporates a newly enhanced recessed-emitter structure, which accounts for the performance boost, National says. The 0.8-μm lithography delivers effective n- and p-channel lengths of less than 0.65-μm, and the process is highly scalable. ∎

SPARC-BASED MULTIPROCESSOR DEBUTS FROM SOLBOURNE

Solbourne Computer Inc. of Longmont, Colo., has unveiled what it calls the highest-performing Sparc product to date: a server that houses up to eight processors—each running 31 million instructions/s—in a symmetric multiprocessing (SMP) configuration. The Series 5E/900, or "Enterprise Server," is the first Sparc-based SMP system, Solbourne says. It is based on a 40-MHz microprocessor from Cypress Semiconductor Corp. and a 40-MHz floating-point controller from Weitek Corp. or Texas Instruments Inc. The server uses an 11-slot version of Solbourne's Kbus, with data-throughput rates of 128 Mbytes/s.

Enterprise Server is targeted at applications that require high speeds and high storage capacity. It can be configured with more than 1 Gbyte of memory and more than 27 Gbytes of disk storage. The server has a SPECmark rating of 19.1.

Prices for the 5E/900 range from $99,900 for a single-processor system up to $626,200 for an eight-processor version. Shipments are due to begin next month. Solbourne has also announced version 4.0D of its Unix variant, OS/SM. The new version supports SMP and will be shipped with all of the vendor's Series 4, 5, and 5E products. ∎

OAK BOOSTS VGA GRAPHICS RESOLUTION

A graphics controller from Oak Technology Inc. supports the new industry-standard Extended High-Resolution VGA specifications, offering resolution of 1,024 by 768 pixels. The Sunnyvale, Calif., company's new device, the OTI-067, extends its predecessor's 800-by-600-pixel resolution but is backward-compatible with previous video graphics standards, including EGA, CGA, MDA, and Hercules, Oak says.

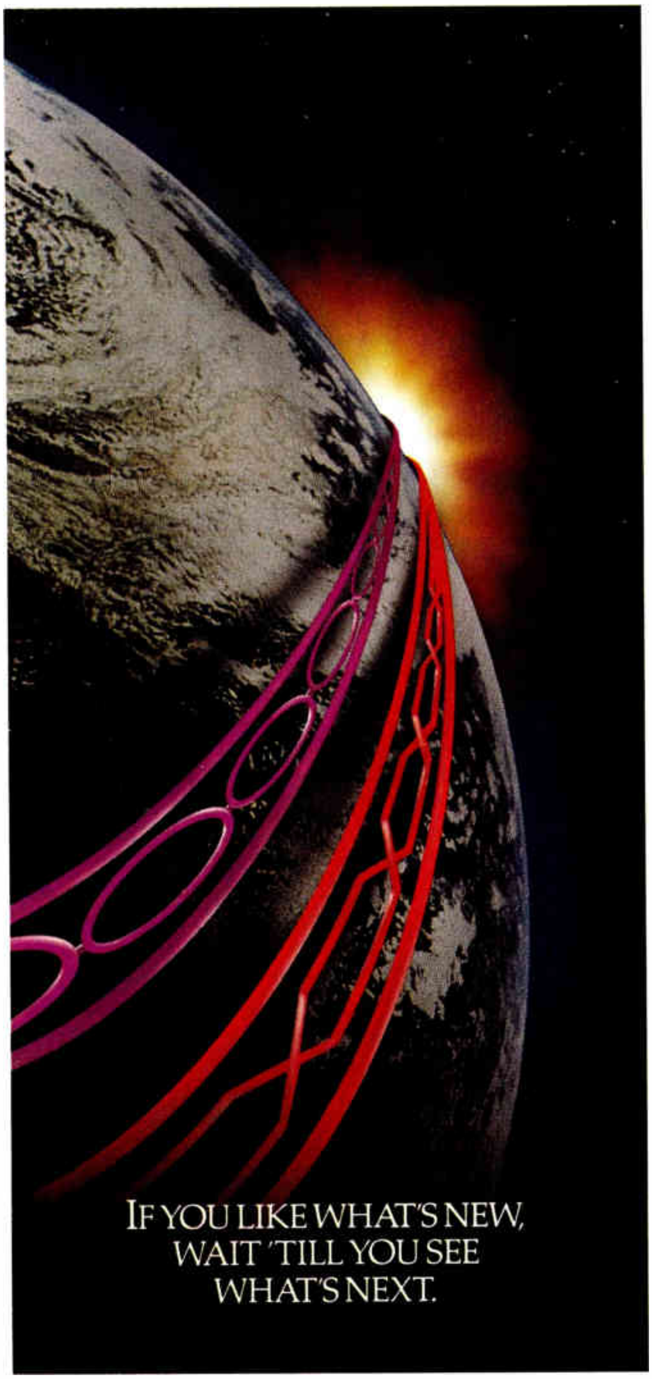
Aimed at designers of VGA controller boards and IBM-compatible systems, the OTI-067 reduces the number of DRAMs needed to provide high resolution. Where most VGA controllers require eight 256K-by-4 DRAMs for noninterlaced operation, the Oak device requires just two to four. "Because we support flexible DRAM configurations, the OEM can create higher-performing graphics systems at less cost," says Oak president David Tsang. ∎

AT&T OFFERS 10BaseT CHIP SET

A three-chip family from AT&T Microelectronics is the first complete family of devices complying with the latest industry standards for twisted-pair Ethernet LANs. The CMOS chips are all that's needed to design a complete twisted-pair Ethernet system compliant with the IEEE's 802.3 LAN standard, says the Berkeley Heights, N. J., company. What's more, the chips also comply with the draft of the IEEE's proposed standard for 10BaseT devices.

The family comprises the T7220 twisted-pair medium attachment unit, the T7240 port receiver, and the T7201 multiport repeater. ∎

Speed or size.



Get true no-wait-state performance in a 256K Fast Static RAM, with the famous reliability and performance that comes from Motorola's pure CMOS technology.

To squeeze 15ns access times out of a 256K Fast Static, we had to go to the drawing board and rethink Fast Static design from the start. First, we eliminated the need for shortcut measures like Address Transition Detection (ATD). We replaced them in a design that incorporates several new memory innovations.

LOOK WHAT'S NEW.

As part of our redesigned Fast Static architecture, we radically increased the array subdivisions to 32 blocks (with 128 rows and 64 columns per block). We then added small signal techniques, pre-amps,

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and current regulation throughout. The result is a 256K, pure CMOS Fast Static that keeps up with even the fastest 32-bit microprocessors.

Four versions of our 256Ks are available. The 64K x 4s and 256K x 1s are available with 15ns access times. The 32K x 8s and 32K x 9s both offer 17ns.

JUST TWO MORE OF MANY.

These new Fast Statics are just two of the many exciting products in Motorola's complete line of memories—which includes Fast Static RAMs, one and four-megabit Dynamic RAMs, 256K and one-meg Slow Statics, and modules. For more information, complete and return the coupon, or contact your local Motorola sales office, or call us toll-free at 1-800-521-6274.

MOTOROLA CMOS FAST STATIC RAMS				
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64K x 4	MCM6208	15, 20, 25ns	PDIP, PSOJ	
64K x 4 OE	MCM6209	15, 20, 25ns	PDIP, PSOJ	
32K x 8	MCM6206	17, 20,† 25,† 30, 35	PDIP, PSOJ	
32K x 9	MCM6205†	17, 20, 25ns	PDIP, PSOJ	
64K x 1	MCM6287	12, 15, 20, 25	PDIP, PSOJ	
16K x 4	MCM6288	12, 15, 20, 25	PDIP	
16K x 4 OE	MCM6290	12, 15, 20, 25	PDIP, PSOJ	
8K x 8	MCM6264	15, 20, 25, 35	PDIP, PSOJ	
8K x 9	MCM6265	15, 20, 25, 35ns	PDIP, PSOJ	
4K x 4	MCM6268	20, 25, 35, 45	PDIP	B
4K x 4 CS	MCM6269	20, 25, 35ns	PDIP	
4K x 4 OE	MCM6270	20, 25, 35ns	PDIP, PSOJ	
Cache Tag RAM Comparators				
4K x 4	MCM4180	18, 20, 25ns	PDIP, PSOJ	C
4K x 4	MCM62350	20, 25ns	PDIP, PSOJ	D
4K x 4	MCM62351	20, 25ns	PDIP	
Synchronous Fast Static RAMs				
64K x 4	MCM62980/2	15, 20ns	PSOJ	E
4 x 64K x 1	MCM62981/3	15, 20ns	PSOJ	F
16K x 16	MCM62990†	20, 25ns	PLCC	G
16K x 4	MCM6293/4/5	20, 25, 30ns	PDIP, PSOJ	H
4K x 12	MCM62973/4/5	20, 25, 30ns	PLCC	I
DSPRAM™				
8K x 24	MCM56824	25, 35ns	PLCC	J
Latched Fast Static RAMs				
8K x 20	MCM62820†	23, 30ns	PLCC	K
16K x 16	MCM62995†	17, 20, 25ns	PLCC	L
BurstRAM™				
32K x 9*	MCM62940 (68040)	50, 40, 33 MHz	PLCC	M
32K x 9*	MCM62486 (i486)	50, 40, 33 MHz	PLCC	N
32K x 9*	MCM62960 (SPARC)	50, 40, 33 MHz	PLCC	O
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MOTOROLA

THE CONTINENT'S SEMICONDUCTOR SALES ARE COMING ON LIKE GANGBUSTERS

EUROPE'S IN THE CHIPS

BY PETER FLETCHER and ANDREW ROSENBAUM

DRIVEN BY EXPLOSIVE growth in mobile communications, personal computers, and automotive electronics, sales in Europe of semiconductors are going to grow far faster than those in the U. S.—the only thing close will be PC sales. That's the forecast from the analysts at Dataquest Inc. That growth will make Europe the only region of the world that is likely to increase its consumption of semiconductor devices in 1990, they add.

The figures and opinions were trotted out at a Geneva conference sponsored by Dataquest. Looking at the Dataquest forecasts, executives at the meeting agreed that Europe is preparing to become the world's principal market for the industry. As SGS-Thomson vice-president Philip Gere pointed out at the conference, Japan and the U. S. will see negative growth in semiconductors in 1990, while Europe is still hopping.

In chips, Dataquest expects European manufacturers to absorb $10.5 billion worth of ICs and discrete devices this year. That's 9.5% more than the $9.6 billion in 1989. Earlier in the year, Dataquest had forecast growth of just 3%. By contrast, the Dataquest experts say, consumption in the U. S. will drop by over 3% from $17.7 billion to $17.2 billion, while the Japanese electronics industry will cut its chip purchases 2%, from $22.9 billion to $22.45 billion.

Meanwhile, PC sales in Europe are expected to increase 50%, with shipments going from 6 million to 9 million units, between now and 1994, according to analyst Gregg Nelson. "And that does not take into account the potential opportunities offered by Eastern Europe," adds Bernard Giroud, president of Intel Europe.

PCs are key drivers of the European electronics market, and Europe's white-collar workers are still just starting to use the machines. Only 12% to 14% of Europe's white-collar workers have them now, and the rate of penetration should rise to 55% or 60% by 1994. "Between now and 1994, the purchase of a PC in Europe will become like the purchase of a telephone or a television," says Nelson.

Improved, more specialized distribution will also bolster the European PC market, he adds. The larger value-added resellers are expected to home in on large corporate clients with more complete offers than they have had in the past, he says. Previously, European distribution has lagged behind that of the U. S. But it can be expected to grow and change as the market matures, Nelson says.

Yet outsiders cannot count on being able to take advantage of the rapid growth. "For the first time in eight years, the top vendors are the same two years in a row. This indicates that the market has reached maturity; in other words, getting into the European PC market will be harder than finding chicken's teeth," says Nelson.

The numbers point to U. S. chip makers being hit hardest. Despite valiant attempts to regain its former position of world leadership, the U. S. semiconductor industry is continuing to lose ground in international markets as Japanese and Pacific Rim competitors increase their share. The latest Dataquest figures for 1989 show that while the world market increased by 12% from $50.1 billion in 1988 to $57.2 billion in 1989, North American companies managed only a 7% increase. And their share of world markets dropped from 36.54% in 1988 to just under 35% in 1989.

Other major semiconductor-producing regions all managed to top or at least approach the average growth rate. The fastest growth was achieved by companies based in the Pacific Rim—mainly Korean and Taiwanese. These firms aggregated a total growth of no less than 40%. Close behind, Japanese firms claim among them a total of more than 52% of the world market, with 1988–89 growth of 15% and total sales of $26 billion. By comparison, U. S. sales were $18.6 billion in 1989.

In Europe, Siemens AG is the new

SEMICONDUCTOR MARKET SHARE: LITTLE CHANGE AT THE TOP

1989 Rank	1988 Rank		Sales 1988	($ million) 1989	1988-89 change (%)	Market share (%)
1	1	Nippon Electric	4,543	5,015	10.39	8.77
2	2	Toshiba	4,395	4,930	12.17	8.62
3	3	Hitachi	3,506	3,974	13.35	6.95
4	4	Motorola	3,035	3,319	9.36	5.80
5	6	Fujitsu	2,607	2,963	13.66	5.18
6	5	Texas Instruments	2,741	2,787	1.68	4.87
7	8	Mitsubishi	2,312	2,579	11.55	4.51
8	7	Intel	2,350	2,430	3.40	4.25
9	9	Matsushita	1,883	1,882	-0.05	3.29
10	10	Philips	1,738	1,716	-1.27	3.00
11	11	National Semiconductor	1,650	1,618	-1.94	2.83
12	14	Sanyo	1,083	1,365	26.04	2.39
13	12	SGS-Thomson	1,087	1,301	19.69	2.27
14	18	Samsung	905	1,260	39.23	2.20
15	15	Sharp	1,036	1,230	18.73	2.15
16	20	Siemens	784	1,194	52.30	2.09
17	17	Oki Semiconductor	947	1,154	21.86	2.02
18	13	Advanced Micro Devices	1,084	1,100	1.48	1.92
19	16	Sony	950	1,077	13.37	1.88
20	19	AT&T	859	873	1.63	1.53
Total top 20			39,495	43,767	10.82	76.50
Total all other companies			11,364	13,446	18.32	23.50
Total market			50,859	57,213	12.49	100.00

SOURCE: DATAQUEST INC.

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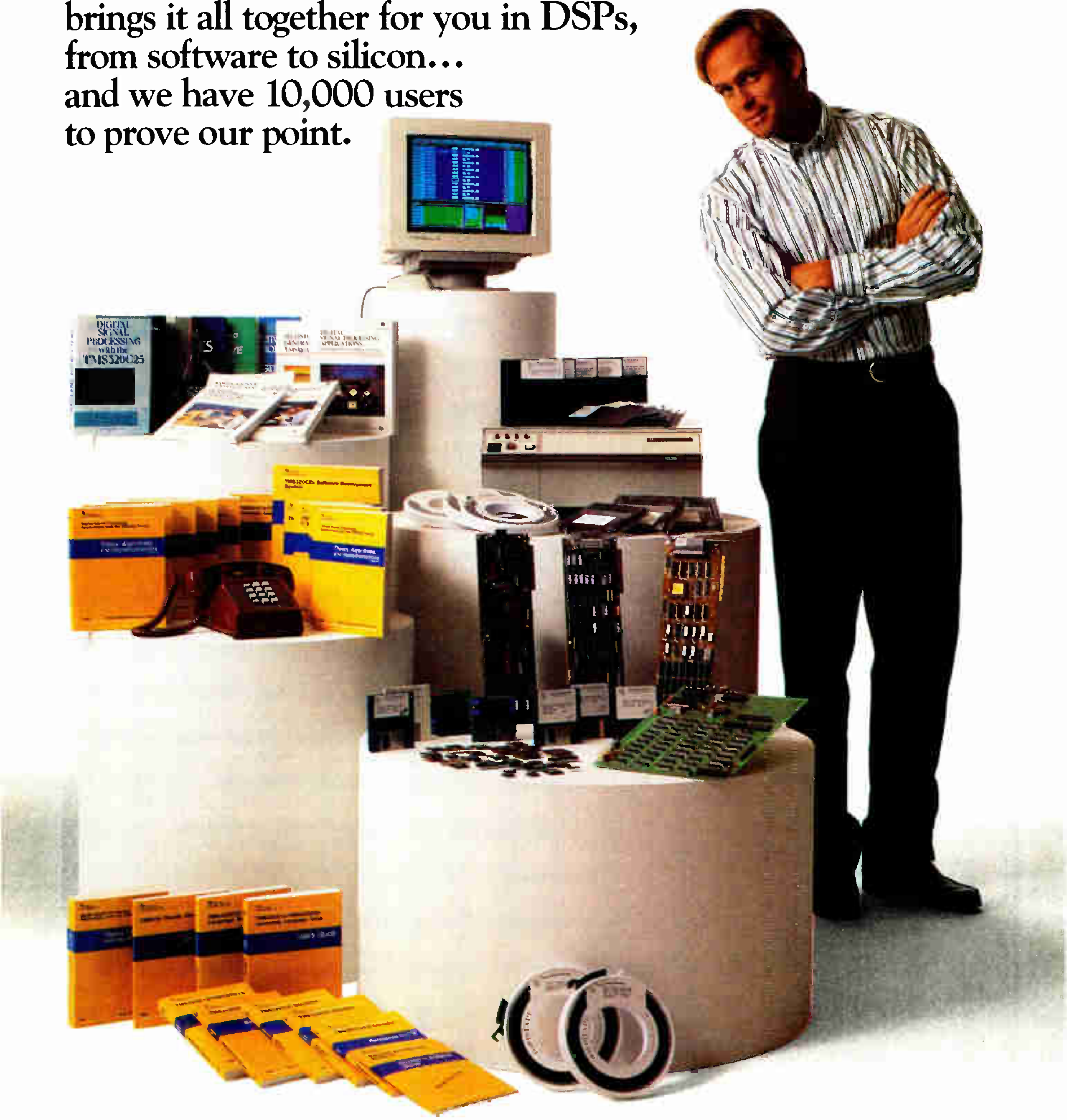

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☐ Yes ☐ No **2. Is world-class support in place to help speed my design to market?**

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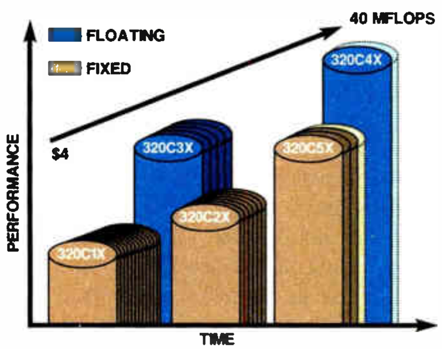

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TEXAS INSTRUMENTS

WHERE THE CHIPS COME FROM

	Sales ($ millions) 1988	1989	1988-89 change (%)	Market share (%)
Japan	25,942	29,809	14.91%	52.10%
Europe	4,917	5,443	10.70%	9.51%
North America	18,586	19,978	7.49%	34.92%
Asia-Pacific	1,414	1,983	40.24%	3.47%
Total Market	50,859	57,213	12.49%	100.00%

SOURCE: DATAQUEST INC.

shining star, with a growth in its semiconductor sales a staggering 52%—by far the biggest spurt in Dataquest's list of top 20. Now holding some 2.1% of the world market, the German firm's sales hit $1.2 billion in 1989. That moves it out of last place and all the way up to 16th. That rise was matched only by Korea's Samsung, which moves into 14th place from 18th. It also seem highly probable that during 1990 Siemens will topple Philips from the first position, Dataquest says.

In total, European companies accumulated sales of $5.4 billion in 1989 compared with $4.9 billion the year before—growth of 11%—giving them a 9.5% share of world markets.

Other changes in position were most noticeable at the top of the Dataquest list with Fujitsu Ltd. pushing one-time pack leader Texas Instruments Inc. down to sixth position. With six out of the top 10 companies Japanese, Dataquest estimates that their share of the U. S. domestic market grew to 26% while U. S. penetration of Japanese markets remained constant at 9%—far from the U. S. industry's goal of 20%.

However, says Dataquest, U. S. companies still continue to dominate the microprocessor market, the second fastest-growing sector in 1989. All told, U. S. firms hold 55% of this business, with Intel Corp. claiming at least half.

Nevertheless, the memory business continues to dominate world semiconductor revenues; it has boosted sales at both Siemens and the Japanese firms. Dataquest UK analyst Bipin Parma estimates that sales in this sector alone grew by 40% between 1988 and 1989.

"Companies that are strong in MOS memory will continue to dominate the market," Parma says, adding, "It is clear that companies that participate in the volatile dynamic-random-access-memory market will continue to gain market share over the long term, although in the past severe market downturns and questionable profitability have caused U. S. firms to abandon this market." ∎

LASERS

SIEMENS'S GaAlAs LASER IS LONG ON EFFICIENCY, POWER ECONOMY, AND DURABILITY

BIG NUMBERS? NOT HERE

BY JOHN GOSCH

TO A SYSTEMS MAKER IN need of high-performance yet economical components, records for device operation set in the laboratory may not mean much if they are achieved under carefully controlled conditions with expensive technologies, complicated structures, or elaborate designs. The systems producer may be better served if less spectacular results are obtained with a simple device design and conventional technologies allowing low-cost parts fabrication.

Take a semiconductor laser from Siemens AG. Developed at the West German company's Corporate Research Laboratories in Munich, the gallium aluminum arsenide laser diode, designed for use as a small-signal optical transmitter, boasts a modulation bandwidth as high as 14 GHz. At the same time, the device offers high efficiency, low power consumption, and long life.

Although remarkable, the 14 GHz is by no means a record value for a laser bandwidth. As high as 22 GHz has been reported—with lasers based on relatively complicated structures such as buried heterostructure gallium indium arsenide phosphide designs. Such designs are expensive to implement, and they do not come close to meeting the requirements for processing reproducibility and reliability.

By contrast, since it's based on well-established semiconductor technology, the Siemens laser is easy to fabricate. "It lends itself well to volume production, and that makes for low-cost devices," says Hans-Günther Lang, a member of the Siemens development team. What's more, results are highly reproducible, which means that the characteristics are the same for device after device in large production runs.

The GaAlAs structure also permits integration with GaAs-based circuits. Furthermore, the laser's wavelength of approximately 830 nm makes it compatible with a silicon photodiode, given the photodiode's sensitivity to that wavelength. This compatibility simplifies signal-processing circuitry.

Besides high bandwidth, the Siemens laser offers a high degree of efficiency and low power consumption. At threshold currents between 10 and 15 mA, the efficiency checks in at a respectable 0.4 mW/mA. The power consumption is a low 60 mW (electrical) for 10 mW of optical power.

Impressive, too, is the laser's high operating-temperature range. Bandwidths greater than 10 GHz are achieved at up to 80°C. This makes the device suitable for use in computers, where temperatures may climb to 70°C. Another feature is the long projected operating life, which is also important in a computer application. GaAlAs lasers have been running for several years without system degradation at the Siemens labs.

The new laser "could enter production as soon as there's a demand," Lang says. Potential applications are in short-haul signal transmission over glass fibers between computers. Also, the laser could be used within future optical computers.

Responsible for the laser's high bandwidth and other characteristics is the way the layers in the active, or light-emitting, zone are structured. The active zone consists of three 7.5-nm

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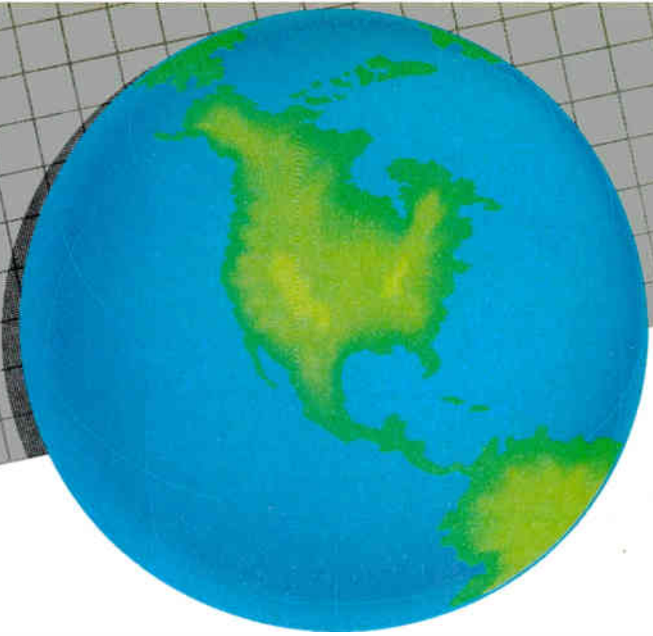
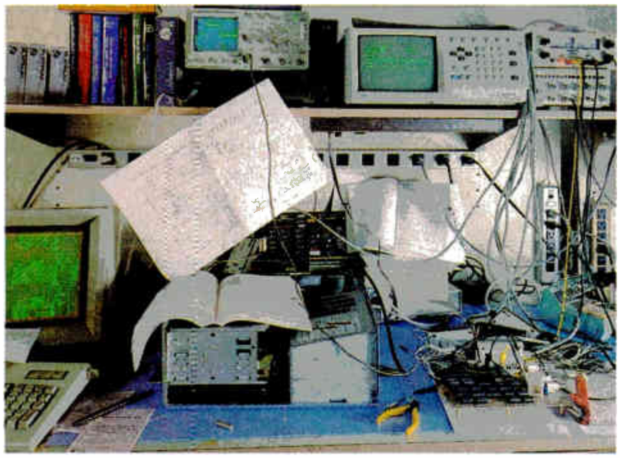


There Are Two Ways to Do DSP!



The Hard Way

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- Steep learning curve for software and hardware
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CIRCLE 199

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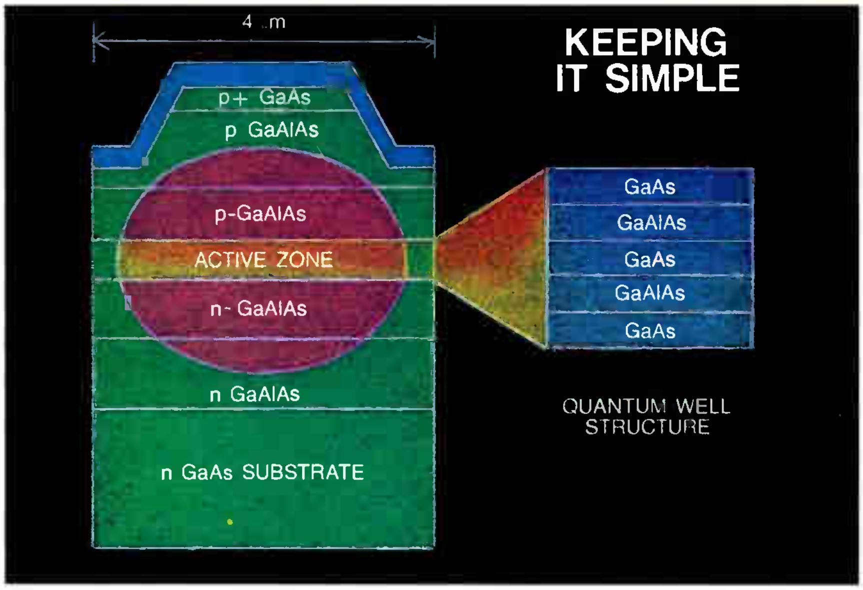
Signal Processing Solutions

GaAs layers separated by two 8-nm GaAlAs layers, forming so-called quantum wells. This sandwich is enclosed between n- and p-conducting GaAlAs layers of a semiconductor diode. So-called ridge waveguide lasers are fabricated from this multiple quantum-well structure using photolithography and a dry-etch process.

This structure, which Siemens pioneered 10 years ago, introduces slight changes in the refractive index leading to a waveguide for the passage of light. This, in turn, results in high conversion efficiency and speed despite lateral carrier diffusion out of the ridge region. Compared with other structures, such as buried heterostructures, the ridge waveguide structure is less susceptible to leakage currents.

The heterostructure is grown by metal-organic vapor-phase epitaxy, which ensures homogeneous growth of uniformly thin layers with sharp boundaries between them; it is suitable for volume device fabrication. The epitaxial layers are grown on an n-GaAs substrate in a horizontal, water-cooled reactor system using metal-organic Ga and Al compounds and As precursors, as well as doping-source materials.

A small-area T-shaped contact metalization is used to reduce parasitic capacitances. Lasers with cavity lengths of 150 to 200 μm are cleaved from the wafer, and the facets are coated with aluminum oxide layers by sputtering. The low temperature sensitivity of the lasers allows for easy substrate-down mounting schemes. ■



The key is the laser's active zone structure—three 7.5-nm GaAs layers separated by two 8-nm GaAlAs layers forming quantum wells.

GOALS ARE MACHINE-READ ADDRESSES, MECHANICALLY SORTED LETTERS AND PACKAGES

IS SMART MAIL COMING?

BY LEE TESCHLER

FOR A KING-SIZE PROBLEM in customer service, consider this: the U. S. Postal Service must handle more than 150 billion pieces of mail annually, or a little over 4,756 pieces every second.

The USPS is turning to technology to better deal with this immense volume. The most obvious approach is to automate: machine-read addresses and mechanically sort the mail accordingly. Toward this end, the USPS wants to have bar codes on 95% of all mail by 1995. Bar-code readers are cheaper and more reliable than the optical character readers (OCRs) that are now used to read typewritten addresses. "Present OCR systems can read only about 40% of the mail," says Gary Hering, director of the USPS Office of Advanced Technology in Washington. "Research in OCR technology dropped off in the 1970s. Developers back then had to assume that computational capabilities were limited."

The USPS says that many mass mailers will apply the bar codes themselves. For anything else, the USPS will have to read the address and then apply bar codes at postal facilities. Manually reading addresses would defeat the purpose of bar coding, so the USPS is now studying long-range approaches that it hopes will enable machines to read and understand addresses on most mail by 1995.

The magnitude of the problem becomes clear by considering just one aspect of it, the handling of what are called irregular parcels and pieces, or IPPs. These include mailing tubes, film mailers, and boxes of all shapes and sizes. Postal workers manually sort about 200 such parcels per hour, picking pieces off a large table and putting them into sacks.

By 1995, robotic handling systems coupled with machine vision may take over the sorting process. One system aimed at such tasks was developed for USPS by the GE Advanced Technology Laboratory in Morristown, N. J. Key to the system is a pattern-recognition algorithm that determines the shape and orientation of IPPs on a circular conveyor. The packages pass under a laser beam that provides structured lighting for a video camera. The laser projects a strip of light across packages on the conveyor. Images go to a Sun 3/160 vision-processing system.

This system first identifies individual packages on the conveyor, calculates physical parameters (such as center of gravity and position) for each one, then sends the information to a 68020-based robot-arm controller. This controller tells a five-axis robot arm how to position its specially developed suction gripper to pick up packages from the moving heaps. The robot then moves one package at a time to a take-away conveyor.

Once packages have been separated, the next step is to find the address and then read the zip code. But even finding the address can be a knotty pattern-recognition problem. One complicating factor, says Yubin Hung, an Arthur D. Little Co. senior technical consultant, is that commercial mailers frequently put extraneous writing and advertising on envelopes and packages. Developers have had trouble getting recognition systems to ferret out addresses from clutter.

But several companies now think that they have a handle on finding address blocks reliably. One approach: divide the surface image into blocks of pixels that have a similar intensity, then analyze the block location and shapes within each block to determine the most likely candidate for the address.

The USPS has three main projects aimed at recognizing address blocks because "we still don't know what the best approach is yet," explains Hering. One is taking place at an Italian OCR vendor that will develop add-on hardware improvements for existing USPS OCR gear. Ektron, a vision systems supplier in Bedford, Mass., and researchers at the State University of New York at Buffalo are both pursuing more long-term approaches to the problem that may result in equipment that will completely replace existing USPS OCR hardware.

In addition, SRI International Inc. in Palo Alto, Calif., has developed a vision system for finding address blocks on packages. Plans call for the SRI system to be mated with the IPP robotic handling system developed by GE. The goal is to assess the feasibility of producing a single unit that can both sort and recognize the addresses.

The USPS also reports progress with systems that decipher typewritten—and even handwritten—addresses that existing OCRs can't understand. The idea is to look at word shapes and use contextual information to guess at what the address says. SUNY Buffalo and the Environmental Research Institute of Michigan in Ann Arbor are leaders in theoretical work taking place in this area. In one test, an experimental system was able to read about 30% of the rejects from an existing USPS OCR. The hope is to have systems by 1995 that can do 50%.

In addition to finding zip codes, USPS wants to be able eventually to perform a contextual analysis of the zip codes and city-state part of the address. The idea here is to first read the city, state, and zip, then cross-check all three from a huge, nationwide data base.

However, monetary obstacles seem to be more important than technical ones. "From a theoretical viewpoint, many of these systems will be available well before 1995," says Hering. "The question is whether we'll get the budget to implement them." ◼

2.5-OUNCE 'PRIVATE EYE' DISPLAY LOOKS LIKE A 12-IN. PICTURE—AND IT CAN GO ANYWHERE

A SMALL BIG PICTURE

BY LAWRENCE CURRAN

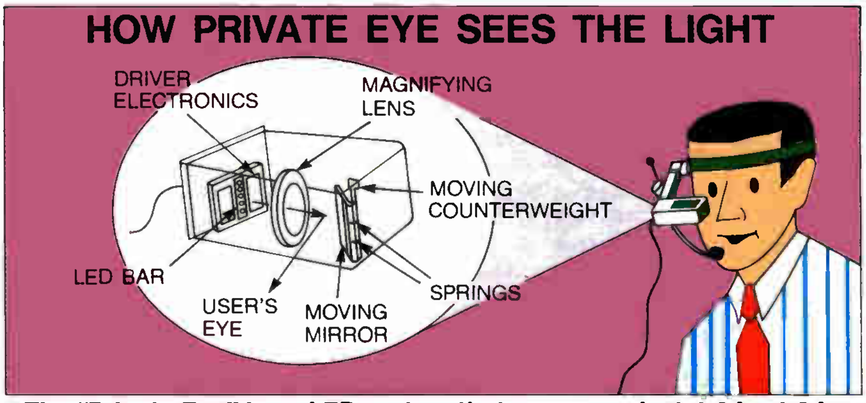
THIS SUMMER'S HIT MOVIE *Dick Tracy* prominently features the super sleuth's two-way wrist radio—a visionary idea for Tracy creator Chester Gould in the 1930s. But unlike Gould's, the vision that Allen Becker had for his "Private Eye" is within the reach of contemporary technology, and it's becoming almost as popular with users as Warren Beatty's film is with moviegoers.

Becker is founder and president of Reflection Technology Inc., a Waltham, Mass., startup. Several customers are designing the company's 1.2-by-1.3-by-3.5-inch light-emitting-diode display into a number of announced products ranging from portable computers to electronic "books," and hundreds more are evaluating the unit, says Neil Golden, director of sales.

Private Eye gives users the impression of seeing an image equivalent to that of a 12-in. monitor [*Electronics*, October 1988, p. 172]. The 2.5-ounce display can be hand-held, mounted on a lightweight head set, or clipped onto eyeglasses. It draws less that 0.5 W and can be driven by a battery.

Two of the latest customers for the surprisingly simple device are Colby Systems Corp. of Palo Alto, Calif., and

HOW PRIVATE EYE SEES THE LIGHT



The "Private Eye" is an LED system that measures just 1.2 by 1.3 by 3.5 in. whose picture appears as big as that of a 12-in. monitor.

Empruve Inc. of Knoxville, Tenn. Colby's 8-lb portable Apple Macintosh computer clone, poised for formal introduction next month, offers the 720-by-280-pixel unit as an option.

At Empruve, president Danny McCall says Private Eye is the sole display for Scout, a portable electronic book that incorporates text and graphics media ranging from hard disks to CD-ROMs. It replaces the often hard-to-read pocket-size displays common to portable information products. The 1.6-lb Scout is to be introduced this month.

Plans for products that use the display from at least six more companies have been announced. They include another portable computer, a hands-free portable industrial workstation, a monitor that enables an anesthesiologist to see vital data while watching a patient, and a paperless pocket facsimile machine. Golden says that like many other breakthroughs, the unit is a unique combination of existing technologies: a staggered column of LEDs, a magnifying lens, a spring-mounted resonating mirror, and a counter-moving weight.

The CMOS electronics consist of a digital application-specific IC control chip, which is a 6,000-gate array, along with a 256-Kbit static random-access memory that acts as a buffer for the screen data. The control chip takes serially transmitted bit-map data from the host system and sends it to the SRAM, which then places the data in shift registers adjacent to the LED array.

THE DISPLAY IS AUTOMATically and continuously refreshed with this image until the host device sends a new bit map. Red LEDs are used in the initial model because they're power-efficient and readily available. A combination of other colored LEDs are planned for later versions to provide multicolored images. Higher resolutions are also possible.

"There's room to innovate without going to state-of-the-art technology," Golden says of the display. "The innovation here is in Al Becker's taking simple things and grouping them in a unique way. That means that we and a lot of others can build it easily." Reflection Technology manufactures and sells the Private Eye directly, and it licenses OEMs to manufacture it.

Evaluation units sell for $795 each. The OEM price is $495, dropping to less than $100 in volume. ■

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64K	UM6188	2 x (4K x 8)	25/35/45
64K	UM61164	4K x 16	25/35/45
64K	UM61165	2 x (2K x 16)	25/35/45
64K	UM6264AL	8K x 8	70/100/120
128K	UM61168	8K x 16	25/35/45
256K	UM62256AL	32K x 8	70/100/120
1Mb	UM621024	128K x 8	70/85/100

SRAMs include DIPs, SDIPs, and SOs. 1Mb available 4th qtr.

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CIRCLE 204

ASICs Update

A REPORT FROM THE NETHERLANDS FOREIGN INVESTMENT AGENCY

In mid-1989, the Netherlands completed an innovative electronics development program that demonstrated the efficient use of Application Specific Integrated Circuits (ASICs) by 19 small- and medium-sized Dutch companies. This Demonstration Program in Microelectronics has enabled these companies to gain experience in using ASICs and in implementing these circuits in competitive products, ranging from electronic access systems to automobile shock absorbers, for international markets.

Today, the European ASIC market represents a more than $1 billion market that will grow more than 15% annually in the next few years, according to Dataquest. Meanwhile, the Dutch market will be growing in excess of 50% between 1989 and 1992. Here are some of the results of the Demonstration Project that are a part of that growth:

BRONKHORST HIGH-TECH, a provider of electronic sensor systems, developed an analog ASIC for its mass flow meters.

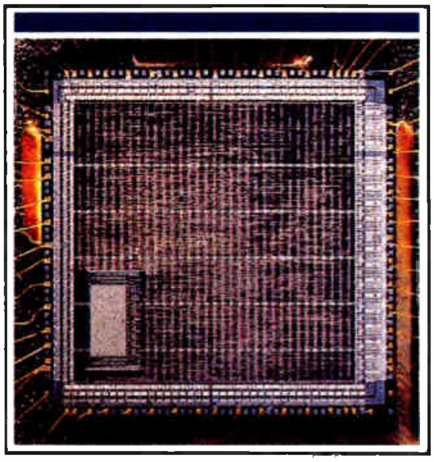
DAHEDI, an electronic systems producer, developed a miniature medical infusion pump controller on a 1.7 sq. inch hybrid circuit with a 2500-gate array.

DELFT INSTRUMENTS, a manufacturer of advanced optical and electro-optical systems, developed an analog controller chip to intensify the clarity in night-vision binoculars.

ECONOSTO, a distributor and manufacturer of heaters and heater-boilers, developed a 2300-gate ASIC for electronically controlling an advanced ceramic heater element to realize both heat reliability and low emission of NO_2.

HYDRAUDYNE, a hydraulic systems manufacturer, developed drive-shaft ASICs to control hydraulic valves.

KONI, a supplier of automobile shock absorbers, developed an EPROM-controlled



microprocessor ASIC line for both customer-specified and adjustable shock absorbers.

LIPS, a manufacturer of locks, safes and electronic security systems, developed a full custom CMOS-EEPROM and a 4000-gate HCMOS array for an electronic access system.

NIEAF-SMITT, a producer of electronic measuring instruments, developed a 130-transistor analog-bipolar chip for transducer/multiplier applications in a watt-meter.

NKF-TELECOMMUNICATIE KABEL SYSTEMEN, a supplier of cables and equipment for transmission systems, developed an ASIC for signal processing of video images.

OCE VAN DER GRINTEN, a producer of copiers and office equipment, developed a 3300-gate CMOS ASIC for electric motor control.

PIV ELDUTRONIK, a distributor and manufacturer of industrial drive shafts, developed a PLD-based ASIC for electric motor control.

ROOD MEGATRONICS, a supplier of broadcast studio equipment, developed an analog-digital ASIC stereocoder for generating a stereo multiplex signal.

SCANTECH, a producer of bar-code laser scanners, developed a two-chip set analog/digital ASIC for control of their slimline scanners used in retail stores.

SPRUYT-HILLEN, a provider of medical disposables, developed an ASIC to control insulin flow through an injection needle.

TULIP COMPUTERS, an IBM compatible PC maker, developed a Clock Parallel and Serial I/O ASIC.

To find out how you could profit from these developments, please contact the Netherlands Foreign Investment Agency at the numbers below.

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COCOM EASES ITS RESTRICTIONS . . .

Electronics companies in the West will find doing business in East European countries a lot easier now that Cocom has considerably relaxed restrictions on the export of sensitive high-tech products. Cocom, the Coordinating Committee for Multilateral Export Control, is the 17-nation association of Western countries that oversees sales of security-sensitive technology to the East. At a June meeting in Paris, the group gave the green light to increased exports of products in three categories: machine tools, telecommunications, and computers. Western electronics manufacturers have long been lobbying for such a move [*Electronics*, March 1990, p. 47].

Under the new regulations, sales of lathes and milling machines with controls accurate to 3 µm are now allowed. So are computers with data rates up to 550 Mbits/s, an eightfold performance increase over what was permitted before. As for communications gear, restrictions are lifted on packet-switching systems, radio telephones, and other sophisticated equipment. **E**

. . . WHICH MEANS THAT A BOOM IN BUSINESS MAY BE IN STORE

Just what the sales potential is for Western firms in East Europe is difficult to say, but an indication of the communications equipment market's size in at least one country, East Germany, suggests that it will be huge. The Bundespost, West Germany's postal and telecommunications authority, says that to upgrade East Germany's communications infrastructure and thus help raise its standard of living to that of West Germany, the country needs telecom investments of $33 billion between 1991 and 1997. That money could be raised in capital markets through loans and increases in telephone-call charges in East Germany, the Bundespost says.

Companies in the West as well as installation services in East Germany could benefit handsomely given the huge demand for products in some equipment categories: the number of subscriber lines in East Germany must be increased from today's 1.8 million to 7.2 million to serve the population of 16 million people, according to the Bundespost. Also, coin-operated phones should rise from 10,000 to 68,000, and telefax systems from 2,500 to 360,000. In addition, some 50,000 packet-switching lines, 300,000 mobile radio systems, and 2.2 million cable-TV connections must be installed if East Germany is to have a modern communications infrastructure by 1997. **E**

SIEMENS HAS SILICON ON 16-MBIT DRAMs

West Germany's Siemens AG now has first silicon of 16-Mbit dynamic random-access memories. Using 0.6-µm CMOS technology, the devices integrate more than 33 million elements on a 142 mm² chip. Organized as 16 Mbits by 1 bit or 4 by 4, the DRAMs access in 60 ns and consume only 5 mW of power in the quiescent state and 350 mW in operation. Construction of the device is based on 35-fF trench cells.

The Munich-based electronics giant is now transferring the chips into pilot production. The 16-Mbit DRAM parts are the result of a two-year development effort that draws heavily on the success Siemens has achieved as part of the 1-Mbit and 4-Mbit Mega project, a joint five-year Siemens-Philips project. **E**

SEVEN UNITE ON LASER DISKS

Seven companies have just formed the European Laser Disc Association to promote the laser-disk system in Europe. Their aim: to create a better awareness of the medium, broaden program availability, promote system applications, and maintain compatibility within the laser-disk standard.

The seven, which represent European, Japanese, and U. S. concerns, are Panasonic, Philips International, Pioneer, Polygram, Sony, Telemedia Bertelsmann, and Warner Home Video.

While laser-disk systems have begun to catch on in Japan and the U. S., sales have lagged in Europe. The reasons, say industry watchers, include differences in language and tastes that complicate marketing. **E**

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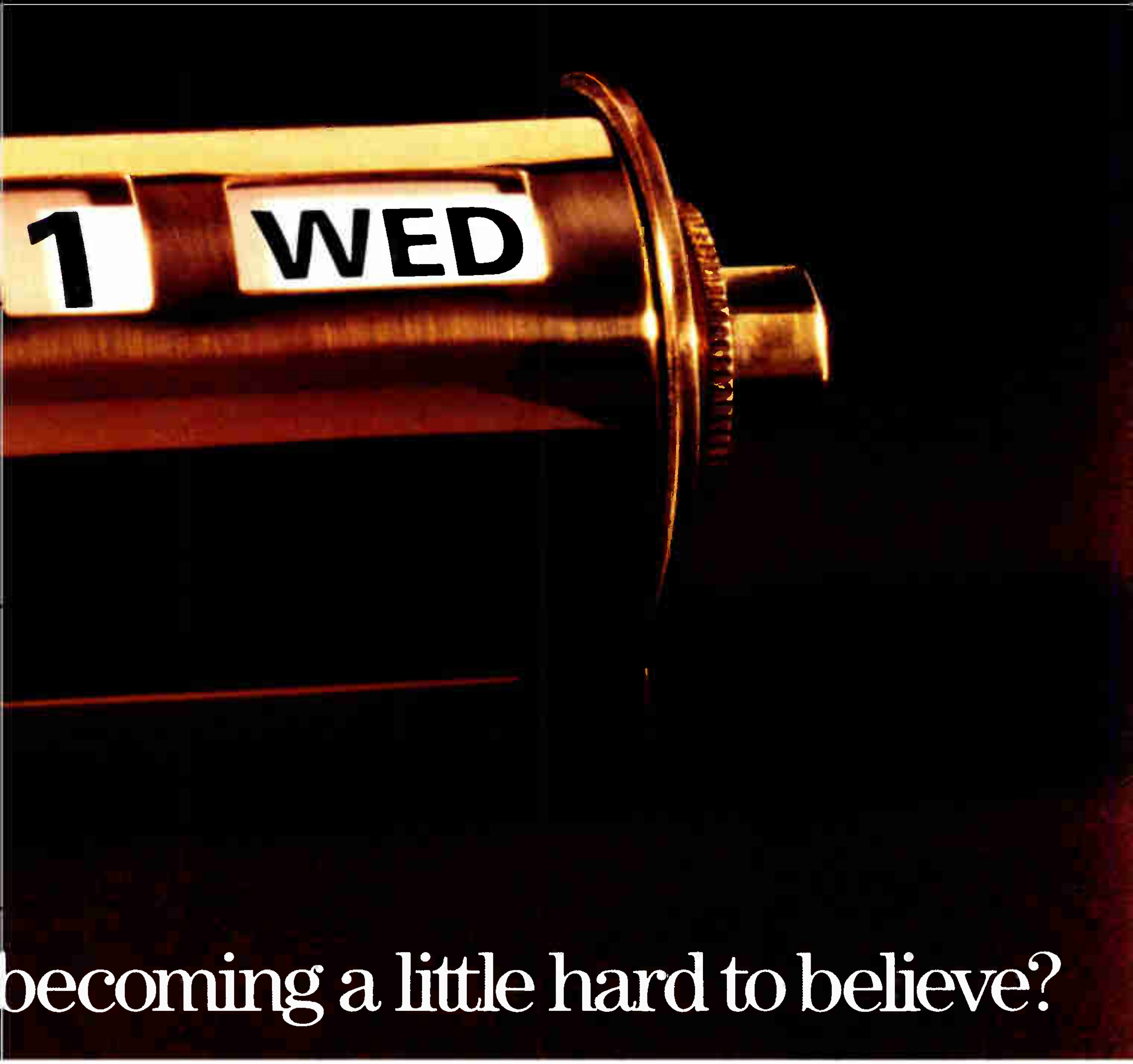

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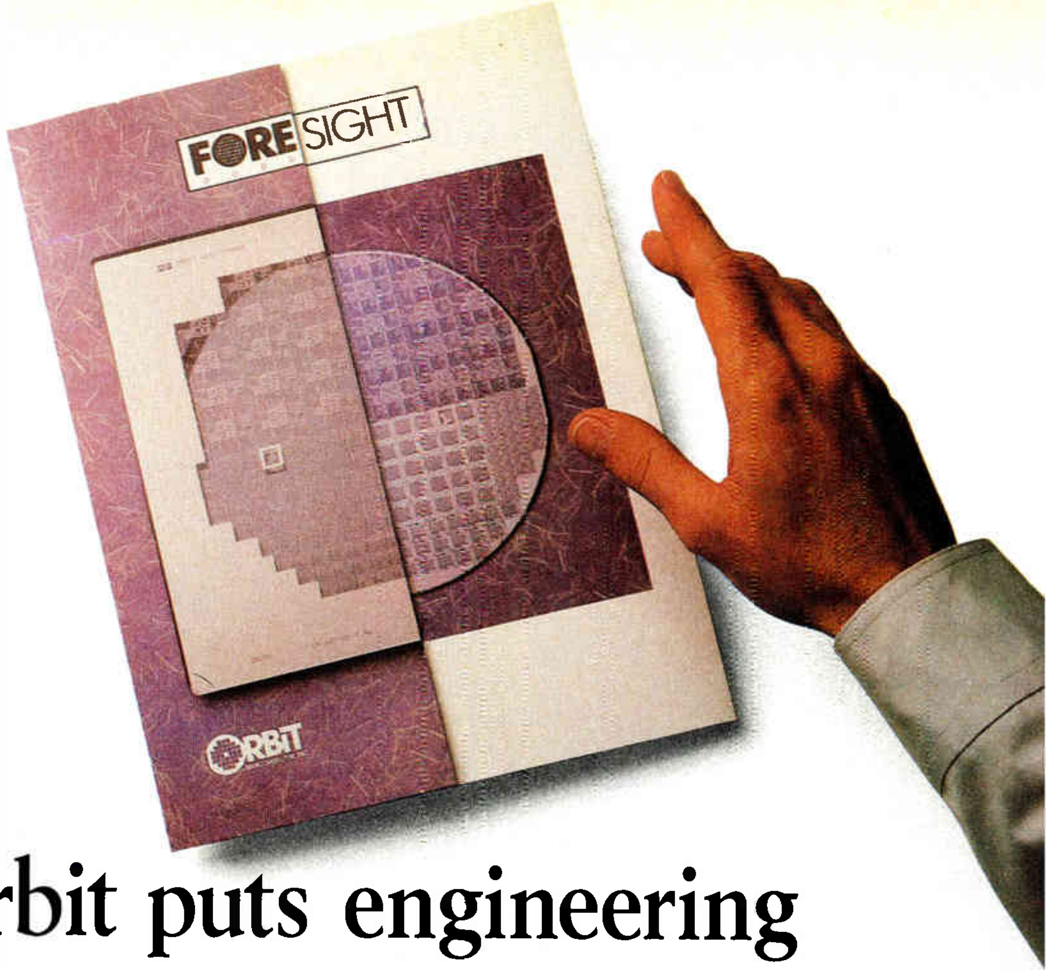

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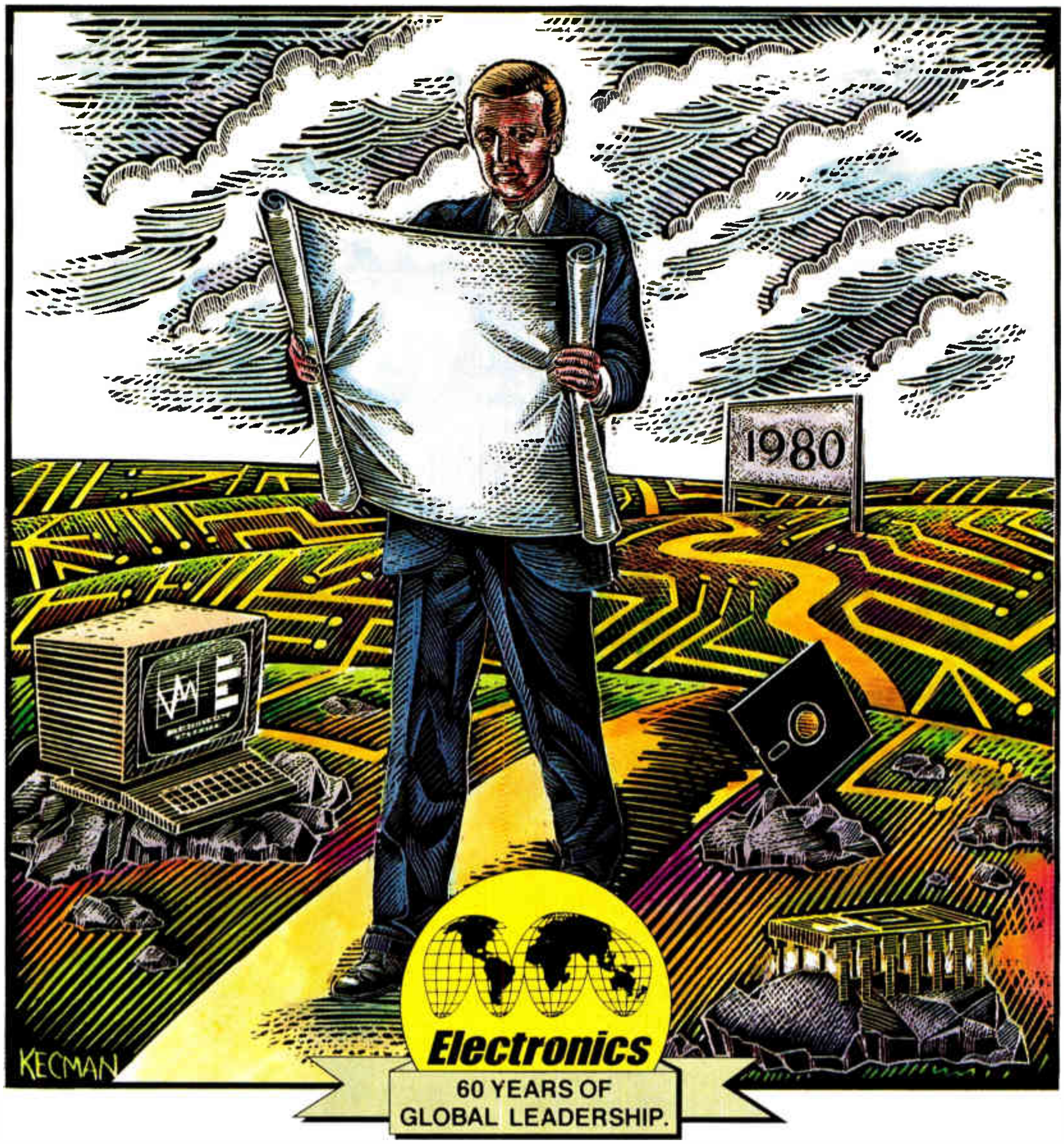


EYE ON THE INDUSTRY

HOW DO U.S. ELECTRONICS EXECUTIVES VIEW THEIR INDUSTRY? WHEN *ELECTRONICS* POSED THAT QUESTION ON THE OCCASION OF THE MAGAZINE'S 60TH ANNIVERSARY, SOME RESPONDED WITH OPTIMISM, SOME WITH PESSIMISM, AND ALL WITH DISTINCTIVE VIEWS OF THE STATE OF THE INDUSTRY. WHAT FOLLOWS IS A COLLECTION OF COMMENTARIES—IN INTERVIEWS AND CONTRIBUTED ARTICLES—ON THE LANDMARKS OF THE '80s AND AN AGENDA FOR THE '90s.

A Call for 'An American Agenda'

THE PRIVATE SECTOR MUST CHART A COURSE TO NAVIGATE THE CHALLENGES AHEAD

BY ROBERT W. GALVIN

The past is a story of surprises, and the failure of most institutions to adapt to those surprises. In our industry I can account for 16 exceptional surprises. In our business we talk about 16 bits of this, 32 bits of that, so let me tick off those 16 bits of surprises I have seen.

When I started in the company in high school, almost 50 years ago, few knew that Marvin Camras, at the Illinois Institute of Technology, was about to present the concept of magnetic recording. TV was known, but even David Sarnoff didn't expect what that was going to represent. Nobody anticipated the semiconductor. There were no vivid expectations of using the very-high-frequency spectrum. Satellite communication, radar, cellular telephones, lasers, fiber-optic cables, digital signal processing, computers, software, data communications, defense electronics, superconductivity were all later surprises. And finally, a phenomenon called "Japan electronics" fills out the 50 years of the unexpected. These surprises have driven our industry.

While my father, Paul V. Galvin, who founded our company, was struggling to survive, he humbly looked up at everybody else in the business—companies like Atwater Kent, Majestic, Philco, and scores of others. Very few of these companies are still around. They didn't adapt. They couldn't anticipate what to do with the surprises. The future is going to be very full of surprises, and these will come faster. I speculate that 50 years from now, observers will take account of 32 new major bits of surprises. And as in the past, relatively few of the old-timers are likely to adapt.

Couldn't we be doing something purposeful about these challenges and others? Couldn't we enhance the wealth-creating nature of our society? The effect of wealth creation on our republic is vital. The essence of our republic is freedom to afford to make many choices. Will we be able to afford all of the possible choices of the future? If we drift while other nations move ahead purposefully and concertedly; if we are overcome by surprises and do not actively commit, we will only accomplish the ordinary. We can do so much more. The essence of my response to the questions I posed above is affirmative—if we will chart a course.

I call for an American Agenda of Private Sector Industrial Intents and Initiatives. I suggest that there be a Private Sector Board of Intents and Initiatives, to be proclaimed by Congress. This proclamation would follow in spirit the legislation that established the Malcolm Baldrige National Quality Award, which in effect ordained that the private sector should finance and operate a quality-award system for the country. The members of this board, from 10 to 20, would be chosen entirely from the private sector. No members from labor, no government, no academia—just private-sector leaders.

ROBERT W. GALVIN

CHAIRMAN OF THE EXECUTIVE COMMITTEE MOTOROLA INC.

■ BOB GALVIN, A 50-YEAR MOTOROLA VETERAN, SERVED AS PRESIDENT AND CHAIRMAN OF THE BOARD BEFORE ASSUMING HIS CURRENT POSITION LAST JANUARY. HE IS A PAST PRESIDENT OF THE ELECTRONIC INDUSTRIES ASSOCIATION AS WELL AS THE RECIPIENT OF NUMEROUS INDUSTRY ACHIEVEMENT AWARDS.

The board's charter would be to invite and receive proposals from the private sector. The board would review the merit of the suggestions. Each considered worthy would be publicly acclaimed. The acclamation would herald the importance of the particular intent. The board would use its good offices to encourage those with appropriate resources to embrace that intent and consider an initiative.

However, the board would have no authority or resources to activate these initiatives. The private sector, in the form of each individual enterprise, would elect its reaction individually. Certain intents may deserve to have the support of a declaration of national policy.

The Private Sector Board could seek from the appropriate public body such support or endorsement.

Why a congressional mandate of what is supposed to be a private-sector program? The intents and initiatives can be substantial and significant; thus the national recognition of the program would

(Continued on p. 55)

Advanced Linear can help you raise system performance levels.

A leadership family of analog circuits from Texas Instruments is helping designers meet difficult design challenges.

The evidence is strong. Throughout the design community, systems using the new breed of Advanced Linear functions from Texas Instruments are achieving the keener performance edges that can spell marketplace success.

TI's new analog devices are enabling design engineers to link digital brains to analog worlds more effectively and efficiently than ever before. Some offer new standards of accuracy or speed while others are highly integrated devices combining analog and digital functions on a single chip. The result is superior system performance and design flexibility.

These Advanced Linear functions are the result of leadership process technologies that we at TI firmly believe are the key to the advanced analog devices your future applications will demand.

Intelligent power for automobiles

Designers in the automotive industry face a tough challenge: Handle high reverse voltages and achieve rapid load turnoff while providing fault protection, detection, and reporting and efficient load management. To provide the needed intelligent power devices, we developed one of our newest process technologies, Multi-EPI Bipolar. It is unique because it can combine rugged power transistors with intelligent control functions.

The resulting circuits are now providing reliable, cost-efficient control of solenoids and valves in such automotive applications as antiskid braking systems, electronic transmission controls, and active suspension systems.

Other industry segments are also benefiting from TI's Advanced Linear process technologies. Here are a few of the winning designs to which we have helped add an analog edge:

Toledo Scale

Challenge: Improve the accuracy of point-of-purchase scales by eliminating drift over time and temperature.

Solution: The TI TLC2654 Chopper op amp. Our Advanced LinCMOS™ process makes possible chopping frequencies as high as 10 kHz, reducing noise to the lowest in the industry.

Pulsecom

Challenge: Develop a linecard capable of driving low-impedance loads with greater precision.
Solution: Our TLE206X family of JFET-input, low-power, precision operational amplifiers. These devices offer outstanding output drive capability, low power consumption, excellent dc precision, and wide bandwidth. Fabricated in our Excalibur process, they remain stable over time and temperature.

Leitch Video

Challenge: Design a compact, cost-efficient direct broadcast satellite TV descrambler for consumer use.
Solution: TI's TLC5602 8-bit Video DAC. Our LinEPIC™ process combines one-micron CMOS with precision analog to satisfy the demands of the application for video speeds and low-power operation.

U.S. Robotics

Challenge: Build a modem for high-speed data transmission between computers; allow flexible operation and minimize data errors.
Solution: Our TLC32040 Analog Interface Circuit (AIC). A product of our Advanced LinCMOS process, the AIC combines programmable filtering, equalization, and 14-bit A/D and D/A converters with such digital functions as control circuitry, program registers, and a DSP interface.

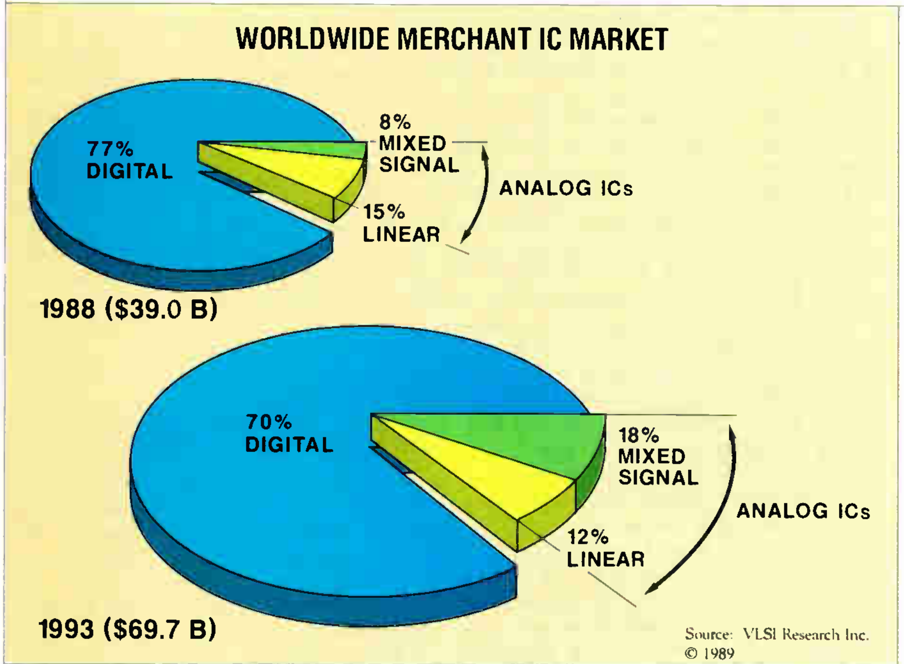
Xerox

Challenge: Cut component count and cost of copier systems while boosting reliability.
Solution: Our TPIC2406, a top-performance peripheral driver in a standard DIP package that is capable of driving heavy loads. It is fabricated using our Power BIDFET™ process which permits greater circuit density and incorporates CMOS technology for low total power dissipation.

Mr. Coffee

Challenge: Design an intelligent coffee maker that brews faster, maintains optimum temperature, shuts off automatically, and has a built-in cleaning cycle.
Solution: Our LinASIC™/LinBiCMOS™ capability permits us to combine both analog and digital library cells with custom analog cells. This results in cost-efficient integration of temperature monitoring, timing, and high-current outputs on a single control chip.

All of these examples point to one conclusion: TI's Advanced Linear functions are adding an analog edge to many system designs. They are contributing significantly to the enhanced system performance that marks a market winner.



Helping you implement your designs in a changing world.

An increasing share of the total analog market is being captured by mixed-signal devices. As they gain more widespread acceptance, they are driving the expansion of the overall analog market (*see above*).

Changes such as this are the order of the day in the IC marketplace. Texas Instruments continues to provide not only the high-performance circuits you need but also the depth of experience, support, and service fundamental to successful completion of your designs.

Experience: Building on three decades in ICs

We at TI can successfully meet your requirements for mixed-signal devices because we have acquired the necessary knowledge from 30 years of experience in developing both analog and digital functions. We have also drawn upon our digital ASIC strengths in developing our LinASIC capabilities.

Support: Speeding our chips to you

The faster we move new products through our design cycles, the faster you can get through yours. We employ a wide variety of design-automation tools and sophisticated software to speed our development process.

Service: Providing a surety of supply

However advanced our circuits may be, they are of little value if they are inaccessible to you. TI operates on the principle of global coverage, local service. We manufacture semiconductors in 13 countries and operate support centers in 22. We have product and applications specialists, designers, and technicians around the world. They are linked by one of the world's largest privately owned communications networks so that we can bring you our best — circuits and support — from wherever they may be to wherever you are.

Keeping our communications open

The relationship between you as customer and us as vendor is vital: You are our chief source for firsthand information that can help guide us in developing the circuits you will need for your future designs. We at TI welcome your comments and your suggestions.

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LinBiCMOS — Combines Advanced LinCMOS, digital ASIC CMOS, and up to 30-V bipolar technologies to allow the integration of digital and analog standard cells and handcrafted analog components on a monolithic chip.

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Power BIDFET — Merges standard linear bipolar, CMOS, and DMOS processes and allows integration of digital control circuitry and high-power outputs on one chip. Primarily used for circuits handling more than 100 V at currents up to 10 A.

Multi-EPI Bipolar — A very cost-effective technology that utilizes multiple epitaxial layers instead of multiple diffusion steps to reduce mask steps by more than 40%. Used to produce intelligent power devices that can handle loads as high as 20 A and voltages in excess of 100 V.

Excalibur — A true, single-level poly, single-level metal, junction-isolated, complementary bipolar process developed for high-speed, high-precision analog circuits providing the most stable op amp performance available today.

If you would like a more detailed explanation of our Advanced Linear process technologies, please call **1-800-336-5236, ext. 3423**. Ask for a copy of our *Advanced Linear Circuits* brochure.

TEXAS INSTRUMENTS

(Continued from p. 50)
be influential. The government imprimatur of the process would be a vital lever. Legislation could simultaneously circumscribe the government from operational and decision-making involvement.

Here are seven examples of possible national intents.

• First, I recommend that it be the national policy of the country that all business would go for the Malcolm Baldrige National Quality Award. That single policy, if acclaimed and endorsed by the federal government, would raise the growth rate of the GNP by an increment of at least 0.5%. Every company that would plan to compete for the award would discover the necessity to improve its processes or its research and development, and raise its investment in tools and capital equipment. These, as all of us know, are economic multipliers. Within three years, all these individual quality initiatives would elevate the growth rate.

• Second, I recommend that it be the policy of the United States to wire the nation with fiber-optic cable. In the past, we have benefited handsomely from a purposeful determination to wire the nation for phones, pave it with highways, and grid it with railroads. A similar objective of vastly increasing the communications network of the nation would multiply business opportunities. All manner of new services would be conceived, many of which would be happy surprises. The very investment in the cable system would be a leveraging tool for growth. The benefit to the professional and the consuming user would be dramatic.

• Third, with the new terrestrial media of high-capacity, high-quality cable, it would be possible to allocate space on the cable to all TV stations. Thus, we could recover 400 MHz of precious natural resource—the radio-frequency spectrum. We could turn this back to the engineers to invent new services.

This spectrum, which is now incompletely used because of technical and regulatory reasons, could be intensely used, which would more than double the amount of business that is done today. Wouldn't this be an invitation to create wealth-producing surprises? If one had confidence, as I do, in the prospect for high-definition TV, for example, here would be a combination of ideas that would readily offer its quality delivery to the home.

• Fourth, we need another major laboratory for the generation of the next eras of technology. The Bell Telephone Laboratories have been a remarkable engine for our country. There should be a parallel private-sector laboratory for similar purposes, appropriately conceived and structured. It should be the intent of the private sector to support this laboratory by rather universal tithing.

• Fifth, America needs a technology road map. The laboratory described above, or a separate entity of the private sector, could author such a stimulating document. The clearer vision of future needs would stimulate a greater private-sector outreach and would encourage investment in long-term growth.

• Sixth, there could be an intent and allowable initiatives with regard to control of the drug problem. American business is presently burdened with $60 billion to $100 billion in drug-related costs, which it must pass on to its customers.

Why not a policy acclaimed by the Private Sector Board that American industry be allowed to rid itself of all chemically dependent employees who are unwilling or unable to take advantage of medical assistance?

• Finally, it could be intended that a fundamental study—a reexamination of the American enterprise system—be engaged. Of course, our system is sacred to us, but it is not perfect. We are seeing that other systems are producing competitive results better than our own. Under the auspices of the Private Sector Board, it may be that we can synthesize improvements in our process that could strengthen the private enterprise system. Some of us are at least concerned that we have changed emphasis from a time when the financial community primarily existed to support investment in the wealth producers to where now, the wealth producers are being used to favor gain by the financial community.

I have long believed that our expectations are too low. Thus I believe that there is promise of greater opportunity and greater wealth creation if we can stimulate commitment to these more identifiable, privately selected commercial intents. I believe the leaders in our society could intend and initiate so much more, and thus America's wealth creation would soar. ■

IN A WIDE-RANGING INTERVIEW, NATIONAL SEMICONDUCTOR'S CHARLES E. SPORCK PINPOINTS MANUFACTURING AS THE KEY

'We Must Focus on What's Truly Important'

BY SAMUEL WEBER

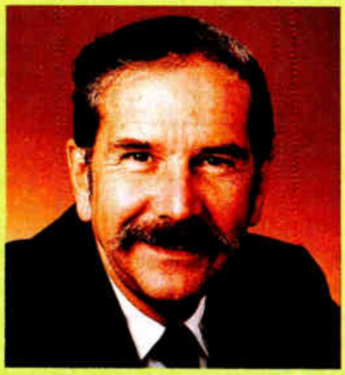
■ ***What changes do you foresee in the semiconductor industry 10 years from now?***

You know that whenever you ask that question, you get hopes more than a solid forecast. I think that there certainly will be an entity in Washington in that time frame that will promote an industrial strategy. I'd like to see it in a year from now, or else 10 years from now we'll have a much higher mountain to climb. I think there's a flattening out of our loss of the semiconductor market, primarily because the U. S. industry does recognize that manufacturing is the key. And that will make a big difference.

■ ***What changes have you seen in the past 10 years?***

I guess if I were to look at the changes that I think are the most important, I'd

CHARLES E. SPORCK



PRESIDENT AND CEO
NATIONAL SEMICONDUCTOR

■ CHARLIE SPORCK JOINED NATIONAL SEMICONDUCTOR CORP. IN 1967 AFTER SERVING IN MANAGEMENT POSITIONS WITH GENERAL ELECTRIC CO. AND FAIRCHILD CAMERA AND INSTRUMENT CORP. A FOUNDING MEMBER OF THE SEMICONDUCTOR INDUSTRY ASSOCIATION, HE IS CHAIRMAN OF THE BOARD OF THE SEMATECH MANUFACTURING CONSORTIUM.

have to start with the one that I think is not very positive: that is, the change in market share that U. S. electronics companies have in the world market. There is certainly a shift in the wrong direction. In 1984–88, there was a 10% drop in market share worldwide for the U. S. electronics industry. Obviously that's continuing. I find that to be the most significant change.

■ ***That's really bad news, isn't it?***
Probably what bothers me most are the specifics of that. It started with the consumer industry, which we lost a long time ago. Now most of that shift is coming in areas where we really perceive ourselves as being world-dominant. And indeed there are a number of people predicting that sometime in the 1991–92 time frame, our leadership position will shift to the Japanese specifically in computers; they will have a larger share of the world market than the U. S. Now that really bothers me. I think that this area is so critical to our effectiveness as a developed country, so critical to the health of our entire industrial base.

And obviously that has ramifications for the semiconductor industry. I really felt that for some time we were making a certain amount of progress in coming to grips with the problem, but recently I have felt less than encouraged. That's basically because we have an administration today that recognizes we have a problem and even takes the position that we ought to do something about it—but [actually] is opposed to doing anything. That's kind of scary as to where that's all going to lead.

■ ***What are the reasons for this U. S. decline?***
We've spent so much time talking about reasons. I don't happen to blame the Japanese. They're doing what they should do in their own best interest. Our problem is that we're not. If we want to look for a cause, we have to look at ourselves. If we must focus on what's truly important, it is the issue of manufacturing. If we don't manufacture here, we're not going to be in business long term. As business executives, to a very significant degree, we've not faced up to that issue. We've been altogether too willing to subcontract manufacturing to somebody else, to move our manufacturing offshore, or give up our manufacturing rights entirely in this market. I think that has contributed very significantly to our decline in market share.

The other part is that we have not as a nation taken seriously the importance of industrial health, and as a result we do not have a healthy growing industrial base, as evidenced by our trade deficit. And that's got to change. Our trading partners do understand the importance of this. They work hard at it, they have become very good at practicing industrial strategy. Unfortunately, we are 20 or 30 years behind them.

■ ***You think, then, that the U. S. should have an industrial policy?***
I don't think there's any choice. We have to match the competition. And we'd better get at it soon, because we haven't got a lot of time before the comparative energy of our trading partners becomes impossible to match. We need an industrial strategy. We need an entity in government that focuses on industrial health. We're going to have it. The only question is, will we have it when we're in really bad shape.

■ ***What other important changes have you seen in the industry?***
We've gone through several phases since the early days. At first, everything could be wrapped up in the one task of getting the gee-whiz product out. You get the gee-whiz product out, you could sell it at a high price, with lousy quality, no service, and it didn't matter, it was a gee-whiz product. That phase lasted quite a while, and most of us grew up in that era. Then we got into the period in which quality became the major factor. None of these issues ever dropped—gee-whiz products were still important, but no longer the only thing. But now we were in the age of quality where suddenly the customers were focusing on the question of quality, the cost of quality, the cost of ownership. The Japanese clearly focused on that before we did. And that caused a big effort on the part of our industry and we made tremendous strides. Now quality is a given. If you ain't got it, you don't play the game.

Currently, we're in the age of service. You've got the world saying, "We don't only want a product that solves our problems and that's perfect in terms of quality, we want it when we want it—not before or after. We want engineering support, we want to be able to introduce our ideas on what it should do before it's designed," and on and on. I think most of us are accepting that. I think we're coming to an age where you need balance, where you've got to have everything, where you've got to be perfect in all ways because the marketplace, the customer, is reducing his supplier base. He recognizes, especially the sophisticated ones, that the more suppliers he has, the more expensive it is, the more difficult it is to do the things he likes to do from a cost standpoint. But in addition to that, if he really wants to innovate he has to engage in depth with his suppliers, and to do that effectively he has to pick the ones from which he will get the best service.

■ ***Can the U. S. beat the Japanese in service?***
I have no doubt in my mind that we have the ability to perform quality-wise

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and performance-wise with the Japanese, and we're doing it. I have no doubt in my mind that we are ahead of them and will stay ahead of them in innovation. In the manufacturing area, where you're talking about commodity products, that's where they are beating us. This is something that requires intense engagement over a long period of time, an engagement of investment, of focus, of concentration of assets. We have a disadvantage in the capital area, in that our financial system encourages investment on a short-term basis. I could go on and on, but that's really what I was talking about in my reference to an industrial policy.

■ ***Does this talk about an industrial policy represent a shift in your philosophy?***
Going back into the 1950s and '60s, we were in the forefront with the semiconductor industry in moving our manufacturing offshore. In retrospect, I think that was a mistake. It was done for economic reasons. It was a dumb, stupid thing to do. Other countries were doing the opposite while we were encouraging movement offshore. I happen to think that was a mistake. At the time I didn't.

■ ***How much government supervision would you put up with?***
Very little. That can't be our way. You can't have government supervising industry. You don't want a government picking winning companies. You do want government to say, "Hey, the supercomputer industry is important, and we must have a healthy supercomputer industry. Now what do we need to do to achieve that?" Obviously, there are generic things we can do—financial things. Some of them may not be especially attractive at first blush, like investing in R&D in the industrial area or investing in manufacturing. That kind of investment in the future [is something] the government has got to come to, as has been the case elsewhere.

■ ***Would you like to have an agency like Japan's Ministry of International Trade and Industry?***
If that's the only thing I can get, I'll take it. But I don't think we need anything like the level of control MITI used to have (I don't think they have it any more). We sure need an entity that has the authority to analyze the impact of future trends and to raise these issues so that a debate comes to the surface and we can do something. Instead, now we have nothing.

■ ***Are you optimistic?***
No. About a year ago I was very optimistic, but this administration is so violently opposed to doing anything! Look at this last move they made with Craig Fields [former head of the Defense Advanced Research Projects Agency, recently removed after making a controversial R&D investment; *Electronics*, June 1990, p. 4]. Here's a guy who really did understand the importance of an industrial base, and that you don't have any military defense without an industrial base. Why that can't get through, I don't understand.

■ ***What has to happen to change things?***
I'd like to see the debate get louder, more people looking at the issues and discussing them, because that's our system. I have faith that if the debate becomes broad enough, we will arrive at doing some correct things. Meantime, I'm very much committed toward returning National Semiconductor to its justifiable position in the semiconductor world. Which is happening.

■ ***How is National Semiconductor responding to all these changes?***
I think the big thing that's changing at National, and which has accelerated over the past couple of years, is the swing toward what I call "design-rich" products. These are products that get their success more from the solution they bring to the marketplace than the sheer manufacturing cost. We're going through that swing and obviously, it's playing to our strength. We're good at design, we're good at definition. We're far along in the reorganization of a major hunk of our company into the VLSI Division, with its segmented business units that concentrate on market segments like local-area networks, telecommunications, imaging peripherals, and so on. We have a small group of designers, application engineers, and business managers focusing on each market, thoroughly understanding it technically, so they can engage in depth with the customer. ■

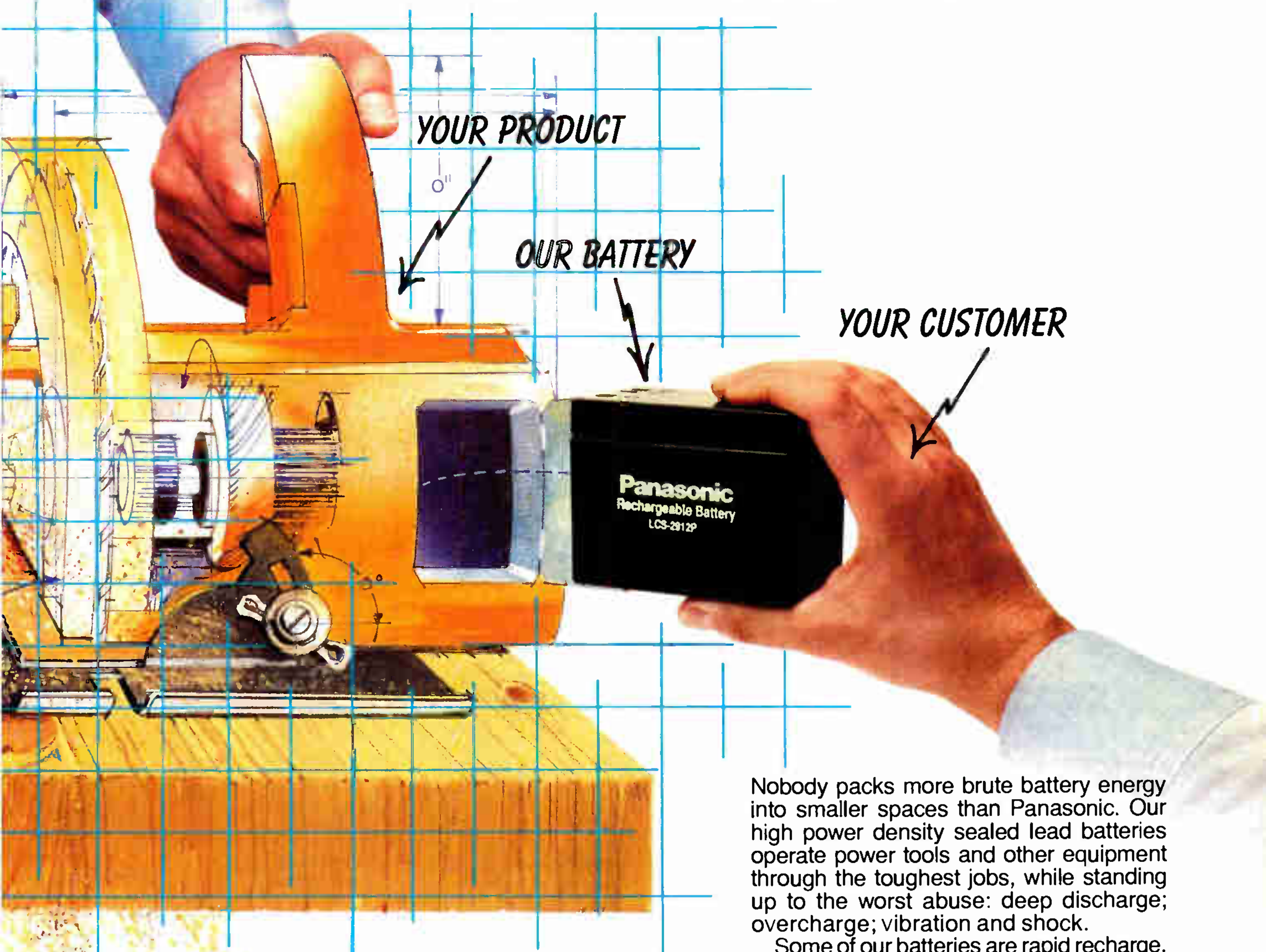
THE BACK PAGES

ONE JAPANESE MANUFACTURER OF ELECTRONIC SYSTEMS REPORTS SIGNIFICANT DIFFERENCES IN THE FAILURE RATES OF SEMICONDUCTORS FROM JAPANESE AND FOREIGN SUPPLIERS. THE PERCENTAGE OF FAILURES AMONG DEVICES MADE [IN JAPAN] WAS 0.11% AT INCOMING INSPECTION, 0.009% DURING EQUIPMENT ASSEMBLY, AND 0.002% IN THE FIELD. THE COMPARABLE PERCENTAGES FOR DEVICES MADE ABROAD WERE 0.54%, 0.11%, AND 0.008%.
ELECTRONICS, MARCH 13, 1980

JAPAN'S SEMICONDUCTOR MANUFACTURERS ARE COMING TO WASHINGTON TO CORRECT "MISUNDERSTANDINGS" ABOUT THEIR RISING SHARE OF THE U. S. MARKET AND THUS DEFLECT THE KIND OF POLITICAL CRITICISM THAT ACCOMPANIED THEIR COUNTRYMEN'S EARLIER U. S. SALES SUCCESSES IN STEREO COMPONENTS, TV RECEIVERS, MOTORCYCLES, CARS, AND STEEL. THEIR MESSAGE: JAPAN'S QUALITY CONTROL IS BETTER AND PRODUCTIVITY IS HIGHER—AND THEY WOULD LIKE TO SHARE THESE BENEFITS WITH THEIR AMERICAN RIVALS.
ELECTRONICS, APRIL 10, 1980

OKI ELECTRIC INDUSTRY CO. HAS ANNOUNCED THAT IT IS ABANDONING PLANS TO HAVE SILICON VALLEY FIRMS MAKE CHIPS UNDER CONTRACT FOR THE U. S. MARKET. THE COMPANY SAYS IT ORDERED SAMPLES FROM THREE UNNAMED SUPPLIERS BUT WAS DISSATISFIED WITH THE QUALITY.
ELECTRONICS, APRIL 24, 1980

Shear Power.



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TO SUCCEED IN THE '90s, COMPANIES NEED A GLOBAL RESOURCE NETWORK AND AN INFRASTRUCTURE THAT KNOWS THE LOCAL BUYER

The Emergence of the Global Customer

BY JERRY R. JUNKINS

JERRY R. JUNKINS

PRESIDENT, CEO, AND CHAIRMAN OF THE BOARD TEXAS INSTRUMENTS INC.

■ JERRY JUNKINS, WHO JOINED TI IN 1959, IS A TRUSTEE OF THE FOUNDATION FOR THE MALCOLM BALDRIGE NATIONAL QUALITY AWARD AND A MEMBER OF THE NATIONAL ADVISORY COMMITTEE ON SEMICONDUCTORS.

The decade of the 1980s was one of significant change for both the electronics and semiconductor industries. Many of the trends behind those changes will still be with us in the 1990s, and how companies respond to them will determine the ultimate competitiveness of the U. S. industry in the 21st century.

One continuing trend is that complex semiconductor devices will be the driving force. Today's $50 billion world chip industry leverages a $750 billion global market in electronic equipment and information services, and about 3 million jobs in the U. S. This is more than double the number of jobs in the U. S. steel and auto industries combined. By the year 2000, electronic equipment and information services will be the world's largest industry at more than $2 trillion.

As chips become more complex, the cost of staying at the leading edge of technology escalates rapidly. Chip makers are at the forefront of all U. S. industries in their annual investments (as a percentage of total revenues) for research and development and new plants and facilities. Since 1980, the cost of a typical state-of-the-art facility for semiconductor memory chips has risen eightfold, from $25 million to $200 million. That trend, if continued, could result in wafer fabs costing more than $500 million by the end of the decade. TI's capital expenditures alone for the 1988–90 time frame will total more than $2.5 billion.

Since the semiconductor industry will continue to be capital-intensive, those companies or countries with lower cost of capital have a built-in structural cost advantage that the U. S. urgently needs to correct. This advantage involves more than just the ability to borrow money at lower interest rates. For example, Japan's cost-of-capital advantage over U. S.-based companies is the cumulative effect of lower interest rates, lower profit-after-tax expectations, and teaming arrangements between banks and companies that permit higher debt-to-equity ratios. The net result is that in the mid-1980s, a Japanese company TI's size (roughly $5 billion at that time) had an extra $400 million available to invest in factories, products, R&D, or in lowered prices to gain market share.

In addition to having low cost of capital, some companies in the early 1980s gained a further competitive advantage through access to technology at little or no cost. Today, there is general recognition that intellectual property, particularly as embodied in patents, has considerably greater value than has been recognized in the past. The protection of intellectual property in the 1990s is absolutely essential for the continued development of new technologies and products. No company can afford to invest in areas where those assets will not provide adequate return.

The 1980s also saw dumping and other unfair trade practices become tactics to gain market share while eliminating competition. The U. S.–Japan Semiconductor Trade Agreement was a historic step not only toward eliminating dumping around the world, but also in forcing the issue of open access to domestic markets for foreign competition.

As the 1980s ended, we began to see the emergence of the global customer, which in turn is driving the global semiconductor manufacturer. This global customer operates in all the major markets of the world. This customer often designs a product on one continent, sources the parts from another, assembles and tests it in a third, and delivers it to a fourth. As a result, the 1990s will see a premium being placed on worldwide service.

In the 1980s, service meant the lowest cost of ownership based on price, quality, reliability, and on-time service. In the 1990s, we will see more "knowledge-based" service, involving such items as electronic data interchange, software simulation models, and testability features built into the chip. In my opinion, companies that succeed in the 1990s will have an infrastructure in place that knows the local customer (language, culture, and customs) while being able to tap into a global resource network that can provide these differentiating services.

The 1990s will continue to be a period of change. Although our challenges are many, a key enabler to solving them is increased communications among industries, governments, and customers. This will let us resolve the difficult problems and issues that confront a global industry, while delivering to our customers the highest levels of technology, quality, and service in what will become the world's largest industry: electronics. ■

AS A SOLO DEVICE, SAYS LYNN CONWAY, THE COMPUTER SEPARATES PEOPLE; THE SOLUTION IS GROUP COMPUTING

'Haunted by the Metaphor of the PC'

BY WESLEY R. IVERSEN

The computer as a tool for collaboration: that's the future that Lynn Conway envisions as the PC becomes truly interactive, not just for individuals but also for groups. "The concept of the personal computer was that everyone would have his own computer. That was the dream back in the early 1970s," Conway says. "Now, of course, everyone does have his own computer, and we are haunted by the fact that the metaphor is that the computer is *personal*—that it's a solo device used by one person. And so in fact, if anything, it now separates people."

But the separation could end with the advent of group computing, which Conway sees as a big market opportunity that's just starting to emerge in the PC arena. The move is supported by a research area called "collaboration technology," which uses computers and electronics to help groups work together more effectively. Software in this arena is sometimes called "groupware." It's a field that has long captured Conway's imagination, and thanks in part to her influence, the University of Michigan has become one of several leading U. S. centers in collaboration technology research.

"Technology shouldn't prevent you from having multiple people working in one editing space," Conway declares. "You can imagine working on an article, or a spreadsheet, or a design file, and you have it on a large screen, and you're changing something down in one corner and watching while one of your friends is changing something in another corner. And you can all group-edit the thing and have a conversation about whether you like what's emerging. You can't do that now, except at a few research labs."

Though still largely a research area, collaboration technology is primed to emerge from the labs, Conway says. "Many companies are using the term to describe an aspect of their new products that somehow relates to this," she notes. As this happens more, Conway expects to see more entrepreneurs as well as established firms enter the field.

"The concepts are emerging in the labs, and those ideas are now available for exploitation," she says. The increasing emergence of networks, standards, and interoperability will be an enabling factor.

If collaboration technology unfolds as Conway expects, it will transform the workplace. "Now, all of a sudden, you don't just have a computer on your desk. You really have the whole question of how do you even do the architecture of a meeting room, so you can have some larger screens; so you can have privacy when you want it but group settings when you want it; so you can have the lighting low when you want to look at the screen, but bring it up when you want to work in your space." These kinds of issues are already changing the way architects and office planners think, Conway says. "Electronic technology is intruding and reshaping our world in other ways than just the systems themselves would suggest."

Another key to the future hinges on how computing and video technologies ultimately are merged in multimedia systems. "You can view either medium [the computer or video] as eventually becoming dominant. Is video a thing within computing? Or is computing a thing within video? It may depend on which side really jumps in and does it."

In either case, says Conway, the results are bound to reshape the technological landscape. "When you add in the other dimension, that all of these systems—video computing and multimedia—could possibly be used by groups simultaneously instead of just by individuals, you get a different image of a technical future."

As the scenario unfolds, Conway says, "the sense I have is that there is a very major underlying opportunity, and a power struggle that's going to go on in this whole set of industries, around how computing and video will integrate, and which groupings of firms and nations will have the major presence in the final form it's all going to take."

Despite Japan's lead in high-definition TV and other video technologies, Conway is not counting the U. S. out. But she is concerned over a current lack of direction in the U. S. and a lack of a sense of urgency. "Forming collaborations and exploring opportunities with European firms might be extremely beneficial," she says. **E**

LYNN CONWAY

PROFESSOR AND ASSOCIATE DEAN OF ENGINEERING UNIVERSITY OF MICHIGAN

■ LYNN CONWAY, WHO CAME TO THE UNIVERSITY OF MICHIGAN IN 1985, IS THE COAUTHOR WITH CARVER MEAD OF *INTRODUCTION TO VLSI SYSTEMS*, WHICH HELPED LAUNCH A REVOLUTION IN VLSI CIRCUIT DESIGN AFTER ITS PUBLICATION IN 1980. A VETERAN OF THE XEROX PALO ALTO RESEARCH CENTER AND OF DARPA, CONWAY SHARED WITH MEAD THE 1981 *ELECTRONICS* ACHIEVEMENT AWARD.

INDUSTRY, GOVERNMENT, AND THE PUBLIC MUST WORK TOGETHER FOR A NETWORKED FUTURE

Choosing to Be Linked

BY ROCCO J. MARANO

There are forces in North America pushing us toward a networked, integrated world. There are other forces holding us back. In my view, we can choose either to be linked together or to live on mutually incomprehensible islands.

At Bellcore, we envision a future in which people can gain access to information at any time, in any volume, and in any form. The telecommunications infrastructure is key to this vision of the future. This is a future in which people would be able to use information as a kind of inexhaustible natural resource. They could use it to create wealth, knowledge, and amusement. They could use it to remake their world—for the better, I hope—in ways we can't even imagine. But before we can choose any future, we must consider the present.

Telecommunications in North America is a jumble of discrete networks, often built to different standards and for different tasks. If we're able to realize our vision of the future, there will be an architecture of integrated networks in place of several disconnected networks designed for different tasks. People will be able to communicate whenever they need to, in whatever medium seems best to them. The forces driving us in that direction concern technology, standards, and what I can only describe as customer expectation.

By technology, I mean the capabilities that allow national and global interconnection of networks. A new public network infrastructure is absolutely necessary, because the current one isn't up to the job, and that new infrastructure is beginning to take shape.

• Digital switches, many times faster and more flexible than the analog switches supporting the current network, are being installed all over North America.

• Fiber-optic cable, with its great bandwidth, continues to replace copper as the main transmission medium.

• Intelligent-network systems are major steps toward making the network more responsive to customers. Such systems are being deployed all over the continent. They make it possible to use the same data bases for different kinds of services.

• Bellcore is working toward a target architecture—Information Networking Architecture—that will facilitate the seamless interconnection of networks and give customers access to information on demand.

A second force pushing us in the direction of an integrated, networked world is the standards process. Agonizingly slow though it is, the process is bearing some fruit. For example, the interfaces for the integrated services digital network have now been standardized.

The third force pushing us toward the future, customer expectations, means that people and institutions, customers large and small, are beginning to make changes in the way they gain access to information. They have bought personal computers, workstations, modems, cellular telephones. They have constructed LANs and metropolitan-area networks; they have bypassed the public, switched network when it didn't meet their needs. They've become accustomed to pieces of the future—and they expect the rest of the future to fit together. But they've noticed that it doesn't fit together very well. And they're beginning to ask why not.

In the U. S., especially, we continue to behave as if we were an island economy, independent of the rest of the world. In our management style, in our laws, in our methods of regulation and our approach to international standards, this view of the world retains a strong grip on us. For example, our antitrust laws were written to ensure fair competition in an isolated, independent U. S. economy—one that no longer exists.

In the U. S., we have no single telecom policy. Consequently, it's harder for us to achieve a unified national point of view. For example, other countries formulate their international standards positions with reference to national strategies. We don't have one. Industry, government, and the general public need to get together and choose an integrated, networked future. There are some things we can do to make that happen.

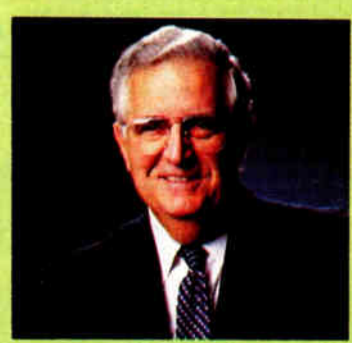
• Industry can expand the frontier of fundamental technologies by upstream cooperation; and government can amend the antitrust laws to allow that cooperation.

• Industry can continue the good standards work that has been done and it can work toward streamlining the process by which we arrive at our international standards position.

• Government can lead the way to a national telecom policy, and revise its laws and regulations as needed to support that policy.

If our choice is to be linked together or to live on mutually incomprehensible islands, I cannot believe we would consciously choose the latter. And yet, that is the future that is being chosen for us by our individual motives. It need not happen that way. ■

ROCCO J. MARANO



PRESIDENT
BELLCORE

■ ROCCO MARANO BEGAN HIS BELL SYSTEM CAREER WITH NEW YORK TELEPHONE CO. IN 1953, MOVING ON TO NEW JERSEY BELL, WHERE HE ULTIMATELY SERVED AS PRESIDENT, AND AT&T CO. IN 1982 HE WAS CHOSEN TO ORGANIZE BELLCORE, THE R&D ARM OF THE SEVEN REGIONAL BELL HOLDING COMPANIES.

BY THE MID-1990s, HIGH-END MICROPROCESSOR CHIPS WILL INCLUDE SEVERAL CPUs, EACH OPTIMIZED FOR A DIFFERENT TASK

What to Do With Millions of Transistors

BY MICHAEL SLATER

MICHAEL SLATER

EDITOR AND PUBLISHER MICROPROCESSOR REPORT

■ THE INDUSTRY CONSULTANT MICHAEL SLATER HAS BEEN PUBLISHING HIS SEBASTOPOL, CALIF.-BASED TECHNICAL NEWSLETTER FOR THE PAST THREE YEARS.

With million-transistor chips, Motorola Inc. and Intel Corp. have produced fully integrated implementations of their 32-bit microprocessors, complete with floating-point, memory management, and cache memory. In the next two years, similarly integrated versions of Sparc, MIPS, and other reduced-instruction-set processors will appear. These central processing units are likely to include 2 million transistors or more to accommodate larger caches than the 8 to 12 Kbytes provided by today's million-transistor i486, i860, and 68040.

Near the middle of the decade, it should become practical to build microprocessors with about 8 million transistors. At this density, it will be possible to include 128 Kbytes of cache RAM along with very fast floating-point and integer execution units, an MMU, and superscalar instruction decode and dispatch logic on a single chip. At this level of chip complexity, existing architectures will be nearing their performance limits.

Making caches bigger than 128 Kbytes, or enlarging memory-management translation look-aside buffers beyond 64 or 128 entries, will have little effect on performance. In a 10-million-transistor chip, a million or more transistors could be allocated to the floating-point unit, which will produce near-minimum calculation times. Multiple instruction decoders will be extracting all the available parallelism from the instruction stream, and multiple arithmetic logic units will process these instructions as quickly as they are decoded. For the first time since the invention of the microprocessor, integrated-circuit technology will have advanced to a point where it is not clear how to use more transistors to improve performance.

The ability to integrate tens of millions of transistors on a single chip will lead to a proliferation of microprocessor implementations optimized for different applications. High-end microprocessor chips will include several CPUs, each optimized for a different task. A microprocessor chip designed for a desktop computer might include a graphics processor to speed up creation of displays, a digital signal processor for audio I/O and modem functions, a processor to manage the disk drives, and another to control the network interface. Some chips may include multiple instruction decoders—or even multiple complete CPUs—for more than one architecture, to gain compatibility with additional software.

Microprocessors for desktop computers will also subsume most, if not all, of the logic now included in PC system-logic chip sets. By the mid-1990s, a typical PC design will consist of one processor chip, a small number of DRAMs, and some input/output circuits. All of the chips to form a complete desktop computer, including memory, will be packaged in a single multichip module for the highest-performance systems.

The large number of transistors available on a single chip will also lead to many different embedded-control processors designed for specific application areas. Already, microprocessors are appearing that are specifically designed for laser-printer, communications, and engine controllers. Many more varieties will appear as high-volume markets emerge.

Today's architectures appear poised for a relatively long reign, but inevitably, new architectures will continue to spring up. Most will die out, unable to compete with the plethora of excellent alternatives. Some will find niches in which they have special advantages. Eventually, however, a new crop of architectures will emerge that will displace those in use today. This takeover will occur only when a number of factors coincide: new architectures will need significant performance gains (or cost advantages) over others, backing from a credible vendor, and the right technical and business climate to encourage users to switch.

For high-end applications, a move to true 64-bit architectures—which provide 64-bit integers and 64-bit addresses—seems inevitable. While few applications are crying out for more than 4 Gbytes of address space today, some large data-base systems and multiprocessor systems are already feeling the pinch of 32-bit addressing. The first 64-bit architectures are likely to be extensions of existing 32-bit architectures. Many other architectural styles and techniques show promise for the next-generation microprocessors. Examples include data-flow architectures, very-long-instruction-word designs, and custom architectures created with synthesis tools. It is not yet clear how big a role each of these will play in the next generation of architectures. ■

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GLOBALIZATION WILL NOT ELIMINATE NATIONAL INTERESTS AND TRADE BARRIERS; THE U.S. GOVERNMENT MUST BETTER MANAGE TRADE

New Frontiers in Fast Forward

BY WILFRED J. CORRIGAN

The 1980s will be remembered as the decade when the Berlin Wall came down, democracies flourished, and some Eastern European countries began reshaping their borders.

There were equally dramatic changes in technology that mirrored these political changes. Open systems tore down the wall of proprietary operating systems, granting freedom to computer users. The PC and—toward the tail end of the decade—the workstation blossomed as the computers of choice for users who wanted greater individual independence and power. These products blurred the lines separating computer-market borders, practically obliterating traditional minicomputers and prompting a major reexamination of the role of the mainframe.

One of the key agents of change in the 1980s was the application-specific integrated circuit. The ASIC approach to designing systems became popular because it allowed computer makers to get their products to market more quickly by using a configurable method to create and update circuits in real time. ASIC technology accelerated the pace of innovation and shortened computer life spans, giving new opportunities to computer makers with novel ideas. ASIC is, in short, an enabling technology.

In the 1990s, "time to market" will be the clarion call that drives the electronics industry, especially the fastest-growing segments, such as consumer electronics, workstations, and laptop and notepad computers. ASIC technology will be central to the challenge of developing products at an ever quicker pace.

Within this environment of accelerated technological change, many of the buzzwords of the 1980s—Unix, RISC, PCs, and workstations—will continue to be prominent in the 1990s. They will also be supplemented by other terms, such as VHDL, HDTV, concurrent engineering, multimedia, megascale integration, personal workstations, and notepad computers.

Our industry will also be strongly affected by nontechnical issues, such as managed trade, regionalism, cost of capital, intellectual property, and what some are calling "glocalism," meaning a global company with a strong local presence.

The 1990s are beginning on a very rapid course of technological change that was set in the last decade. The magnitude of the progress that was achieved in only 10 years is astonishing. For example, in 1980 workstations didn't exist, and minicomputers most likely performed 1 million instructions per second at a price of $300,000. By the middle of the decade, a 4-mips workstation was selling for $28,000, or $7,000 per mips. Today's newest workstations offer up to 40 mips of performance and sell for about $400 per mips. At this rate, we'll see 100-mips systems selling for $10,000 by the middle of the 1990s.

We'll also see tremendous advances in software to keep pace with the growth in power of workstations. It won't be of any use if our computer engines are revving up, but we've got no gas left in the tank.

To put this progress into perspective, the advances we are seeing in computing would be the same as if we had horse-drawn carriages as our most advanced form of transportation 10 years ago, and now we have jet airplanes.

The rapid innovation in computers has been made possible especially by ASIC technology. Although I'm admittedly biased toward ASICs, I firmly believe that the last decade will be remembered as much for the development of ASIC methodology as it will for the pervasiveness and success of the microprocessor. What began as a convenient way to collect a system's random logic in 1980 was, by the end of the decade, the primary agent of change in both ICs and computers.

Thanks to the quick-turn capabilities of ASICs, the era of the three-year design cycle for complex semiconductors is over. Today, arrays with 100K gates can be designed in two to three months, and a cell-based IC with 200K gates can be developed within six months. Turnaround time from design sign-off to prototype is two weeks for arrays (and two to three days when necessary) and four to six weeks for cell-based designs. By the end of this decade, we'll be measuring the time in hours, if not minutes.

ASIC technology has helped compress computer life cycles down to 12 months today. By 1995, a six-month life cycle for computers won't be un-

WILFRED J. CORRIGAN

CHAIRMAN AND CEO
LSI LOGIC CORP.

■ WILF CORRIGAN IN EFFECT INVENTED THE ASIC INDUSTRY WHEN HE FOUNDED LSI LOGIC IN 1981. A FOUNDER OF THE SEMICONDUCTOR INDUSTRY ASSOCIATION AND CURRENTLY ITS CHAIRMAN, HE WAS THE WINNER OF THE 1989 *ELECTRONICS* ACHIEVEMENT AWARD.

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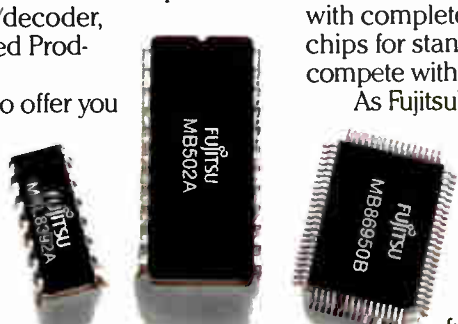

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usual. To survive in an environment of such rapid change, computer makers will have to rely on ASIC technology. Consequently, in the 1990s, ASIC methodology will be adopted across the board by all IC vendors.

ASIC technology will spread even more quickly with current innovations in design methods. These new methods will let a system designer describe on an abstract level the type of circuit that is needed, and then the software will automatically generate the layout. This approach, based on VHSIC Hardware Description Language (VHDL), will revolutionize circuit design.

Semiconductor processing technologies will track with advances in design methodology. By the middle of the decade, we'll be producing ASICs with 4 million to 5 million transistors. These circuits will be processed in 0.25-μm channel lengths with a 100-Å gate-oxide thickness and four metal layers. The performance of CMOS arrays as measured by the gate delay of a two-imprint NAND will begin to plateau in the 1990s, and interconnect resistance will increase. Additionally, power supplies will drop from 5 V to 3.5–3.3 V, thereby reducing the available drive.

These trends will promote the integration of more functions onto a single chip of silicon. The 1990s will be the period of true megascale integration, enabling future computers to consist of just a few ASICs and memory. The ASICs will contain microprocessors, memory-management functions, and analog and digital functionality.

In this decade, IC makers will focus more on providing solutions for whole systems, blurring the distinctions between them and systems houses. As IC companies are able to offer more of the functionality of a whole system—be it in chip sets or in a single chip (through greater integration)—they will take on more of the role of a systems company. For example, IC makers that offer chip sets for PCs—and now for workstations as well—will provide most of the value-added for clone makers. IC companies that can integrate advanced graphics, office-automation functions, and telecommunications into computer chip sets will play a strategic role in HDTV and multimedia systems.

Another reason for the greater systems role is that competitive pressures will force systems companies to work more closely with their IC suppliers. Instead of designing a product in isolation and then purchasing the needed components, systems makers will design a product together with their components suppliers—with an eye to quality and manufacturability. Such a "concurrent engineering" approach will cut development time and costs. It will also make IC vendors more intimately involved in the building of whole systems.

The electronics industry will also be strongly affected in this decade by factors other than technology, especially by international politicial and economic issues. Some people argue that our industry is becoming more global. That's true in the sense that production and consumption of electronics goods are less concentrated in the U.S. and more spread out around the world. But such globalization of the industry will not eliminate national interests and trade barriers. The fact is that the world is moving toward distinct regional economic blocks—North America, Europe, and Asia—rather than toward an undifferentiated global economy.

The other regional blocks pursue managed trade, where imports are controlled or restricted, local industries are supported by government, and sometimes aggressive export strategies are encouraged. As Eastern Europe merges with Western Europe, newly developed Asian economies such as Korea and Taiwan become major players, and Japan attempts to maintain its economic leadership, managed trade (and its associated problems of limited market access, dumping, etc.) will become more of a problem for American industry.

Right now, our region is the only one that doesn't pursue managed trade, and as a result, the other regions are managing it for us by default. The U.S. government will have to play a more active role in trade issues in the 1990s, if we want to maintain our competitiveness and independence. The U.S. government should also strengthen the protection of intellectual property and find ways of lowering the cost of capital to reduce the investment risks for American industry so that we can keep up with our foreign competition. Access to investment capital will be a major determinant of the ability to compete in the 1990s.

Finally, in a world of managed trade and increasingly scarce investment capital, it will be necessary for individual companies to establish global organizations catering to local needs around the world, or what some have termed "glocal" structures.

A strong local presence in the various markets—including local manufacturing—will become important in the 1990s, as customers demand greater supplier responsiveness and as regional trade barriers become more of a problem. "Glocal" companies will have the added advantage of being able to draw on local capital for investment. The biggest challenge for companies with such a structure is the coordination of relatively independent local units into a coherent whole so that all the units can benefit from a company's collective technologies, resources, and strategies.

The 1990s will be a time of enormous change in technology, products, supplier-customer relationships, and the global political economy. The one common denominator to these changes is that they will all be played in fast forward. The winners will be those who can cope with, and adapt to, such rapid change. ■

THE BACK PAGES

LITHOGRAPHY FOR LARGE-SCALE INTEGRATED CIRCUITS HAS NOW REACHED THE STAGE WHERE LINES 2 AND 3 MICROMETERS WIDE ARE BECOMING ROUTINE. IN THE FORESEEABLE FUTURE, VLSI CIRCUITS WILL BE MADE WITH FEATURES OF LESS THAN 1 μM. HOWEVER, PRESENT-DAY LITHOGRAPHY IS LIMITED TO LINE WIDTHS OF ABOUT 1.5 μM. TWO NEW LITHOGRAPHY TECHNIQUES, BOTH BASED ON EXPOSING PATTERNS IN RESIST USING A STREAM OF IONS, SHOW GREAT PROMISE FOR THE FABRICATION OF ICs WITH SUBMICROMETER DETAILS.

ELECTRONICS, MARCH 27, 1980

U. S. INDUSTRY AND GOVERNMENT MUST WORK TOGETHER TO SURVIVE THE GLOBAL ECONOMIC WARFARE OF THE 1990s

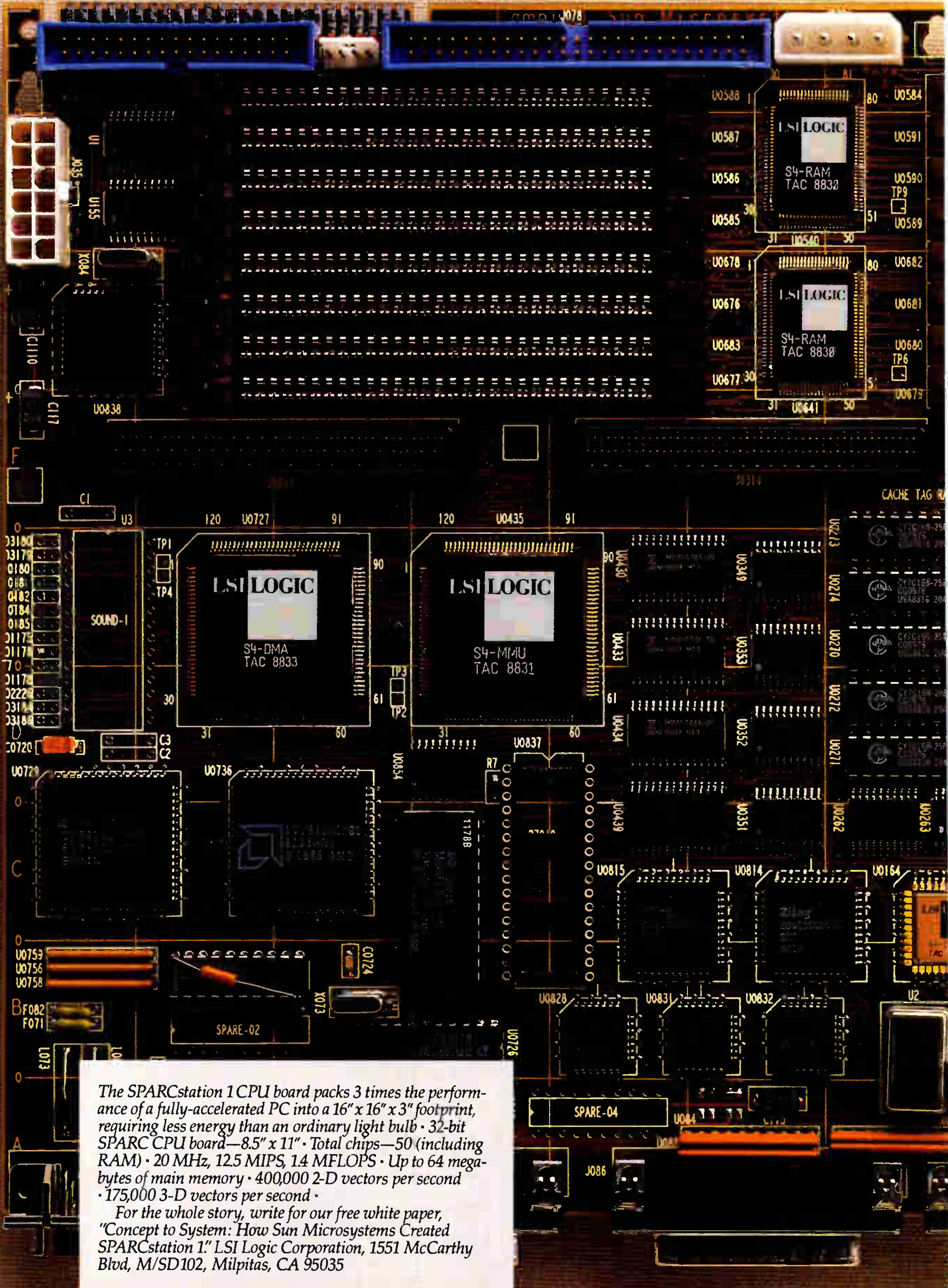
'Hyperchange Is the Only Certainty'

BY TERRENCE L. ROCK

The 1990s will be the first decade of true global competition and global economic warfare, with three major players: the U. S., Japan, and Germany. There will be several other secondary strong Pacific Rim and European Community economies—Korea, Taiwan (China), France, the UK, etc. The decade will also see the emergence of the Eastern bloc as a strong secondary market, but unless the U. S. acts quickly, this market will be taken by Germany and Japan. Tremendous change—hyperchange—is the only certainty.

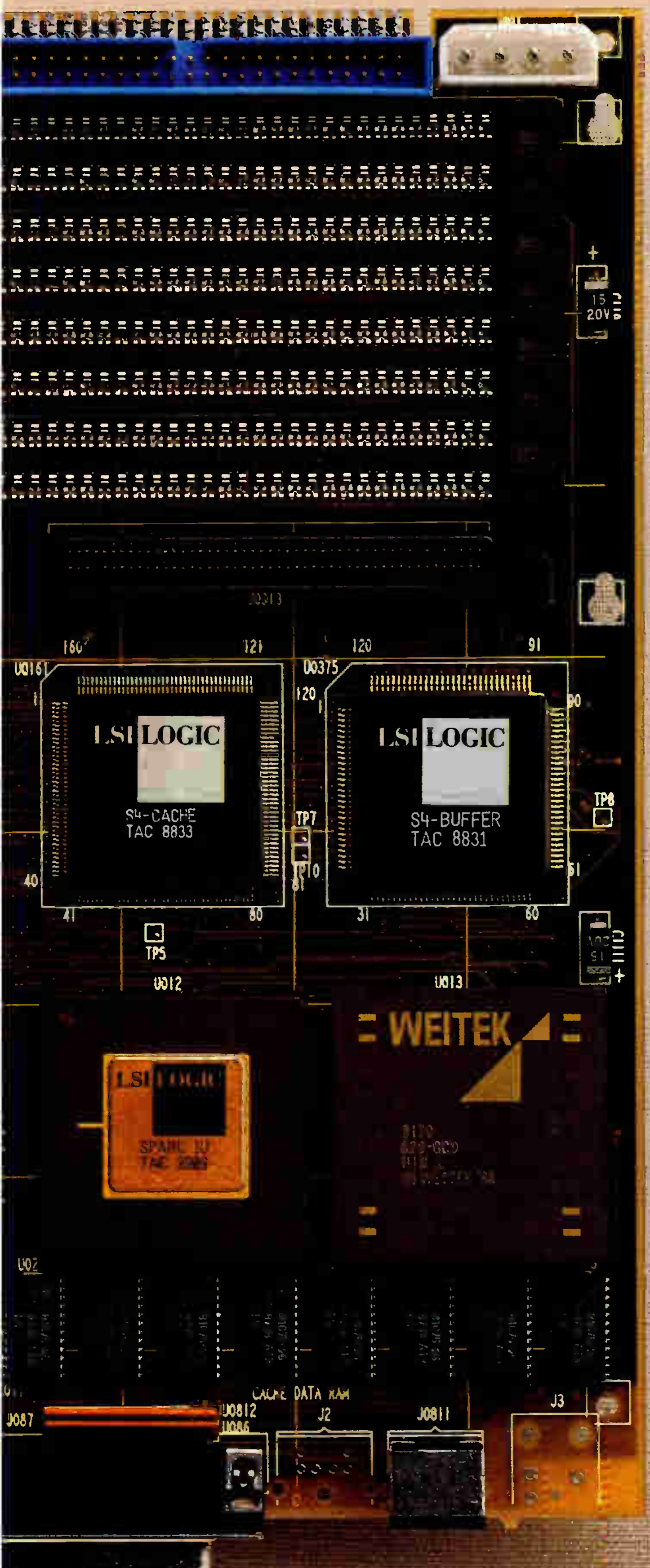
The competitive advantage of the U. S. industry will depend on the U. S. capability to take our tremendous natural-resource advantage and combine it with the will to compete at a world-class level. We must take this spark of competitive resurgence and focus industry on quality, customer, flexibility, cost, and human resources. We must get more entrepreneurial with flatter team-oriented organizations, and a much stronger commitment to research and development, simultaneous engineering, and process engineering. We must invest in our future, in financial and human terms. We must reeducate our work force. We must have world-class information systems and a truly global thought process.

We also need immediate and strong action from Washington. The cost of capital must be reduced or there can be no investment. The deficit must be addressed, and the savings rate increased. There must be incentives to invest, with tax legislation. The export-



The SPARCstation 1 CPU board packs 3 times the performance of a fully-accelerated PC into a 16″ x 16″ x 3″ footprint, requiring less energy than an ordinary light bulb • 32-bit SPARC CPU board—8.5″ x 11″ • Total chips—50 (including RAM) • 20 MHz, 12.5 MIPS, 1.4 MFLOPS • Up to 64 megabytes of main memory • 400,000 2-D vectors per second • 175,000 3-D vectors per second •

For the whole story, write for our free white paper, "Concept to System: How Sun Microsystems Created SPARCstation 1." LSI Logic Corporation, 1551 McCarthy Blvd, M/SD102, Milpitas, CA 95035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TERRENCE L. ROCK

SENIOR VICE PRESIDENT, OPERATIONS
CONVEX COMPUTER CORP.
■ BEFORE JOINING CONVEX IN 1983, TERRY ROCK SPENT 13 YEARS IN PLANT MANAGEMENT AT TEXAS INSTRUMENTS INC.

control and antitrust laws must be liberalized, or our global competitors will capture the new and emerging markets, as well as keep U. S. companies from combining to fund billion-dollar investments that cannot be funded by our now smaller electronics companies. Partnering must be encouraged.

The combination of industry and government can compete in this global war. We are at a crossroads, and it will take both of us to survive. ■

APPLICATION-SPECIFIC CPUs ARE POSSIBLE WITH NETWORKED ENTERPRISE-WIDE COMPUTING

Tomorrow's Computers

BY LAWRENCE CURRAN

The central processing unit in tomorrow's computers "becomes almost irrelevant" if the system passes the following tests: the application software is transportable, the system and software run on an enterprise-wide network, and the CPU runs any operating system on the desktop. That's the view of tomorrow's computers held by Kenneth H. Olsen, founder and president of Digital Equipment Corp. Olsen envisions that the CPU "can be optimized for an application" if the system passes those tests. He says computer users increasingly have pushed vendors toward this networked enterprise-wide computing model, especially in the past few years.

Customers "want transportable software, and they want all their computers to run on one network, no matter who makes them. At Digital, we've added one more thing" to that model: the recognition that users want flexibility on the desktop. "They want to have a choice of Apple, Digital, IBM, Unix, OS/2, or whatever they want," Olsen points out, and it's foolish to try to limit their choices. For example, he says, "Don't bother trying to change Apple users; they'll walk away from you."

Olsen calls enterprise-wide computing, a concept Digital pioneered in the 1970s, one of the most important technical and marketing phenomena of the 1980s. He also lists among the decade's big changes the advent of the personal computer, speed and density improvements in both random-access memory and CMOS processes, the emergence of RISC architectures, improvements in mass-storage devices, and the dawning of open standards, including Unix.

Enterprise-wide network computing began as an in-house solution to an in-house problem—"we set out to network a whole organization together," Olsen says. He recalls that the idea dates to about 1972, when the company had 3,000 terminals tied to many computers

KENNETH H. OLSEN

PRESIDENT
DIGITAL EQUIPMENT CORP.

■ KEN OLSEN HAS SERVED AS PRESIDENT OF DIGITAL EQUIPMENT SINCE HE FOUNDED THE COMPANY IN 1957. PRIOR TO THAT TIME, HE WAS ON THE STAFF OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY'S DIGITAL COMPUTER LABORATORY. IN 1988, THE NATIONAL MANAGEMENT ASSOCIATION NAMED OLSEN "AMERICAN MANAGER OF THE YEAR."

in its headquarters. The company developed the DECnet communications protocol to link those resources in its Maynard, Mass., headquarters with Digital's many facilities around the world.

In the early '80s, Digital took the idea to market, but by that time had refined it to include one hardware architecture and software environment—the VAX/VMS combination. "We did very well with it, but the concept was slow in developing," Olsen says. "It was a technical achievement that ran into a long-term problem in marketing, but that's happening now."

Because computer users have become more effective in influencing their vendors, Digital has expanded enterprise-wide computing to enable users to accommodate whatever hardware platforms and operating systems they choose. "Digital was unique in the '70s in setting the goal of enterprise-wide computing," Olsen maintains. That strategy has the company well-positioned for the '90s and beyond. ■

CONCURRENT ENGINEERING IS EVOLVING FROM AN INDUSTRY GOAL TO REALITY

Linking Design and Test

BY ROBERT E. ANDERSON

Before the advent of computers, transistors, and microprocessors, in the days of the vacuum tube, electronics manufacturers were driven by fundamental forces in the industry that are present today. Those forces include the need to improve product quality, to lower manufacturing costs, to utilize the latest technologies, and to speed product time to market. The major difference today is the accelerating rate of change in technology and competition.

On the threshold of the 1990s, the automatic test equipment industry appears to be maturing. The rate of increase for total industry revenue is now single-digit, down from the double-digit heyday of the early 1980s, when the market's appetite for ATE systems was propelled by the personal computer boom. However, the ATE industry does not behave like a mature business. On the contrary, it acts as if it were in its early development stages, with new competitors and new approaches to test bringing new growth potential and challenges to a still growing industry.

During the past two decades, GenRad has developed leading products for mechanical test, electronic design automation, incoming inspection of components, production and field-service test, and manufacturing process-quality management. This expanded product range demonstrates not only how GenRad grew in the past two decades, but also how the need for design and T&M tools kept pace with advances in technological complexity.

During the past decade, the solutions to test challenges reached beyond the test department and have influenced decisions and investments in both design and manufacturing process technology. Even the concept of ATE increasingly means the integration of design and test with manufacturing quality-management information.

Cohesive links among these disciplines ensure that the knowledge gained from both manufacturing and test is available to the design department, so that future designs avoid known problem areas.

Further, the concept of pursuing both design and test in parallel has become not only desirable but necessary. Concurrent engineering, design for testability, and design for manufacturability are evolving from goals to reality.

In the present environment, in which application-specific integrated circuits are so prevalent, keeping pace with technology is a constant, critical challenge for electronics manufacturers. Current ASIC technology demands integration across the design process as well as into the test process, where ATE requirements are driven by increasing ASIC pin counts and the need to bring simulation models and waveforms directly into ATE. This current, new breed of ATE keeps pace with ASIC technology trends, enabling ASIC-based printed-circuit-board performance to be continually improved. The key design-to-test linkage, provided by the ASIC design process, reduces the time required to bring products to market.

ATE has come a long way from the go/no-go tests of 20 years ago. Only a decade ago some industry observers speculated that ATE's role would be diminished as the "board of today becomes the chip of tomorrow."

What these experts couldn't foresee was more complex devices populating more boards as applications multiplied. In fact, this year approximately 700,000 new pc boards will be designed. The electronic content of those boards will be increasingly complex and sophisticated, and the circuitry will be more tightly inte-

ROBERT E. ANDERSON

PRESIDENT AND CEO
GENRAD INC.

■ BOB ANDERSON BECAME PRESIDENT AND CHIEF EXECUTIVE OFFICER OF GENRAD IN 1988, 25 YEARS AFTER JOINING THE COMPANY. HE LEFT GENRAD IN 1973 TO FOUND HIS OWN ATE FIRM, OMNICOMP INC., AND REJOINED WHEN GENRAD ACQUIRED OMNICOMP IN 1980. ANDERSON IS CHAIRMAN OF THE NEW ENGLAND COUNCIL OF THE AMERICAN ELECTRONICS ASSOCIATION.

grated. Those boards will contain anywhere from 50 to 200 devices per board, ASICs with more than 400 pins, and 2,000 to 4,000 nodes per board. This means more performance, more complexity, and more testing.

The 1990s will take GenRad "back to the future" in terms of our strategic test focus. Having evolved from our origins in T&M instrumentation into a leader in pc-board test systems, GenRad in the next decade will see a blend of these technologies in new architectures of test and measurement systems.

This renewed emphasis on T&M responds to an industry need to provide accurate monitoring of manufacturing processes, as more electronics firms push quality efforts beyond measuring defects and instead strive to reduce variation in their design and production processes.

Because of the industry's greater quality consciousness, test equipment suppliers now play a broader, more significant role, as demanded by electronics manufacturers. Manufacturers have set higher standards of product quality and expect them to be met. The quality gurus Deming, Crosby, and Juran have taught us all "to build it right the first time." That is not only the right thing to do—it is the only acceptable thing to do when quality provides the competitive edge and very often economic survival. ■

IN THE COMING DECADE, THE INDUSTRY WILL RALLY AROUND 'TIME TO MARKET'

Battle Cry of the '90s

BY SAMUEL WEBER

The electronics industry has passed through three distinct stages, says Richard W. Anderson of Hewlett-Packard Co. "I designate the 1970s as the cost-reduction decade," Anderson says, the era that brought the microprocessor, which delivered low-cost computing and electronic control. The decade spawned semiconductor memories, the personal computer, digital communications, fiber optics, and computer networking. "All of those things brought sophisticated electronics into a generally usable price range," Anderson says. "So in the '70s, the battlefield was cost."

What drove the 1980s was quality improvement, Anderson holds. And he should know: his controversial 1979 speech, in which he pointed out that Japanese semiconductor memories boasted much higher quality than their U. S. counterparts, launched a frantic effort by the U. S. chip makers to catch up. The effort transformed the industry. "We went from talking about percent defective acceptable quality level to parts per million. We learned about pareto charts and fishbone diagrams. The quality gurus Deming and Juran

THE BACK PAGES

THE DAY MAY NOT BE SO FAR AWAY WHEN MOST ELECTRONICS ENGINEERS WILL HAVE ON THEIR BENCHES A STAND-ALONE COMPUTER-AIDED DESIGN SYSTEM. TAKING A GIANT STRIDE IN THAT DIRECTION IS THE UK FIRM RACAL-REDAC LTD.... [ITS] PC-BOARD DESIGN SYSTEM IS THREE TIMES FASTER THAN MANUAL LAYOUT METHODS.

ELECTRONICS, JUNE 16, 1980

became in great demand. At HP, we set a ten-times improvement goal for the decade and achieved it. So the 1980s was the decade of quality, with cost reduction a given."

What will the 1990s bring? Anderson sees it as an intensely competitive decade with "time to market" as the battle cry. He points to the Europe 1992 initiatives and the opening of Eastern Europe as harbingers of the new, highly competitive era. "These countries are looking to build their technological infrastructures and will be coming into the market as both buyers and sellers. The battleground will be time to market—the ability to take continuing advances in technology and respond quickly with them in a worldwide economic competitive situation. This will be the big differentiator.

"You're beginning to see signs of it now. There are computer-aided-design workstations everywhere, and you can see what a battle of mips/dollars that is turning into. There's an ongoing integration of CAE with measurement so there can be better modeling, verification, and more dependable designs. In this decade you're seeing a lot more use of simulation and modeling technologies. And related to time to market is the growing prominence of international standards in networking, electromagnetic compatibility, and software."

How do you reduce time to market? By continuous monitoring and analysis of ongoing processes, says Anderson. "Take something as basic as sheet metal, from which we build our instrument frames. We must equip our engineers in sheet-metal design with good CAD tools that have links to manufacturing. We have to cut down prototype turnaround time. We have a goal to turn around a sheet-metal part in one day. Also, we can get a lot of improvement by moving from through-hole to surface-mount technology. This greatly reduces the number of parts and cuts down evaluation and decision-making time." E

RICHARD W. ANDERSON

VICE PRESIDENT AND GENERAL MANAGER OF THE MICROWAVE AND COMMUNICATIONS GROUP HEWLETT-PACKARD CO.

■ DICK ANDERSON, WHO JOINED HP IN 1959, BECAME A VICE PRESIDENT IN 1985. PRIOR TO THAT, HE RAN THE COMPANY'S COMPUTER SYSTEMS DIVISION.

THE PC HASN'T SUPPORTED PEOPLE'S NEED TO ACCESS INFORMATION AND COMMUNICATE WITH ONE ANOTHER

A Call for Cooperative Computing

BY JOHN A. YOUNG

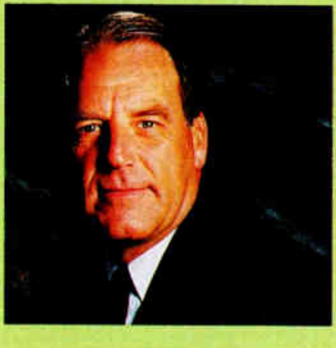
Information is a potent tool, a means to achieve productivity and, ultimately, a means to raise the standard of living. The 1970s was the era of the minicomputer, which was used for *operational* effectiveness, and the 1980s of the personal computer, used for *personal* effectiveness. But personal computing has remained just that: personal. It hasn't supported what white-collar people do most, namely, access information and communicate.

Instead, the PC has been used to automate routine tasks like word processing. It has not worked its way into decision support and organizational communication. Whereas in the manufacturing sector, people have used total-quality-control programs to improve all processes, people don't look at office work as a process that could also be improved by quality control.

This may help explain some interesting findings by Morgan Stanley economist Stephen S. Roach. He discovered that white-collar productivity in the manufacturing sector has been rising at a 4.5% annual rate since 1982—fully six times faster than white-collar productivity in the service sector. He also found that the manufacturing sector has done a much better job of reducing the ratio of "information support" (clerical, administrative) jobs to "knowledge workers" (decision makers, professionals).

We at HP are very interested in understanding the dynamics of white-collar productivity. Our own in-house experience has been more positive than

JOHN A. YOUNG



PRESIDENT AND CEO
HEWLETT-PACKARD CO.

■ JOHN YOUNG, WHO JOINED HEWLETT-PACKARD IN 1958, HAS HELD HIS CURRENT POSITIONS SINCE 1978. A VETERAN OF THE COMPANY'S MICROWAVE DIVISION AND ELECTRONIC PRODUCTS GROUP, HE IS ALSO CHAIRMAN OF THE EXECUTIVE COMMITTEE OF HP'S BOARD OF DIRECTORS.

that reported by Roach. We've seen a 5% annual increase in white-collar productivity, compared with an actual decline for U. S. industry overall, as recorded in Roach's study. However, this figure is still well below the 15% productivity rise that HP has seen among its manufacturing employees.

We believe that our white-collar workers are more productive than the U. S. average because we provide broad access to information and computing power. HP has 2,500 minicomputers and 85,000 PCs, workstations, and terminals—almost one for each of our 94,000 employees—plus a communications network that moves 15 billion characters, or 8 million pages, of information daily. All of this supports employees' ability to access and communicate information.

While part of the low office-productivity problem in the U. S. has been lack of improvement methodology, such as the quality-control models used in manufacturing, there have also been technological barriers. The U. S. computer industry needs to develop the technologies and standards that will make it possible to harness the power of information in the form of cooperative computing. Reality is not so far removed from the vision, and prototype environments already exist today. Technical barriers to using information are melting away.

But business leaders must also remove the management and cultural barriers that discourage teamwork and timely decision making. What good does it do if our computers can talk to each other but our people won't? ■

FORGET GOVERNMENT HELP, SAYS T. J. RODGERS: KEEPING THE ENTREPRENEURIAL EDGE IS THE KEY TO U. S. SUCCESS

'You Don't Need Mass Resources to Win'

BY JONAH McLEOD

■ ***How do you think the semiconductor industry will shape up 10 years from now?***

Ten years from now, we will have realized that small is beautiful, that the IBM argument that all fabs need a $200 million synchrotron atom smasher to make wafers, that the Gordon Moore [of Intel] argument that you cannot get into the microprocessor business for under $200 million, were all wrong. These arguments have credibility now because they appear to be our model of the way the Japanese work. This is not true. Smaller companies—such as Ross Technology—can take 22 people with a computer on each desk and do as much as Gordon Moore's building-full of engineers. For $7 million, Ross developed a five-chip set that is four times more powerful than Intel's 80486. The days of needing massive resources to win are over, because the day of a Cray supercomputer on a desk is only 10 years away.

■ ***What is government's role in keeping the industry healthy?***

The government should get out of the electronics industry. Charles Darwin and Adam Smith are what's required to make winners and losers. It is not raw materials, human beings, education, or government support that produces a healthy industry. It is unrestricted competition. The reason we lost our competitiveness in the automobile industry is that there are only three manufacturers. By comparison, the Japanese have 14 very competitive companies slashing one another's throats for market share. Each has to be excellent or per-

T. J. RODGERS

PRESIDENT AND CEO
CYPRESS SEMICONDUCTOR CORP.

■ T. J. RODGERS, WHO COFOUNDED CYPRESS SEMICONDUCTOR IN 1983, FORMERLY WORKED FOR AMERICAN MICROSYSTEMS INC. AND ADVANCED MICRO DEVICES INC. HE IS KNOWN IN THE INDUSTRY AS SOMETHING OF AN ICONOCLAST, AND OFTEN LOBBIES AGAINST CONSORTIA AND GOVERNMENT-INDUSTRY PROGRAMS.

ish in the cutthroat competition of the free market. Ditto in semiconductors. If we ever allow ourselves to be boiled down to three or four companies with a lot of government involvement, you can kiss this industry goodbye.

What about tax reform?
The government should take steps that improve the investment-tax credit, R&D tax credit, capital-gains tax reduction, and so on. My favorite above all would be reducing the budget deficit, since it is hurting the competitiveness of all U. S. companies. What really bothers me is the hypocrisy of the large semiconductor companies. Antitrust laws in this country prevent unfair competition of large companies cooperating to eliminate smaller companies with less economic resources. Arguing their need to compete with the Japanese, large semiconductor companies are lobbying to eliminate the antitrust laws and for industry subsidies, such as [the manufacturing consortium] Sematech. But when the subsidy and law changes get used, they get used just as readily against small entrepreneurial companies like [Cypress] as well as against the Japanese.

What would you do with a government subsidy such as Sematech?
Bulldoze it! And instead of Sematech, you take the $100 million a year it receives [in government funding] and divide it into five $20 million parts. Send one part to Stanford, another to Caltech, one to U. C. Berkeley, one to MIT, and another to the alma mater of your choice. You send a letter that states, "here's a check for $20 million; you will receive one of these every January 1st for the next 10 years. Please write us a quarterly report, not to exceed five pages in length, on how you have used this money to develop the semiconductor industry."

That same $100 million will be infinitely more effectively spent than it is by that boondoggle down in Austin, Texas. I am opposed to tax-supported industry groups that benefit a closed group of companies.

How do you view the current competitive environment between the U. S. and Japan?
The U. S. industry's stock is low, but that's when you buy and make money. I have taken the Semiconductor Industry Association's market-share statistics for the world semiconductor industry and recalculated the numbers, using the 1989 yen/dollar exchange rate. In 1982, the U. S. semiconductor industry had a 51% market share and the Japanese, 35%. In 1989, the Japanese had 51% and the U. S., 35%. The U. S. industry went from being 16 points ahead to being 16 points behind.

However, in that same period of time, the yen/dollar exchange rate went from 248.82 yen to $1 in 1982 to 139.89 to $1 in 1989. Using the current exchange rate, 139 yen to $1, we haven't lost any market share since 1985, when the U. S. industry hit bottom. Of the total 32% of decline, 27% is due to the change in the yen/dollar exchange rate. The remaining 5% is due to actual shifts in market share.

In 1975–85, Japanese companies were improving their manufacturing advantage. They had yields of 75%, as opposed to 25% for U. S. companies—three times higher. In addition, the cost of capital was three times higher for U. S. companies. Since then, U. S. companies have learned how to get good yields, so Japan's lead has been reduced. Cypress is getting 75% and Japan is at 90%—that's a 1.2-to-1 advantage instead of 3-to-1. In addition, we still have an entrepreneurial advantage over Japan. If we continue eating away at the manufacturing lead the Japanese hold and don't lose our entrepreneurial edge, our competitive posture relative to Japan will get better.

THE BACK PAGES

RAYMOND E. KASSAR, CHAIRMAN AND CHIEF EXECUTIVE OFFICER OF ATARI INC., ALSO SAYS THAT HIS STUDY OF CONSUMER TRENDS SHOWS THAT THREE QUARTERS OF THE WOMEN IN THE U. S. WILL BE PART OF THE WORK FORCE BY 1990 AND THAT THE MANUFACTURERS SHOULD CONSIDER THIS WHEN MARKETING THEIR MACHINES. MAKE THEM IN A WIDE RANGE OF COLORS, HE SAYS, MUCH AS IBM DOES WITH ITS TYPEWRITERS; COORDINATE THEM WITH FURNITURE AND FABRIC, ALONG THE LINES ADOPTED BY OHIO SCIENTIFIC FOR ITS LOW-END COMPUTERS.

ELECTRONICS, JULY 3, 1980

Aren't the Japanese beginning to demonstrate an entrepreneurial flair of their own?
This is a great tragedy. While the U. S. is off copying what we think the Japanese are doing, creating Sematech—the equivalent of MITI—with the rationale that the Japanese are winning because they have an organization like MITI [the Ministry of International Trade and Industry], the Japanese are off learning how to innovate. MITI is not the reason that the Japanese are winning in the international markets. The Japanese are winning because Honda is better than General Motors, and Sony is so much better than its competitors in the U. S. that those U. S. competitors no longer exist.

We have an inaccurate and obsolete model of Japan's success. The Japanese are realizing that they have to become entrepreneurial in order to compete in the future. As opposed to manufacturing skills, which are learnable skills, being entrepreneurial has more associated cultural aspects. The Japanese have cultural impediments that will make their ability to become entrepreneurial a lot harder than our ability to learn how to run a more efficient manufacturing operation.

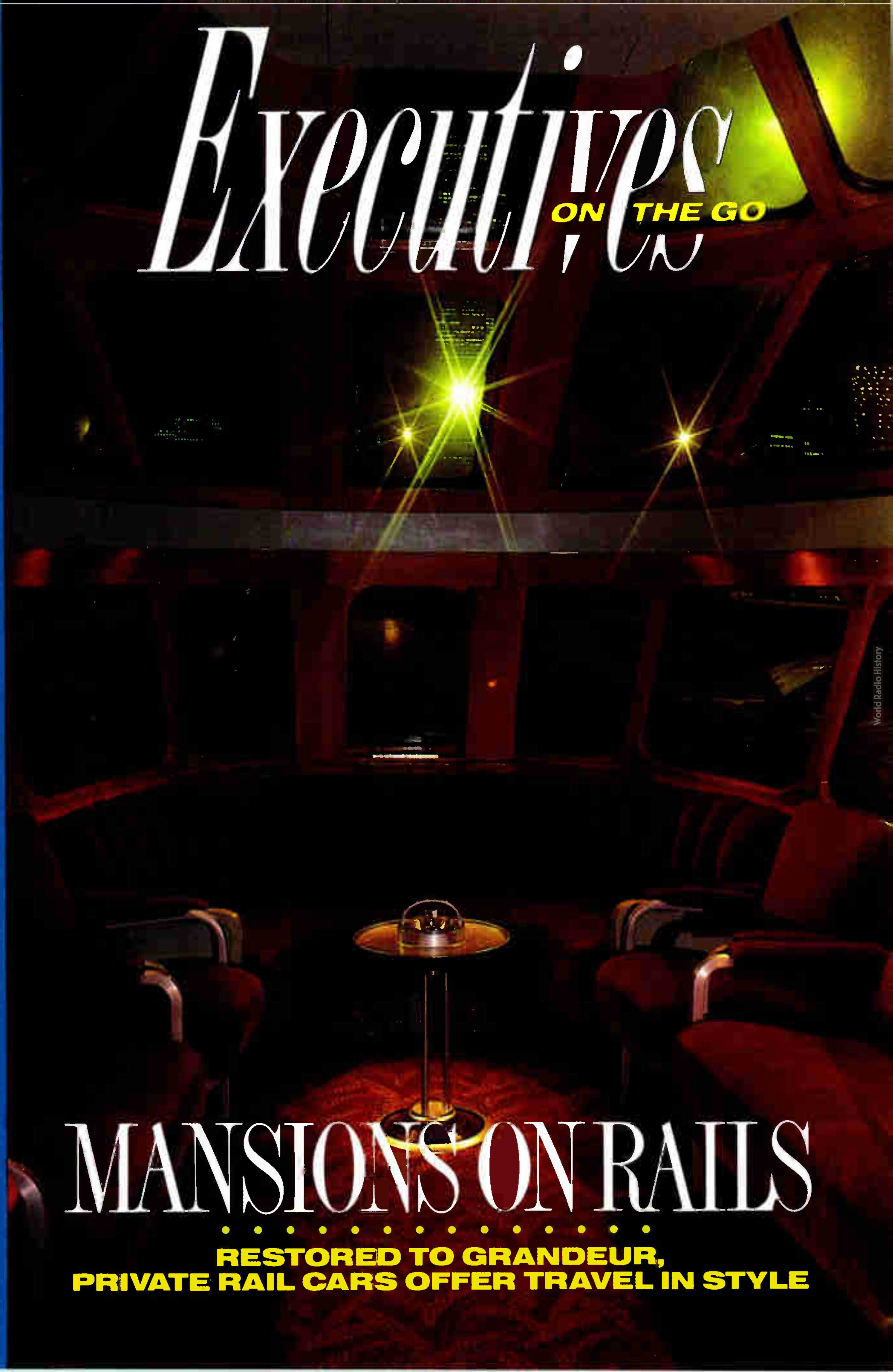
What new technology do you see on the horizon that could boost the U. S. industry?
I think biCMOS technology is one area where U. S. semiconductor manufacturers can seize the initiative in the market once again. I think we can move to the next level of performance in this technology before the Japanese. There is only one Japanese competitor that matters, and that is Hitachi. By comparison, in the U. S., Cypress, Integrated Device Technology, and National Semiconductor—via Fairchild—all have biCMOS technology. ■

A Lifestyle Supplement to Penton Publications/Travel/Lodging/Resorts/Recreation/Leisure

Executives ON THE GO

MANSIONS ON RAILS

RESTORED TO GRANDEUR, PRIVATE RAIL CARS OFFER TRAVEL IN STYLE



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FOR INFORMATION, CIRCLE NO. 11

RESTORED TO GRANDEUR, PRIVATE RAIL CARS OFFER TRAVEL IN STYLE.

MANSIONS ON RAILS

BY JIM BRAHAM

SITTING OUT ON THE observation platform, his feet propped up on the brass railing of his railroad car, Wade Pellizzer ignores the wind in his face and drinks in the beauty and grandeur of America, enjoying a taste of how the high-rolling barons of business and society traveled across this land at the turn of the century. "So what if you get dirty. You just watch everything go by—Colorado...the Rockies...unbelievable!" he exclaims. "Eastbound along the Colorado River, you get some of the most beautiful sunsets. Going through New Mexico, the colors in the mountains...incredible! And Texas! You leave one morning and the next morning you're still in Texas, and the

The classic *Utah* cafe/lounge car seats up to 40 partygoers and includes a bar, piano, stereo, and kitchen.

PHOTOS: ROBERT ASHE (COVER PHOTO); JOHN R. KUEHL train's been going all night! This is a big country!"

A big country to be seen in style, and what better way than in your very own private railroad car?

The Redwood City, Calif., sheet-metal mechanic is one of a small but growing group of train buffs who are recapturing the romance of the railroads; when they were our primary means of long-distance transportation; when his car and others truly were self-contained "mansions on rails," as historian Lucius Beebe aptly described them.

They have purchased some of these stately and splendid "mansions"—the type once enjoyed by the Vanderbilts, Whitneys, and Morgans—and restored them to their former splendor. Now, hitched to the rear of passenger trains, able to go anywhere Amtrak goes, they travel—to Super Bowls, Mardi Gras, and other events, and on cross-country excursions, reunions, parties, and vacations—in a grand, relaxed style.

Each car is unique and Pellizzer's *Virginia City* is one of the most famous. Once the "home away from home" for Beebe and his close friend Charles Clegg, this 1928 platform observation car was, in 1958, the last remaining private car in operation. Beebe and Clegg, who spurned flying as "a barbarous and cheerless way to travel," bought it in 1954 from Pullman Co. and converted it to a self-contained private car by adding a kitchen, dining room, and crew's quarters. They even hired a Hollywood set designer to decorate the car in Venetian Renaissance baroque. Rather than the rich, dark wood paneling and brass trim of the typical private car, the *Virginia City* features crystal chandeliers from Italy, an Italian-marble fireplace, and a living room ceiling painted to resemble that in the Sistine Chapel. Even at 1950s prices, the remodeling cost $350,000. The car that Pellizzer purchased for $72,000 from Clegg's estate in 1984 (it had sat idle for 18 years) is now worth more than $150,000.

As a member of the American Assn. of Private Railroad Car Owners, Pellizzer now offers his car for charter, the most common use of private cars today. The association includes more than 500 car owners but only 100-150 cars meet Amtrak's operating requirements. These cars include both the great, old 90-ton "heavyweights" built until around 1930 and the streamlined, stainless steel "lightweights" built from just before World War II until the mid-1950s.

The *Virginia City* is one of three dozen or so private cars that run more than two or three times a year. Many of these are the self-contained private cars—or business cars, as the railroads described them when they were the owners and operators. A typical 10x85-foot car includes an open observation platform at the rear, small living room, three or four staterooms that can sleep a total of six to eight people, bath and shower, dining room for six to eight, compact kitchen, and crew's quarters. Today's cars generally are air-conditioned and have TV, stereo, phones, etc.

These grand private cars gradually passed from the millionaires to the railroads. Many wound up scrapped. "There was no market. Who was going to buy a dinosaur?" asks Cleveland rail-car owner Bill Polatsek. Since Amtrak took over the nation's passenger system in 1971, private cars have been trickling back into private hands. Their limited number, combined with increased awareness of them, has raised prices. Today a good, up-to-date car in running order sells from $100,000 to perhaps $300,000. Another $100,000 to $1 million can be spent rebuilding a car, with as much as $50,000 required

PHOTO © JOHN H. KUEHL

PHOTO © ROBERT ASHE

▲ **Old world dining is featured on the *Virginia City* while aboard the $1 million *California* dome sleeper the view is the attraction**

The *Cedar Rapids*, owned by retired Iowa businessman William Nicholson, is one of only four skytop lounge cars ever produced (cover).

to convert to the locomotive-supplied electricity mandated by Amtrak beginning next year. Routine upkeep and maintenance run at least $10,000 annually.

Five years ago Polatsek, a retired attorney, paid $160,000 "as is" for a 1925 business car that belonged briefly to the late Ray Kroc, chief of McDonald's restaurants. Since then he has spent over $300,000 refurbishing the *Duchess Lynn* and raising it to Amtrak specifications. "But keep this in mind. They will never build another car like this," he says. "Like a Bugatti or a Duesenberg (auto), there is an absolutely finite supply, especially of the old heavyweights."

Few folks today can afford a private rail car solely for personal travel. One who can is Mitchell (Mickey) Wolfson Jr., the multimillionaire Miami Beach collector who transports himself and his friends aboard his *Hampton Roads* and *Clover Colony* sleeper. Atlanta restaurateur Dante Stephensen even lives aboard his *Survivor*, a showpiece car built for F.W. Woolworth's daughter in 1926.

A few corporations employ private rail cars for entertaining customers. Denver's Ansco Investment Co. also offers its

ultra-luxury *California* dome sleeper (appraised at $1 million), *Utah* lounge car, and *Kansas* diner for charter.

Charter charges vary by owner, ranging from $2,500 to $5,000 a day per car. This includes all Amtrak charges ($1.20 to $2.60 per mile with a minimum of $750 for hauling, plus switching and parking fees), along with a chef, steward, food, and beverages. A car generally accommodates 6-12 passengers overnight or 16-20 during the day.

Most charter operators would be content to merely finance their avocation.

How To Charter

The American Assn. of Private Railroad Car Owners publishes a directory describing most of the private cars available for charter. For a copy, send $4 to Larry Haines, 224 Orr Dr., Somerville, NJ 08876. The association also offers a free primer on private-car ownership and publishes PRIVATE VARNISH, *a bimonthly magazine available at $19 a year from Interurban Press, P.O. Box 6128, Glendale, CA 91205. The May-June issue contains the latest directory.*

"The costs are greater than what you can charge. You just hope to make enough money to pay the costs so you can have fun," says Gordon Crosthwait, the association's executive secretary. The typical owner accompanies his car, often doubling as mechanic and part-time steward.

Finally, private rail travel is like a first-class cruise, Wade Pellizzer observes. "However, instead of seeing water or playing shuffleboard or shooting clay pigeons or seeing a show, you get to see the United States—America—the way it really is."

A Taste of Europe

"Welcome aboard the *American-European Express*, the trip of a lifetime," Edgar F. Zappel proclaimed with a flourish. With that, this dashing young man in cap and cloak—looking very much like someone you'd perhaps imagine aboard the famed *Orient Express*—helped introduce us to the first regularly scheduled luxury train in America in more than 40 years.

The jovial *chef de train* was in charge of our 17-hour overnight adventure from Chicago to Washington, D.C., aboard four very special cars at the rear of Amtrak's *Capitol Limited*. At a cost of more than $1 million apiece, these cars have been refurbished with rich mahogany, marble, and brass, ceiling murals and original oil paintings, to recreate the atmosphere of the luxury European rail cars of the 1920s and '30s.

Operated in conjunction with Europe's *Nostalgie Istanbul Orient Express*, the American-European Express Railway Co. began service last November over Amtrak's Washington-Chicago route. One overnight train of four or five cars (club, diner, and two or three sleepers) runs three days a week in each direction. Since May the company also has been running New York-Philadelphia-Chicago overnighters (19 hours) twice a week in each direction.

Much of the trip is devoted to fine wining and dining. Our ride began with a champagne-and-canapes reception in a plush club car featuring a baby grand piano. The pianist was among a 10-man staff, assuring a surplus of personal attention.

Two hours after our early evening departure from Chicago's Union Station, a superb seven-course gourmet table d'hote dinner was presented, featuring roast sirloin of beef and served on fine china, silver, crystal, and linen. A la carte selections also were available, as were wines, liqueurs, and other drinks.

Following the leisurely, two-hour dinner, passengers usually adjourn to the club car to drink, converse, or simply relax, enjoying the music and scenery before retiring to their bedrooms. Though small, these are comfortable enough for daytime seating and nighttime sleeping. Each room has a water closet and sink, and individually-controlled air conditioning and heat. There's one shower in each sleeping car and the porter schedules your morning time.

Despite a comfortable bed and smooth-riding car, I slept little. However, part of the charm, excitement—and, yes, *mystery*—of riding a train overnight is lying awake and looking out the window at the passing towns and lights.

The next morning, in the luxurious, 40-seat dining car, we enjoyed a four-course breakfast that included, among other delights, seafood crepes, lamb chops, and fresh strawberries with whipped cream. Attended by a pair of chefs and waiters, listening to taped classical music, we dined in splendor, savoring every bite, all the while drinking in the passing parade of people and towns. The signs read Martinsburg and Harpers Ferry and Rockville, but they seemed more like Heaven.

One-way fares on the *American-European Express* run from $600 for one adult in a compartment to $1,550 for two in the presidential cabin. Combination fares, including luxury hotel stay and United Airlines return flight, also are available (800-677-4233).

Another new luxury rail operation is Princess Tours' daily dome-car service between Oakland and Los Angeles, an 11-hour trip costing $179 (800-835-8907). Sentimental Rail Journeys, Mission Viejo, Calif., also runs a variety of personalized tours around the country (714/240-2101).

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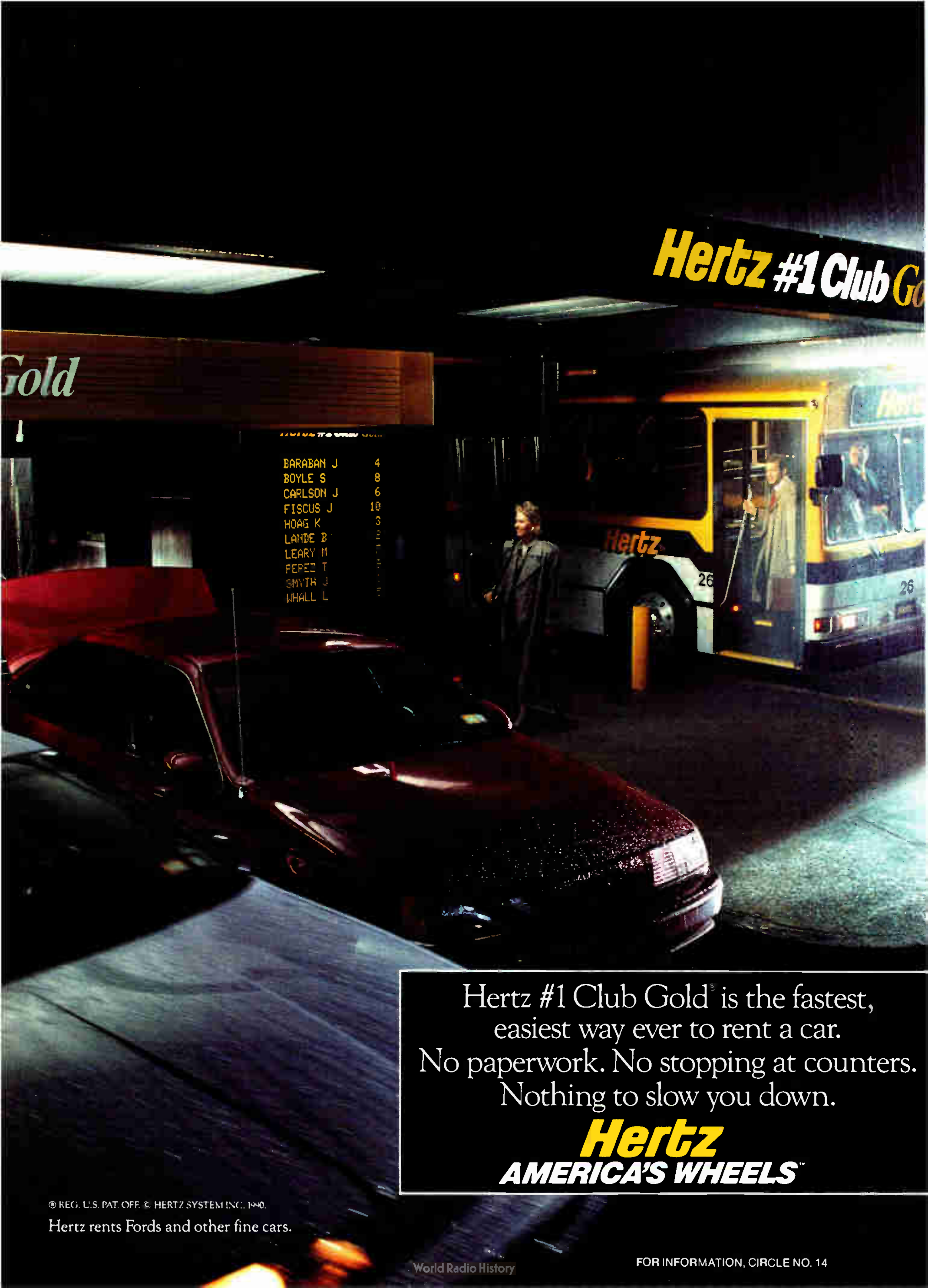
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FOR INFORMATION, CIRCLE NO. 14

INTEL'S EXIT FROM DRAMs WAS INTIMATELY TIED TO IBM'S MICROPROCESSOR STRATEGY

The Tough Choices

BY GORDON E. MOORE

Probably the single most important decision affecting Intel's business wasn't even Intel's to make. That decision was made by IBM Corp. when that company decided to base its personal computers on Intel's central processing units. More than anything it helped to focus Intel's attention on its microprocessor business. As a result, it drove several other key decisions within Intel that have impacted the company's form and focus to this day.

While IBM was building its original PC with Intel's 8088 microprocessor, we started development on the next-generation CPU. In the early stages of that development process, we decided that following generations of microprocessors must be compatible in that software written for the 8088 and 8086 must run unchanged on the new microprocessors. We knew such compatibility was important, but I doubt any of us appreciated how important.

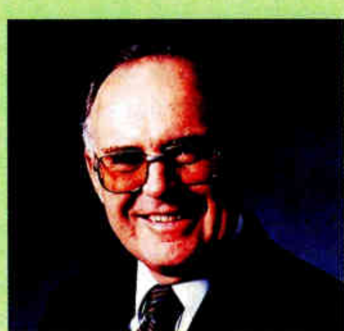
Binary compatibility between the 8086, 80286, 80386, and new 80486 microprocessors allows all generations of Intel's X86 architecture to run the billions of dollars worth of software written to that standard. Compatibility is one of the most important reasons that Intel microprocessors are being used so broadly throughout the world. Our commitment to an upwardly compatible family was clearly important.

During the mid-1980s prices for memory chips had collapsed. Intel's development program for a megabit CMOS DRAM had progressed well, and we were faced with the need for a capital investment of several hundred million dollars to be a significant participant in the coming megabit generation. We chose instead to drop DRAMs and focus our capabilities on microprocessors and related products, abandoning the product family with the largest market of any semiconductor. This was an especially difficult decision because it was a DRAM that was Intel's first big winner. We would not, however, have been able to pursue microprocessors as aggressively had we tried also to compete in DRAMs.

While IBM's use of our microprocessor and our dropping out of the DRAM market seem like independent, dramatic, rapid decisions, they really weren't. They were a series of smaller decisions that ultimately led to a final dramatic outcome. But some equally critical decisions cannot be nailed down to specific actions.

Another important set of decisions resulted from the understanding that competition in semiconductors was changing. Closer relationships with customers were necessary and quality, low-cost manufacturing was a critical competitive capability. We increased our focus on each of these areas by adapting corporate objectives and giving specific responsibility to senior executives to make us a "world-class manufacturer" and "vendor of choice." This focus has improved our competitiveness, but it is necessary to continue to improve as the competition gets increasingly more capable as well. ■

GORDON E. MOORE



CHAIRMAN OF THE BOARD
INTEL CORP.

■ GORDON MOORE WAS A CO-FOUNDER OF BOTH INTEL AND, EARLIER, FAIRCHILD SEMICONDUCTOR CORP. MOORE IS A FORMER CHAIRMAN OF THE SEMICONDUCTOR INDUSTRY ASSOCIATION.

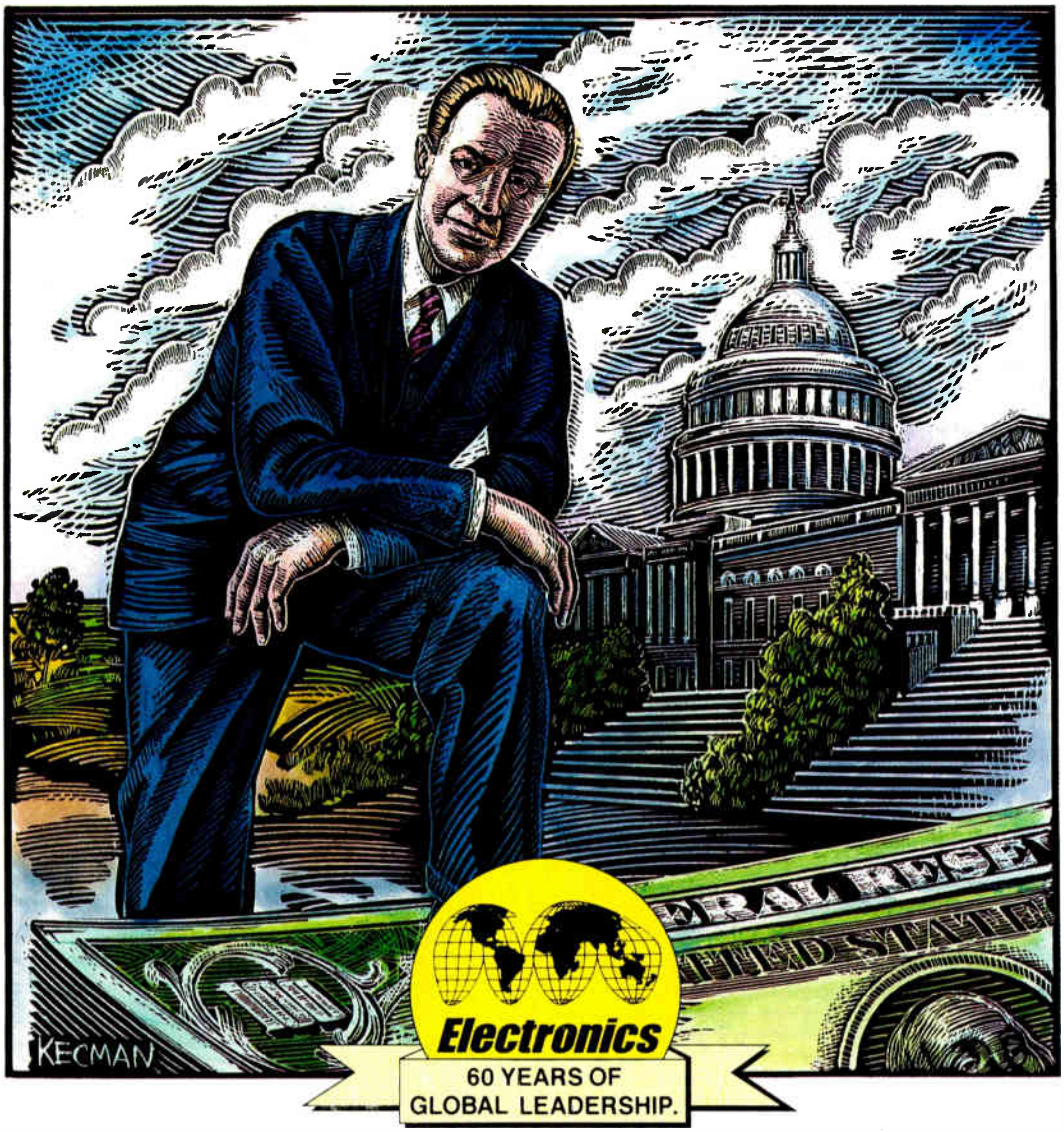
THE BACK PAGES

FROM THE AREAS SURROUNDING ANGRY MOUNT ST. HELENS IN WASHINGTON COME REPORTS THAT THE SETTLING VOLCANIC ASH IS CREATING A NUISANCE FOR SEMICONDUCTOR MANUFACTURERS. INTEL CORP., FOR INSTANCE, TEMPORARILY SHUT DOWN ITS ALOHA, ORE., WAFER FABRICATION FACILITY BECAUSE OF HIGH IMPURITY LEVELS. THOUGH IT IS BACK ON LINE, INTEL IS TAKING "EXTREME PRECAUTIONS" BY VACUUMING OFF CLEAN-ROOM EMPLOYEES.

ELECTRONICS, JULY 3, 1980

INTEL FINALLY LETS THE 8087 MATH PROCESSOR OUT OF THE BAG IN THIS SESSION [OF THE ISSCC]. ITS CLEVER DESIGN WAS CARRIED OUT BY INTEL ISRAEL LTD. IN HAIFA. . . . THESE FUNCTIONS ARE PERFORMED BY OVER 65,000 H-MOS TRANSISTORS ON A 78,000-SQ.-MIL DIE. WITH A 5-MHz CLOCK, EXECUTION TIMES RANGE FROM ABOUT 4 μS FOR A COMPARISON TO 16 μS FOR A MULTIPLICATION AND 35 μS FOR DIVISION AND FINDING SQUARE ROOTS.

ELECTRONICS, FEB. 14, 1980



MONEY AND POWER

THE 1980s WAS A TUMULTUOUS ERA FOR THE NONTECHNOLOGY SIDE OF THE ELECTRONICS INDUSTRY. ANTITRUST POLICY BECAME LESS RESTRICTIVE. INTELLECTUAL PROPERTY RIGHTS EXPANDED. RAISING CAPITAL BECAME MORE DIFFICULT.

THROUGH IT ALL, THE INDUSTRY STRUGGLED TO ADAPT TO THE NEW REALITIES BEING IMPOSED FROM OUTSIDE. MANY PROBLEMS REMAIN, HOWEVER, AND THE 1990s PROMISE TO BE JUST AS INTERESTING.

Antitrust Policy: Darwinism Is Back

THE AT&T DIVESTITURE AND THE DISMISSAL OF A DECADE-LONG CASE AGAINST IBM HERALDED MORE COMPETITION

BY JACK SHANDLE

The 1980s marked a new era in antitrust enforcement. While the government loosened the reins that for decades had held back large companies such as IBM Corp., it also broke up AT&T Co.—the nation's largest monopoly. As head of the Justice Department's Antitrust Division, William F. Baxter helped shape those policies. In an exclusive interview, he reviews the tumultous decade for *Electronics.*

■ ***The case brought by the Justice Department against IBM will be remembered as important in the evolution of antitrust enforcement. It was filed in 1969, but when you took it over in 1981, it still had not been resolved. Why?***
When the government started the case, it was still fashionable to think of Section 2 of the Sherman Act as being aimed simply at large dominant companies that held too big a market share for too long. It was aimed at restructuring an industry almost without regard to any concept of fault or misbehavior.

■ ***What was the effect of this interpretation on U. S. markets and competitiveness?***
It led companies like IBM to compete with kid gloves and often almost to preserve competitors and to raise their own prices so that their market shares didn't get too big. So in this perverse way, a section that was ostensibly supposed to limit monopolies was causing large, successful companies to engage in monopolistic behavior in order to hold their market share down.

■ ***Had the courts changed their interpretation of Section 2 between 1969 and 1982?***
I think it was reasonably clear as a matter of law that the courts no longer viewed holding a dominant position in a market as in and of itself a violation. If anybody needed to have it spelled out for them in plain language, I think that the Second Circuit Court's opinion on Kodak did that.

■ ***What did you do as head of the Justice Department's Antitrust Division?***
I dismissed the case as a failure after having spent eight months studying the record and then actually having the parties conduct a series of oral arguments. At the end of this lengthy series of sessions, it was fairly clear to me that the government had simply not proved any significant misbehavior by IBM.

■ ***Why was the dismissal of the IBM case important?***
It gave a green light to the larger firms in the computer industry in particular, but also in the American economy in general, that the Justice Department would no longer bring cases on the basis of size. We turned the corner from kid-glove competition to the concept of hard-nosed competition.

■ ***The other big antitrust case in the 1980s with an electronics industry tilt was the AT&T divestiture. What was the government's basis for that case?***
Whereas IBM was attacked because it was too broad horizontally, AT&T was attacked because it was too extensive vertically. That vertical integration crossed the boundary between regulated natural monopoly and some potentially competitive areas.

■ ***You negotiated the out-of-court settlement. How do you view the conduct of the seven "Baby Bell" holding companies since divestiture in 1984?***
Well, certainly they are trying to chip away at the settlement. Each one of them is trying to turn itself into another vertically integrated AT&T, and replicate the old problem, so to speak. Judge (Harold) Green (who administers the settlement) has been pretty good about not letting them do that, but they couldn't really do it even if you turned them loose, because there

WILLIAM F. BAXTER

LAW PROFESSOR
STANFORD UNIVERSITY

■ WILLIAM BAXTER HEADED THE JUSTICE DEPARTMENT'S ANTITRUST DIVISION EARLY IN THE REAGAN ADMINISTRATION. HE HAS WRITTEN EXTENSIVELY ON ANTITRUST AND TECHNOLOGY ISSUES AND HAS CONSULTED FOR COROPRATIONS AND INSTITUTIONS INCLUDING THE FEDERAL RESERVE BOARD, BROOKINGS INSTITUTION AND JET PROPULSION LABORATORIES. HE HAS BEEN A VISTING PROFESSOR AT YALE.

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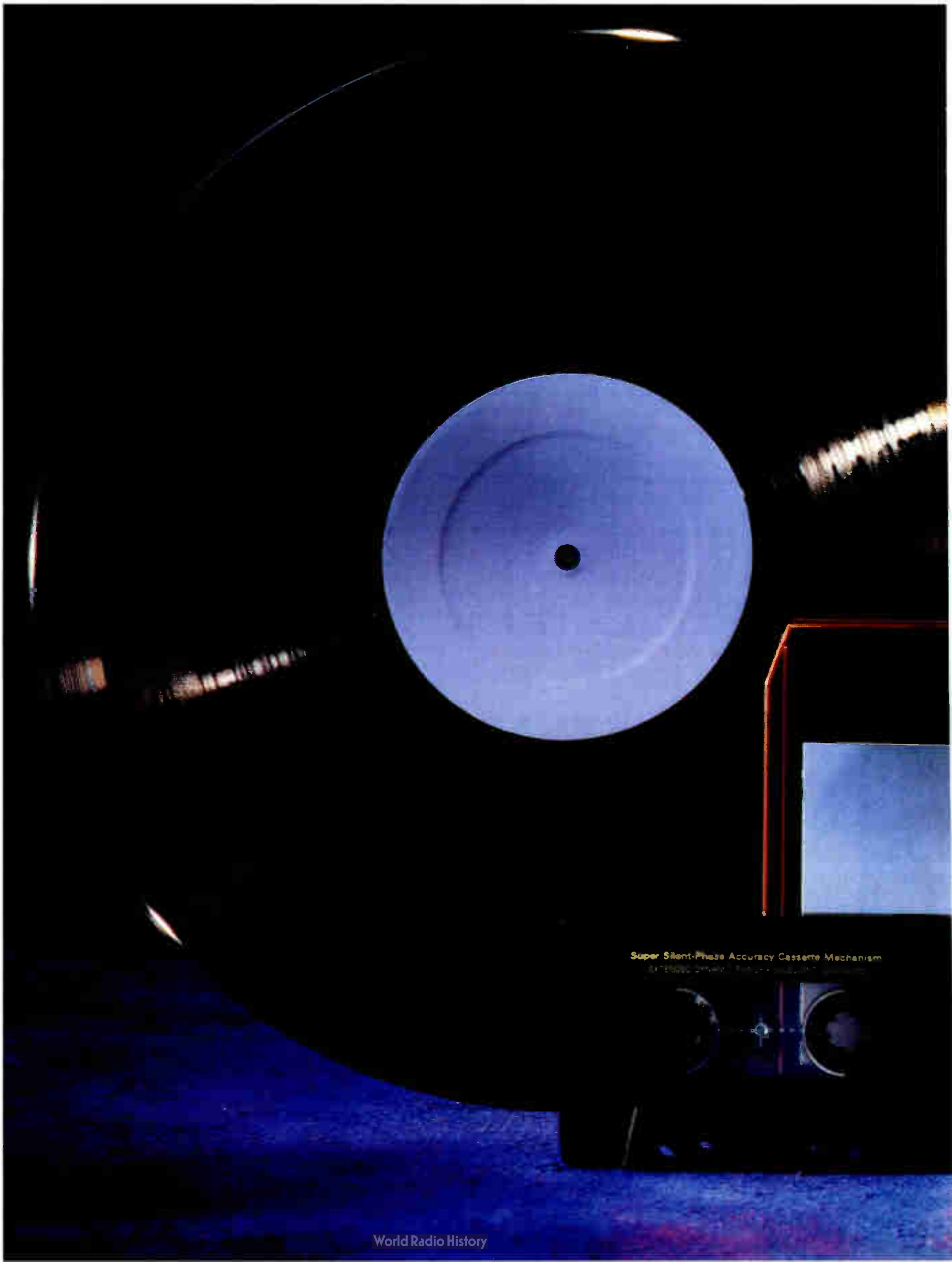
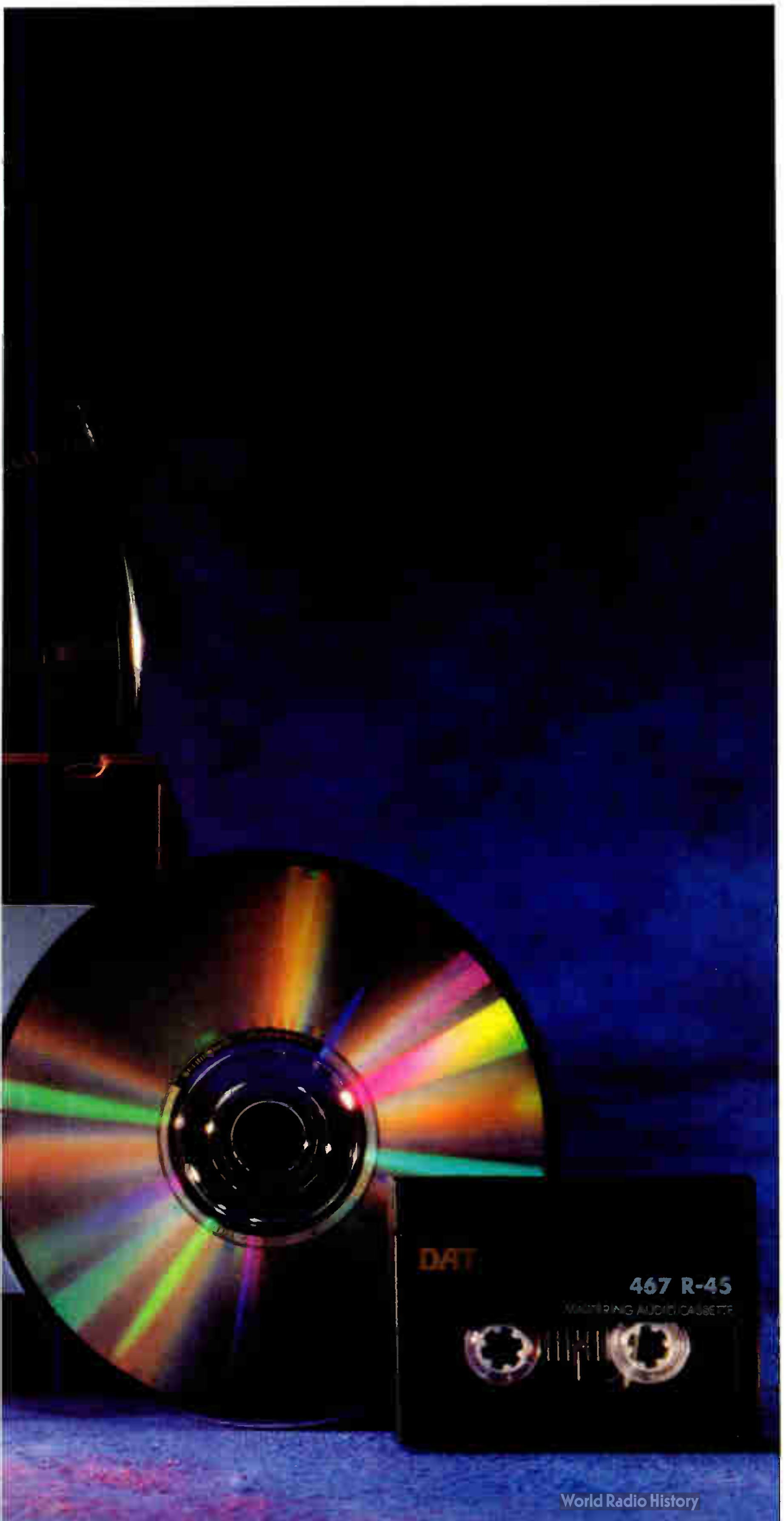
CIRCLE 250

What happens when the market



turns faster than your product?



In electronics, sometimes the life of your product is measured in months. But it can take years to get a product off the "drawing board" and onto the shelf.

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are seven of them. Each constitutes a standard by which the others would be judged. They can no longer get away with the nonsense that AT&T did.

■ ***Is there any instance of chipping away at the settlement that has been particularly disturbing?***
The judge has been inclined to let the local companies back into the marketing of telecommunications equipment. The initial agreement stated that the regulated phone companies would not be allowed to engage in the design, manufacture, or marketing of telecommunications equipment.

■ ***Why is that a problem?***
Because you can't draw a functionally satisfactory line between manufacturing and marketing or between design and manufacturing. What happens if a telephone company comes along and says it would like to market a piece of equipment with certain characteristics? This draws it into the design and that draws it into manufacturing. I think the judge now sees that it is impossible to separate marketing from manufacturing, so maybe he will let manufacturing go down the tubes along with marketing. But then he's going to find out you can't separate R&D from manufacturing or design.

■ ***The engineering community generally believes divestiture had a negative effect on AT&T Bell Labs. How do you respond to that?***
During the unified days, AT&T was for all practical purposes levying a 1% excise tax on every phone bill in the U. S. to be turned over to Bell Labs to do good work with. I certainly don't mean to suggest that Bell Labs didn't do good work with it. They did magnificent science and an enormous number of important developments came out of Bell Labs. I am a Bell Labs fan, but at the same time, I find something quite wrong with the notion that a private company—totally unanswerable to any constituency whatsoever except perhaps its shareholders—can levy a tax of whatever size it wants on something as basic as telephone service for doing general-purpose basic research.

■ ***Let's talk about antitrust more generally. Is the Sherman Antitrust Act outdated for the 1990s?***
Whether the Sherman Act is appropriate for a global economy, which is sort of what you have asked me, depends on what you think the act means. If it means that no company can get larger than an annual gross sales of $5 billion, then it is terribly inappropriate.

■ ***Are there other options?***
If the Sherman Act simply requires unrestrained, vigorous competition and lets successful companies be profitable while unsuccessful companies are driven out of the marketplace so that the resources they have been wasting are redistributed, then it is completely appropriate. The more you see it as a dynamic pro-competition force that looks not at territorial limits of the U. S. but at the economic boundaries of functioning marketplaces, the better it will work in the global economy or any other kind of economy.

■ ***Has antitrust legislation inhibited U. S. industry in global competition?***
In the late 1960s into the early 1970s, the rules against horizontal and vertical mergers were ridiculously strict. The pressure to grow was channeled very largely into conglomerate mergers. It turns out much of the resulting conglomeration was unwise and unsuccessful.

■ ***What has happened to these companies in general?***
A very large fraction of the merger activity we see today consists of the disassembling of conglomerates along lines of specialization. It requires horizontal mergers to undo the conglomerate mistakes driven by bad antitrust laws 20 to 30 years ago. Excessive restrictiveness today about horizontal mergers will slow the process of deconglomeration, and that's one reason why relative permissiveness about horizontal mergers is important today.

■ ***Given your views on permissiveness on horizontal mergers, how do you feel about consortia, particularly about pending legislation regarding manufacturing consortia?***
I think the case for joint ventures in manufacturing is much weaker than the case for joint ventures in R&D for two reasons. First, the economies of scale are not present in manufacturing as they are in R&D. Second, I think that joint ventures in manufacturing are much more likely to lead to cartel-like behavior.

■ ***Do you oppose the legislation?***
No, I favor it. After all, it does not say manufacturing consortia are legal. It just says that it is not *per se* illegal and that there won't be treble damages. [Treble damages refers to the provision in antitrust law that allows a plaintiff to receive triple the amount of his monetary damage if he can prove the defendant corporation was violating antitrust laws.]

■ ***The bill in Congress requires only that a consortium give formal notice of its plans to the Justice Department in order to avoid the liability of treble damages. There is no certification from Justice that the consortium is procompeti-***

REMEMBER WHEN...

THE CAMPAIGN OF SEMICONDUCTOR MANUFACTURERS TO GALVANIZE GOVERNMENT ACTION AGAINST FOREIGN COMPETITION IS BEGINNING TO BEAR FRUIT. A KEY U. S. TRADE NEGOTIATOR TOLD A SENATE HEARING THAT THE CARTER ADMINISTRATION IS PREPARING TO TAKE A TOUGHER LINE WITH JAPAN ON INTERNAL POLICIES THERE THAT AFFECT FOREIGN TRADE. DEPUTY TRADE REPRESENTATIVE ROBERT HORMATS STOPPED SHORT OF SAYING THAT FOREIGN RESTRICTIONS WILL BE MET BY EQUIVALENT U. S. ACTION. BUT HE DID SAY THAT NEGOTIATORS "WILL ACTIVELY SUPPORT OUR TRADE RIGHTS IN SEMICONDUCTORS."

ELECTRONICS, JAN. 31, 1980

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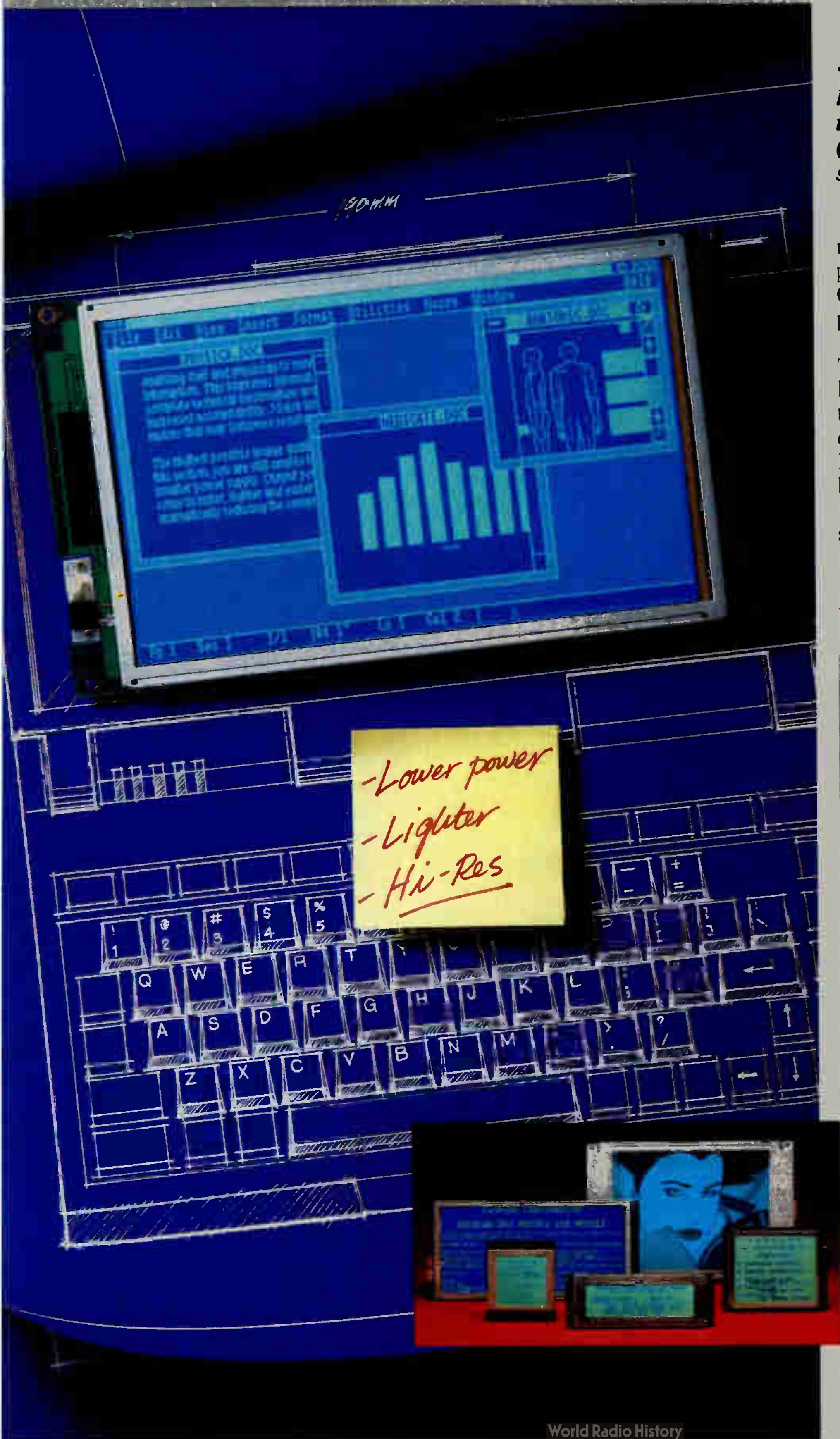

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TLX-1641-G3B	640×400	256×146×10.5	400g	B-ST	EL
TLX-1551A-C3M	640×480	276×182×20.5	700g	M-ST	CCFL
TLX-1342-G3B	640×200	275×126×14	450g	B-ST	EL
TLX-711A-E0	240×64	180×65×12	150g	W-ST	EL
TLX-1013-E0	160×128	129×104.5×14	150g	W-ST	EL
TLX-1391-E0	128×128	84.4×100×14	105g	W-ST	EL

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CIRCLE 252

tive. Why is that the case?

The lack of certification creates an environment in which the Justice Department can have a second look at a particular consortium 10 years or more down the road. Even though I would expect that more joint manufacturing ventures would be struck down than R&D ventures, I really don't see anything wrong with taking the rather short step of eliminating treble damages. There is also a certain amount to be said for detrebling across the board.

■ ***Is the U. S. headed in the right direction on antitrust?***

We are moving unambigously toward no-holds-barred worldwide competition and that is very good.

■ ***Would that put us on a level playing field with Japan?***

The history of merger enforcement put us at a disadvantage in the sense that we were saddled with a lot of inefficient companies. But antitrust laws are not putting us at a disadvantage now. ■

THE BELL DIVESTITURE HATH WROUGHT MORE COMPETITION, MORE PRODUCTS AND GROWTH OPPORTUNITIES GALORE

A Slimmed-Down AT&T Looks to the Future

BY WILLIAM WARWICK

Few decades can match the 1980s as a time of change for both the electronics and telecommunications industries. Without question, the watershed event for the telecommunications industry was the breakup of the Bell System on Jan. 1, 1984.

This event, together with trends unfolding concurrently in the microelectronics industry, has led to a new era of competition in the telecommunications industry. The result has been a wealth of new products and services, more choices for consumers—and vibrant growth in the number of telecommunications manufacturing companies in the United States.

The Telecommunications Industry Association estimates that there are 6,000 companies in the U. S. that are now engaged in manufacturing and distributing telecommunications products. This is a far greater number than we had prior to divestiture. The growth in value of products produced by those companies has been dramatic. From a little over $20 billion in 1977, the total value of U. S. manufacturers' shipments of telecommunications equipment grew to almost $80 billion in 1988, according to U. S. Department of Commerce figures. And American companies are spending $5 billion a year on research and development.

There are three causes of this spectacular growth spurt.

First is the declining cost and advancing complexity of integrated circuits. These factors have enabled the telecommunications industry to develop and market a wide variety of new products and services. These include advanced digital, central-office switches and high-capacity digital fiber-optic transmission products; new telephone systems for the home, office, and motor vehicles; and an ever-growing list of new information services for both business and residential telephone users.

Second, the microelectronics revolution has spurred further growth as it has brought telecommunications and computing industries, once separate and distinct, into convergence. This melding of technologies has stimulated innovative and enterprising companies of both industries to broaden their product and service lines in order to become participants—and also direct competitors—in a larger industry called Information Movement and Management. So, in fact, the divestiture can be looked upon as helping to create a vibrant new industry.

Third, divestiture has provided an additional impetus for growth within the telecommunications industry itself. As a result of divestiture, manufacturers have quickly perceived new opportunities in connection with network and product standards.

The changes helped create a more level playing field for all telecommunications equipment providers and have substantially lowered the cost of market entry for new equipment and service providers.

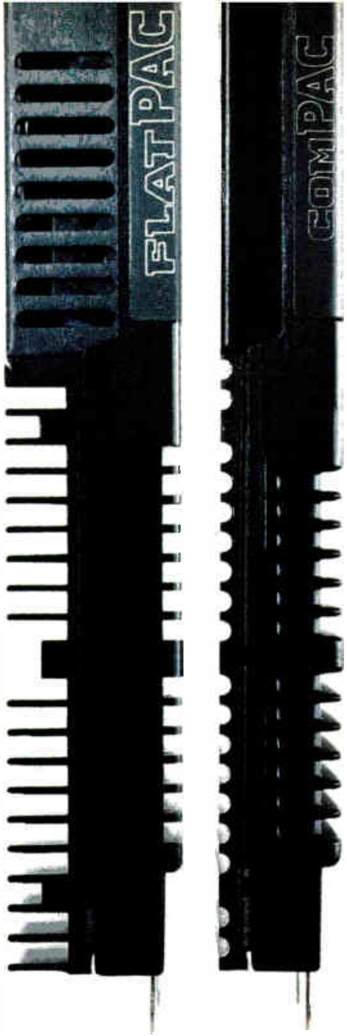
What is the primary lesson to be learned from the 1980s?

Succinctly put, it is simply that a competitive environment spurs growth, innovation, and customer satisfaction in all areas touched by telecommunications. This includes manufacturers of traditional telecommunications equipment; in the broader information-movement-and-management industry; and in the microelectronics industry. ■

WILLIAM JAMES WARWICK

PRESIDENT
AT&T MICROELECTRONICS

■ BILL WARWICK'S CAREER WITH AT&T SPANS FOUR DECADES AND INCLUDES NUMEROUS POSITIONS THAT GAINED HIM EXPERIENCE IN MANUFACTURING, CONSUMER PRODUCTS, DEFENSE AND INFORMATION SYSTEMS. HE ASSUMED HIS PRESENT JOB IN 1986 AFTER SERVING AS GROUP VICE PRESIDENT FOR ENGINEERING AND MANUFACTURING.



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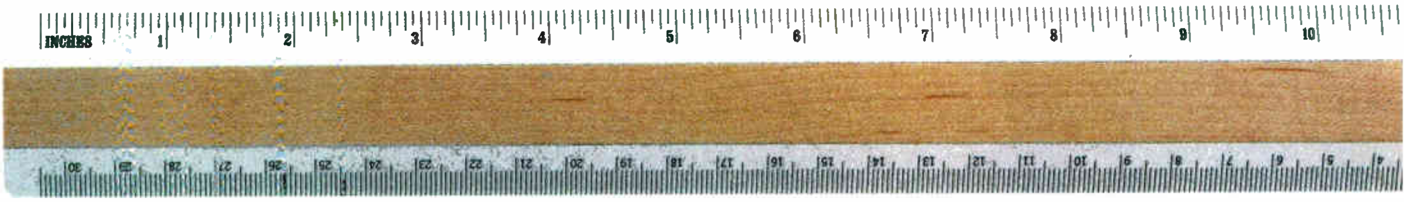

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FCC Part 15, Class A VDE 0871 Class A IEEE Std 587-1980	**Applicable Specifications**	Bellcore (24/48 V) British Telecom (24/48 V) FCC/VDE, Class A (300 V) MIL-STD-461 C (28/270 V) MIL-STD-704A

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CIRCLE 249

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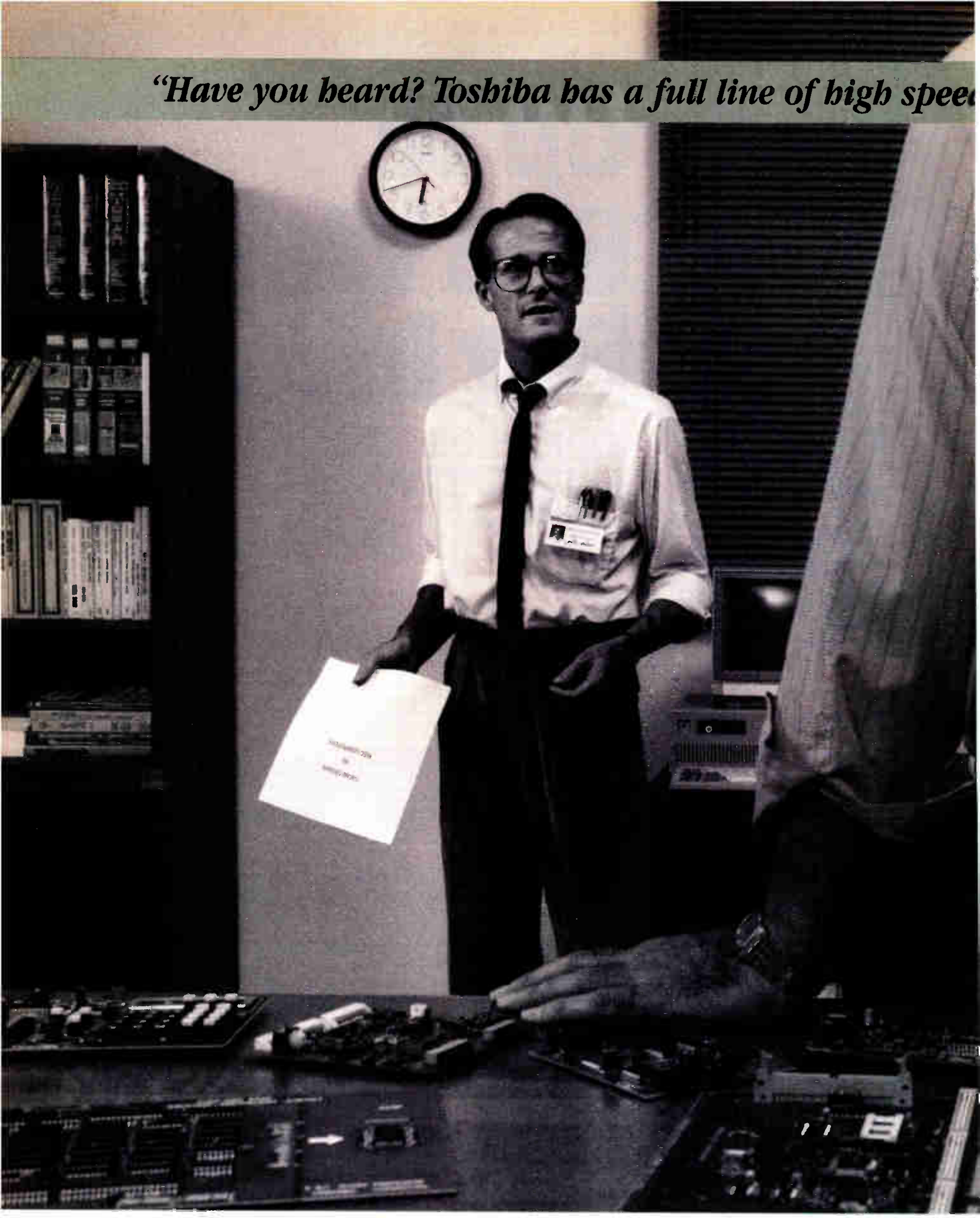

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8K x 8	64K	15	20	25		Now
8K x 9	72K	15	20	25		Now
4K x 18 x 2	144K	20	25	30		Now
8K x 18	144K	20	25	30		Now
64K x 4	256K	17	20	25	35	Now
64K x 4 (OE)	256K	17	20	25	35	Now
32K x 8	256K	17	20	25	35	Now
32K x 9	288K	17	20	25	35	Now
16K x 12	192K module	25	35			Now
16K x 16	256K module	25	35			Now

PART	$\overline{CE}$	A12	t_{acc}	t_{OE}	V_{cc}	PACKAGE
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CIRCLE 236

PROTECTION FOR SOFTWARE DEVELOPERS EXPANDED VASTLY IN THE 1980s, BUT MANY PATENT AND COPYRIGHT ISSUES REMAIN MURKY

Intellectual Property Takes Center Stage

BY ESTHER SCHACHTER

The 1980s witnessed the coming of age of U. S. intellectual property law regarding computer software. Prior to the 1980s, software creators could look only to trade-secrets laws for protection. As it enters the 1990s, the U. S. software industry has the most comprehensive copyright, patent, and trade-secrets protection in the world. Four types of intellectual property law now protect software: trade-secrets laws, the 1980 Computer Software Copyright Act, the Patent Act, and the 1984 Semiconductor Chip Protection Act.

All the developments surrounding intellectual property law must be viewed in the context of one key point: the primary purpose of copyrights and patents is not to reward authors or inventors, but to secure the public benefit derived from the labor of authors and inventors. Until relatively recently, patents typically were reserved for useful, business-type creations (such as mechanical devices or processes). Copyright law applied primarily to works of art, including written material.

Computer software blurred the line between patent and copyright. In 1974, the National Commission on New Technological Uses of Copyrighted Works (Contu) was created to study the issue of whether software qualified for protection under copyright law. Contu's final report, delivered to President Jimmy Carter on July 31, 1978, recommended that the existing copyright law be amended to make it explicit that computer programs, to the extent that they embody an author's original creation, are proper subject matter for copyright.

Congress responded to Contu's recommendation with the 1980 Computer Software Copyright Act. Unfortunately, the legislation does not elaborate on the exact scope of copyright protection. It was left to the courts to determine just what aspects of those programs were copyrightable.

Through the 1980s, legal decisions began to set precedents for such guidelines. In a landmark decision in 1983 (*Apple Computer Inc. v. Franklin Computer Corp.*), the U. S. Court of Appeals for the Third Circuit held operating system programs to be copyrightable. The decision made clear that instructions in an operating system were protected even though the operating system implemented ideas, procedures, methods of operation, and systems that were not protectable.

In what have generally been regarded as logical and appropriate extensions to the law, copyright protection has also been accorded to the source code and object code of application programs and, most recently, to microcode (in *NEC Corp. v. Intel Corp.*).

Issues regarding copyright protection for software are far from being resolved completely, however. The current debate hinges on two lower-court decisions that send conflicting signals regarding the scope of copyright protection for software.

In the first of these decisions, *Whelan v. Jaslow,* the U.S. District Court for the Eastern District of Pennsylvania ruled that the protectable expressions of an idea in a software program were the ways in which "the program operates, controls, and regulates the computer in receiving, assembling, calculating, retaining, correlating, and producing useful information either on a screen, printout, or by audio communication." Because of the substantial similarity between the two programs involved in the case, the court found that the defendant's program infringed on the plaintiff's copyright.

On Aug. 4, 1986, the Court of Appeals for the Third Circuit upheld the district court ruling. The court concluded its review by holding that "copyright protection of computer programs may extend beyond the program's literal code to their structure, sequence, and organization." On Jan. 12, 1987, the Supreme Court declined to review the case, leaving intact the lower court's interpretation of copyright protection for computer programs.

Meanwhile, however, the U. S. Court of Appeals for the Fifth Circuit, in *Plains Cotton Cooperative Association v. Goodpasture Computer Service Inc.*, cited a 1978 Texas district court decision (*Synercom Technology Inc. v. University Computing Co.*)

ESTHER SCHACHTER

ATTORNEY
SCHACHTER, COURTER, PURCELL & KOBERT

■ AS EDITOR AND PUBLISHER OF *THE COMPUTER LAW AND TAX REPORT*, ESTHER SCHACHTER HAS A UNIQUE VIEW OF INTELLECTUAL PROPERTY ISSUES. THE NEW YORK-BASED ATTORNEY HAS LECTURED ON COMPUTER-RELATED SUBJECTS IN JAPAN, CANADA, AND THE U.S. SCHACHTER IS A MEMBER OF THE ADVISORY BOARD FOR RUTGERS UNIVERSITY'S COMPUTER AND TECHNOLOGY LAW JOURNAL AND THE COMPUTER LAW ASSOCIATION.

that held that "input formats" of a computer program—the organization and configuration of the information fed to the computer—were ideas, not expressions, and thus were not protected under copyright law.

On Oct. 5, 1987, the Supreme Court declined to review *Plains Cotton v. Goodpasture.* In so doing, it left two opposing decisions intact; that is where we are today.

Other court rulings since late 1987 have done little to clarify the issues surrounding copyright protection. In *Apple Computer Inc. v. Microsoft Corp.*, a federal district court ruled in July 1989 that the license agreement between the two parties covered most of the discrete visual displays in Microsoft's Windows program that were in dispute, leaving certain icons and overlapping windows not covered by the agreement for determination as to copyright infringement.

In a 113-page decision handed down in June 1990 for *Lotus Development Corp. v. Paperback Software and Mosaic*, Federal District Judge Robert Keeton ruled that Lotus could copyright its menu of commands for its 1-2-3 spreadsheet program. Keeton ruled that the menu is a key element of the Lotus user interface, that it is capable of being expressed in many ways, and that it is the feature of 1-2-3 that has made the program so popular.

Issues regarding software protection under patent law also remain less than clear. Before 1981, both the courts and the Patent and Trademark Office rejected patent claims for software. (This was true except for a short period in the early 1970s, when the patent office had accepted software patents.) Software programs were deemed to be mathematical algorithms and therefore could not by statute be patented. But several U. S. Supreme Court decisions in the 1970s, most notably *Diamond v. Dier*, opened the doors to the patenting of machines that include a programmed computer or of processes that perform a function utilizing a program.

After *Diamond v. Dier,* the patent office began accepting software program patents. Until about 1987, patents were issued only for scientific and industrial software. Then Merrill Lynch, Pierce, Fenner & Smith applied for and obtained a patent for programmed trading systems. Shortly thereafter, patent applications for commercial software substantially increased.

On May 19, 1988, the patent office issued the first of many design patents for icons and computer screen displays. In February 1989, a patent was granted for a red-lining program (a word processing feature that identifies differences between documents) and for a special technique that displays multiple software programs in computer screen windows.

THE BACK PAGES

THE OUTLOOK OF SMALL R&D COMPANIES IS NOT GOOD, SAID PAUL E. RITT, DIRECTOR OF RESEARCH FOR GTE LABORATORIES, BECAUSE VENTURE CAPITAL IS TIGHT COMPARED TO THE 1950s AND 1960s. "THEN, SOMEONE WITH A GOOD IDEA COULD JUST GO DOWN TO THE CORNER, TALK TO SOMEONE IN A LARGE COMPANY, AND GET THE MONEY HE NEEDED TO BRING HIS INNOVATION TO MARKET."

ELECTRONICS, APRIL 17, 1980

Patent protection may become a two-edged sword for software developers, who are now concerned that procedures that have become standard in development may be patented, resulting in inadvertent patent infringements. In addition, securing and defending patents is much more expensive that securing protection under copyright and trade-secrets law.

Lastly, obtaining a patent in the U. S. does not equate to patent protection overseas. In April 1989, the UK Court of Appeals denied a patent for the programmed trading system developed by Merrill Lynch. Since software is marketed worldwide, this last development can be a serious setback.

Before 1980, trade-secrets laws were the only intellectual property law that protected an owner's rights to a software program. Trade-secrets laws offer limited protection to developers. Protection can be claimed only if the software contains some array of secret information that gives the owner a competitive advantage. Trade-secrets laws do not provide protection against persons with whom the owner has no relationship of trust and confidence or contractual rights, or against users after the secret becomes known. It was because of these and other limitations that copyright protection was sought for software protection.

The common practice today is to seek both copyright and trade-secrets protection simultaneously. The advantage is that copyright law protects expression but not know-how or process, and trade-secret protection endures as long as the secrecy continues to exist.

The Semiconductor Chip Protection Act was enacted in 1984 to adequately protect semiconductor chip layouts from piracy. The act provides a form of intellectual protection, analogous to copyright protection, for mask works. The act offers a 10-year term of protection for original mask works measured from their date of registration or first commercial exploitation anywhere in the world.

The chip act protects against literal copying and the misappropriation of a material portion of a mask work; however, it does not prohibit independent development of a work. In fact, the act allows for reverse engineering.

The 1980s saw the recognition of software and data bases as valuable property to be protected. The same decade saw the weakening of antitrust law, a traditional ballast to patent and copyright protection of business property. Whether the scope of copyright and patent law will continue to be broadly defined in the 1990s will depend in part upon the worldwide balance of technology trade and the weight Congress and the courts give to antitrust policies.

The production and distribution of technology is dependent on a world economy, and the laws to protect that technology will expand accordingly. The U. S. government will continue to pressure countries not having copyright laws to enact appropriate legislation, as well as press for enforcement of laws in countries in which software piracy exists. Cooperative efforts through regional and international trade organizations will continue and expand. E

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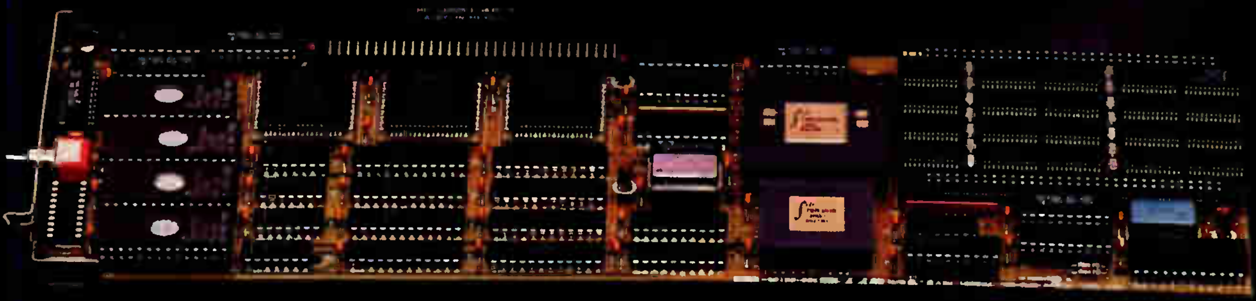

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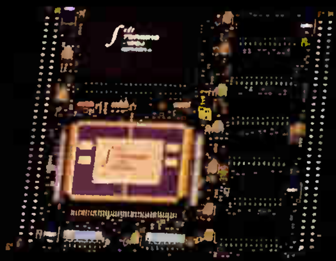

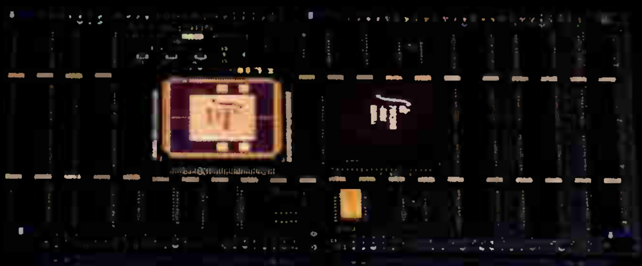

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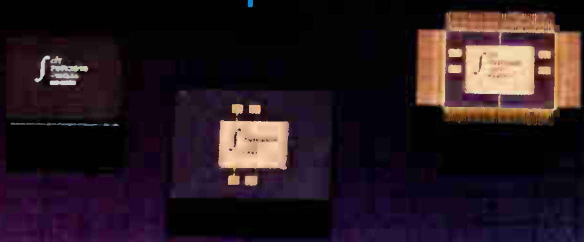

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CIRCLE 190

EXPANDING SOFTWARE COPYRIGHT PROTECTION IS BEING MET WITH NEW DEFENSE TACTICS

Software Comes Clean

BY RICH BELGARD

The term "clean room" in electronics jargon once was exclusively reserved for the dust-free environment in which semiconductor wafers are processed. But during the 1980s, the litigious nature of the computer business fostered another meaning for the term. Clean rooms also are places where computer software is developed in a way that is demonstrably free of any improper use of other software. The clean-room process is a way of independently creating software that is functionally compatible with other software. The key words are *functionally compatible.*

U. S. copyright law, which now is typically used to protect software, is largely responsible for the advent of clean rooms as a means of defense. Copyright protection should not be confused with patent protection. A patent gives an inventor a limited monopoly on his or her invention. But copyright law protects only the expression of an idea—not the idea itself. It is perfectly allowable for anyone to take the idea embodied in a copyrighted work and express it in a different way.

According to case law, a copyright is infringed by a combination of "access plus substantial similarity." In terms of software, access can be proved by showing that the infringing party had access to the source code, decompiled object code, or trade secrets of the company that produced the copyrighted software.

"Substantial similarity" is a fairly vague and subjective term. Two software products might be considered substantially similar if their code structures or sequences are similar, or even if they look remotely similar.

While the determination of substantial similarity of software might best be left to software experts, the legal system confers this responsibility on judges and juries, who often interpret it very broadly. Since similarity is subjective and access is objective, it is a much safer and more certain strategy for a defendant to show lack of access than to attempt to show lack of substantial similarity.

For the developers of the new software, the purpose of a clean room is to document and guarantee a lack of access to any of the expressive nature of the original software. The clean-room development team is isolated in an environment in which the team's only information or communication regarding its task involves the form of the functions to be performed by the software. To verify the extent of the information the developers get, all communication is documented.

The clean-room development process involves three groups: a development team, a specification team, and a coordination team. The development team designs and produces the software. Members of the development team should be chosen carefully at the outset of the project. There are two basic criteria for members of the development team: they must be able to engineer software, and they must not have had access to the original software in question.

The specification team creates the functional specifications for the software. It provides all the tools necessary inside the clean room, responds to questions from the development team, and evaluates results from the clean room from a technical standpoint. Legitimate access to the original software is not an issue for members of the specification team, since the team is not actually developing the product.

The coordination team reviews all information that enters the clean room. It must ensure that only functional descriptions (that is, ideas) enter the clean room by way of project specification, design tools, answers to questions, diagnostic tests, or any other means. The coordination team keeps track of each document entering or leaving the clean room. Although it is probably advantageous to have a copyright lawyer as a member of the coordination team, it is not required.

The specification and coordination teams often begin their work well before the development team is recruited and established. They create the functional specification; design, develop, or purchase any special software tools that may be necessary (such as simulators, assemblers, and debuggers); and obtain any public documentation that can be used by the development team to complete the project successfully.

The coordination team reviews and works with the specification team to ensure that only the "whats" of the software are given in the specifications and tools, not the "hows." This review is complex and must be done carefully.

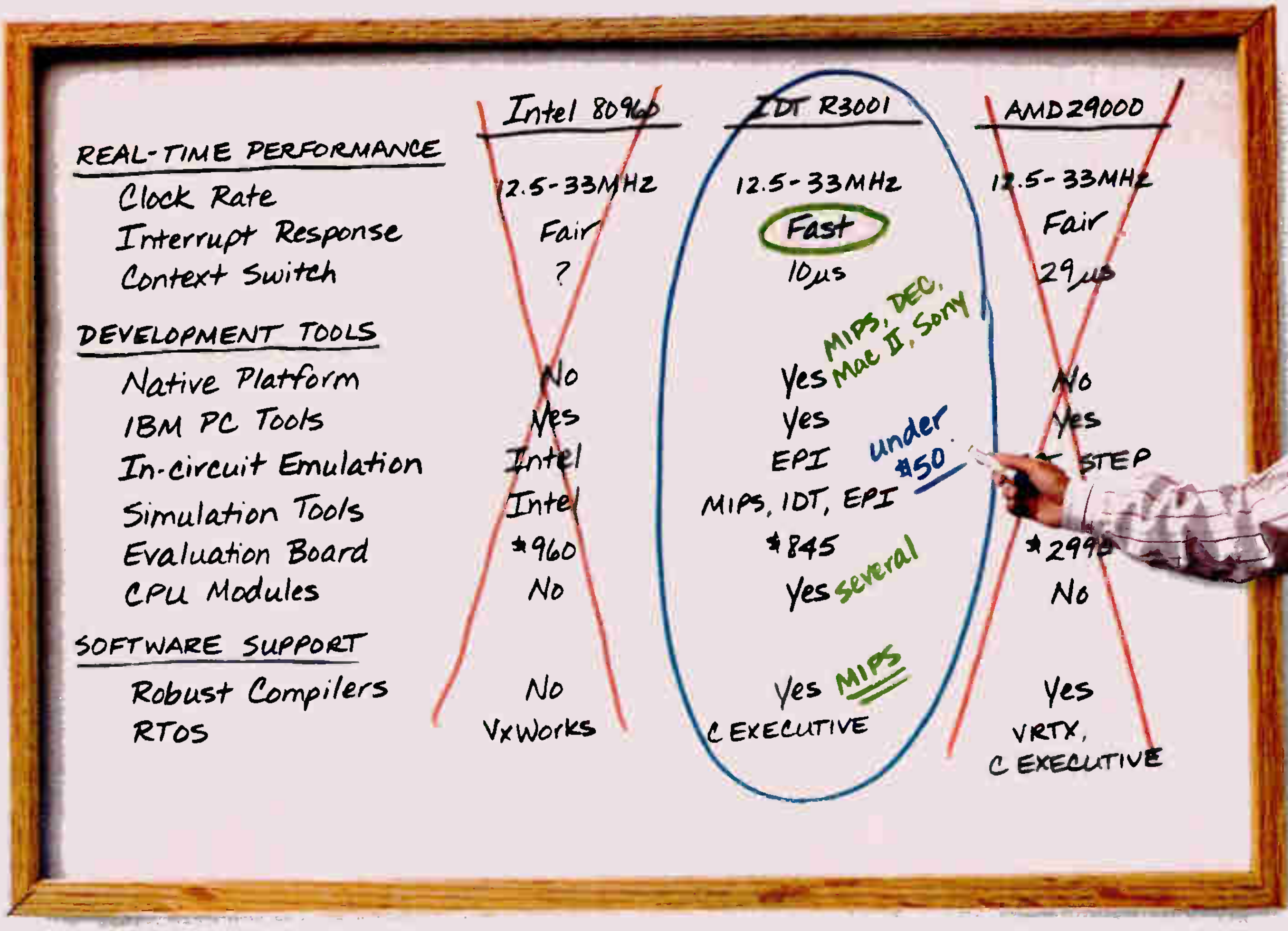
Once chosen, the development team sets up shop. The clean room should be at a different location from the other teams to minimize the chance of undocumented communication. When

RICH BELGARD

CONSULTANT
SARATOGA, CALIF.

■ RICH BELGARD IS AN ENGINEER AND AN EXPERT WITNESS IN INTELLECTUAL PROPERTY CASES. HE HAS PARTICIPATED IN CLEAN-ROOM SOFTWARE DEVELOPMENT PROGRAMS AND IS A HOLDER OF 33 PATENTS. HE FORMERLY MANAGED DEVELOPMENT OF COMPUTER ARCHITECTURES, HARDWARE, AND SOFTWARE FOR BURROUGHS, DATA GENERAL, TANDEM, AND RATIONAL.

Embedded RISC



Get the Facts

When evaluating RISC processors for embedded applications, you need real benchmark data from independent sources. The *R3001 Performance Comparison Report* is a collection of the original third-party data used in the graph below.

Benchmark Your Code

Of course, we know that published data can't give you all the information. You'd prefer to perform benchmarks for your specific application, and our six technology centers are equipped to do just that — bring us your code and we'll run your benchmarks!

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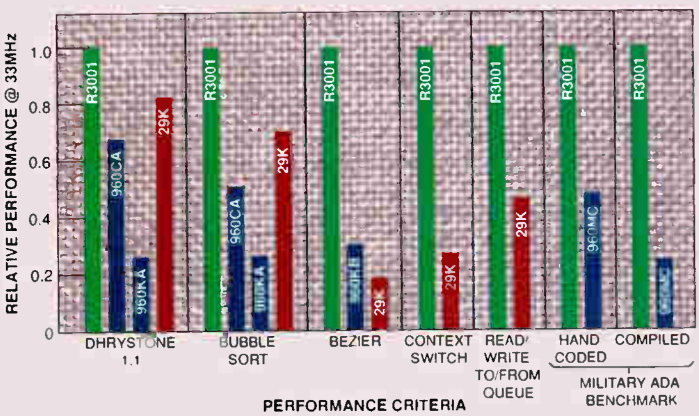


Sources: *Electronic Engineering* Magazine, *High-Performance Systems* Magazine, *Microprocessor Forum* Conference Fall 1989, *Independent Assessment Benchmark Report* Atlantic Research Corporation

When cost-effective performance counts

Integrated Device Technology

CIRCLE 243

4-MEGABIT DYNAMIC RAM: NEC'S GLOBAL SUPPLY PROGRAM.

The transition to second generation megabit memories is speeding up and high performance systems incorporating 4-megabit dynamic RAMs will make a major impact this year.

NEC is ready with a comprehensive line of 4Mbit DRAMs offering access speeds of 80 and 100ns and organizations of x 1 and x 4.

Options include fast page, nibble, static column, and write per bit. Package choices are SOJ, ZIP and SIMM. In the latter half of this year, we will further diversify our 4Mbit line by adding 60ns versions and organizations of x 8 and x 16.

As the leading chip producer, NEC is committed to a steady, global supply of 4Mbit DRAMs. They are now in volume production at two plants in Japan.

Our U.S. fab in Roseville, CA will start 4Mbit DRAM production in 1991. Our European fab near Edinburgh, Scotland, which is producing 256K and 1Mbit DRAMs, will also gear up for denser chips next year.

NUMBER 143

CHILE AIMS FOR NATIONWIDE DIGITAL NETWORK.

Compañía de Teléfonos de Chile, S.A. (CTC) is aiming to double telephone subscribers by completing a nationwide digital network. NEC is supplying the advanced digital switching and transmission systems necessary for this ambitious project.

The core of the network is the NEAX61 digital switching system, which is either already in service or soon to be installed at 127 exchanges with a total of 483,000 subscriber lines. The exchanges are connected in Santiago and neighboring cities with 34MB-to-565MB fiber optic transmission systems and 2MB cable PCM systems.

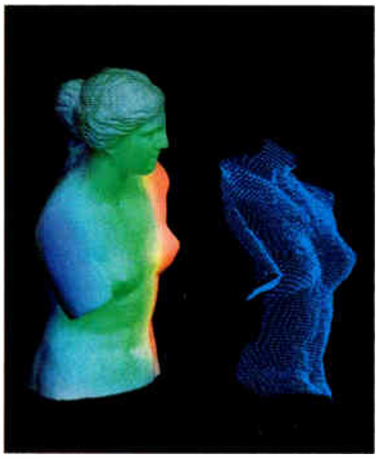
NEAX61 switches in other Chilean cities will be networked with 2GHz–8MB, 6GHz–140MB, and 8GHz–34MB digital microwave systems.

The microwave link uses 50 hops to cover a distance of 1,300km from the Northern border to the Southern end of the South American Continent and across the Strait of Magellan.

CTC is also actively introducing innovative services such as an NEC-equipped cellular telephone system already operating in the Metropolitan Region and Fifth Region. The 800MHz network with 31 cells accommodates a total of 25,000 mobile, transportable and handheld subscriber telephone terminals.

REAL-TIME, 3-DIMENSIONAL MEASUREMENTS.

Making 3-D measurements of moving objects has been a difficult task. Now NEC is developing a simple PC-based system at its C&C Information Technology Research Laboratory.



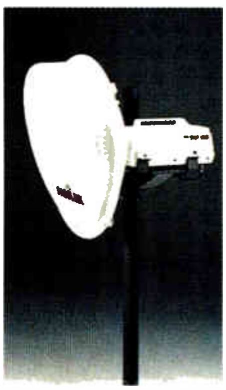
The Rainbow Range Finder (RRF) uses a triangulation principle to take 3-D measurements. Light emitted from a xenon lamp is diffracted through a grating and projected onto a target object in a rainbow pattern.

The object is observed by a color TV camera with two special optical filters. The camera is installed at a fixed distance from the grating. The precise distance to each pixel of the object is obtained by determining the wavelength of the pixel. Measurements can be made with one TV frame in 1/30 of a second.

RRF is expected to become an efficient tool in factory automation, the fashion industry, surgery and many other applications requiring real-time, 3-D measurements.

PASOLINK: SHORT-HAUL MICROWAVE RADIO.

How can you link multiple LANs in situations that rule out cable? Or set up emergency or temporary communications links in next to no time? NEC's PASOLINK is a reliable, cost-effective answer to these and a number of other applications.



PASOLINK is an advanced point-to-point microwave radio operating in frequency bands from 13GHz to 50GHz. Coverage extends about 20km for data, voice and video links. Transmission capacity is from 2.048 to 34.368Mbps,* providing up to three service channels, or one video plus two sound channels.

PASOLINK is easily transported and simply consists of a compact outdoor transceiver with antenna, and indoor modulator/demodulator unit.**

Communications links are easy to set up and no special shelter or tower is required.

*1.544–44.736Mbps also available. **Not needed for 50GHz use.

NEC

the specification and coordination teams are confident that all the information and tools necessary to complete the software are ready (and are purely functional), they deliver them to the development team.

Typically, a substantial amount of communication to and from the clean room is required during the project. Facsimile machines can be provided to control the documentation of each communication. Undocumented communication must not be allowed.

The development team typically has questions about the specifications or tools. It may discover that it misunderstands the specification, or it may find errors or inconsistencies. All of these issues are common in the software-development process.

The uncommon element, and one that is frustrating and unnatural, is that each issue must be dealt with in a separate document between the clean room and the coordination team. The coordination team reviews, logs, and delivers these issues to the specification team for resolution. Often, these issues call for revisions or corrections to the specifications, or even new or additional software tools. Each revision or additional item proposed must be reviewed to ensure that it conforms to clean-room standards. Then it is logged and delivered to the clean room.

The process is complete when the independently developed software has been certified as working by the diagnostic or test suites. The completion is determined initially by the design team. The coordination or specification team performs a final review and may find errors or violations of the specifications. Additional tests to remove errors unforeseen at the outset, or corrections to the specifications, may be required. Any software modifications should be made under clean-room conditions by the development team. Final completion is attained when all specifications have been met and all diagnostic tests passed.

The clean-room process takes substantially more time than the typical software-development project, and it is a strange and cumbersome environment for developers. But companies are using the clean-room approach more frequently as a hedge against copyright infringement lawsuits. ■

THANKS TO NEC V. INTEL, DEVELOPERS OF MICROCODE NOW HAVE SOME PROTECTION AGAINST SYSTEM PIRACY

Intel's Lost Battle: the Ecstasy of Defeat

BY F. THOMAS DUNLAP JR.

In many court decisions, the specific details of a case are not nearly as important as the legal principles in question. Such was true of the landmark case *NEC Corp. v. Intel Corp.*, which dealt with an issue that is critical to the electronics industry: whether microcode can be copyrighted.

The case began in 1984, when NEC filed a suit claiming that microcode is not copyrightable and that, therefore, its V-series microcode did not infringe on Intel's copyright on its microcode for the 8086 microprocessor. In 1989, the federal court hearing the case held that the NEC microcode did not infringe on Intel's copyright. More importantly, however, the court ruled that microcode is a computer program and as such is entitled to copyright protection—a significant legal precedent.

Under the 1980 amendment to the Copyright Act, copyright protection was explicitly confirmed to cover computer programs, which were defined as "a set of statements or instructions to be used directly or indirectly in a computer in order to bring about a certain result." In *NEC v. Intel*, the court expanded the definition of computer programs to include microcode.

By deciding that microcode is a computer program, the court made it illegal to copy microcode. However, copyright law protects only expression; it does not protect the underlying idea. This means that it is legal to develop microcode that performs the same function as the Intel microcode, as long as the expression of the particular Intel microcode is not copied.

For Intel, the precedent set—that microcode is copyrightable—was more important than the specific holding on infringement. Infringement of microcode is now tested under the entire body of law on infringement of software. The precedent provides protection for the high research and development expenditures needed to develop products in today's semiconductor industry. A state-of-the-art microprocessor can cost hundreds of millions of dollars to develop. Companies cannot afford to invest that kind of money in a product that can be copied. ■

F. THOMAS DUNLAP JR.

GENERAL COUNSEL
INTEL CORP.

■ A HOLDER OF DEGREES IN ELECTRICAL ENGINEERING AND LAW, TOM DUNLAP DIRECTED INTEL CORP.'S LITIGATION THAT ESTABLISHED THAT MICROCODE HAS COPYRIGHT PROTECTION. AS VICE PRESIDENT AND GENERAL COUNSEL AT INTEL, HE WAS ONE OF THE MAIN PROPONENTS BEHIND THE PASSAGE OF THE CHIP PROTECTION ACT OF 1984.

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CIRCLE 254

FROM ANTITRUST LAW TO THE FEDERAL BUDGET DEFICIT TO DARPA, THE GOVERNMENT STRUGGLES WITH INDUSTRIAL POLICY

In Congress, the View Is Murky at Best

BY JACK SHANDLE

Global competition in the 1980s thrust the electronics industry into public policy issues as never before. In this interview, Rep. William Frenzel gives the Capitol Hill perspective.

WILLIAM FRENZEL

CONGRESSMAN
WASHINGTON, D. C.

■ MINNESOTA REPUBLICAN BILL FRENZEL WAS A LEADING ARCHITECT OF THE 1978 AND 1981 TAX BILLS AND IS PRESENTLY THE RANKING MINORITY MEMBER OF THE HOUSE BUDGET COMMITTEE. HE ALSO SERVES ON THE HOUSE WAYS AND MEANS COMMITTEE AND IS A CONGRESSIONAL REPRESENTATIVE TO NEGOTIATIONS ON THE GENERAL AGREEMENT ON TARIFFS AND TRADE.

■ ***Does the electronics industry deserve a special place in America's policy-making community?***
Since technology in general is so important—and has so much potential to produce an export surplus—I think Congress will legislate in its favor. I think, however, that we have to be careful not to pass laws that do not apply across the board.

■ ***What about the idea of designating strategic technologies?***
Congress loves to play kingmaker in industrial policy. But it also has terrible, chauvinistic regional impulses to promote local industry. If you are more important than the next Congressman, your temptation is to promote your technology whether it is strategic or not. Congress is about the worst body to be playing God in the marketplace.

■ ***How can Congress promote technology across the board?***
My first preference is to not have the federal government involved in technology. However, there are exceptions to every rule. I do not object to Sematech. But I do not want every development—and a good example is high-definition TV—to come running to Uncle Sam if the market won't finance the development itself.

■ ***Does the Defense Advanced Research Projects Agency have a legitimate role to play in technology?***
Some elements of the technology industry have looked upon Darpa as the mother lode. Darpa does not have unlimited resources, and it can't help everybody. But I also see Darpa as an exception to my industrial policy rule.

■ ***What is the overriding economic problem facing the U. S. and the electronics industry?***
The federal deficit. Until the U. S. puts its fiscal house in order, it cannot cope with any of the other problems, such as the trade deficit or issues of competitiveness. The federal deficit burdens the economy with extra interest costs. Not the least of the problems occasioned by the deficit is that business managers and policymakers spend most of their time worrying about it. They ought to be liberated from that.

■ ***How does one go about that?***
For Congress to stop spending would be a great surprise. But there is some hope that the economic summit [between President Bush and congressional leaders] will induce Congress to take a more substantial bite out of the deficit than it has in past years.

■ ***How about increasing the revenue stream by decreasing the capital gains tax?***
When we took the two big bites out of the capital gains tax in 1978 and 1981, we established what I thought was a responsible differential. That was lost with the 1986 Tax Reform Act. We can get it back this year if we come to a summit conclusion between the President and congressional leaders, which I think will be the case.

■ ***Does Congress perceive that the antitrust laws limit America's global competitiveness?***
Our antitrust laws in general are a self-inflicted wound that discourages U. S. activity abroad and, in fact, in our own market—both in research and development and manufacturing.

■ ***What is going on in Congress that could be helpful?***
The House has passed a bill that would eliminate the risk of treble damages for joint manufacturing ventures. It will be a great impetus to joint ventures between U. S. companies and between U. S. and foreign companies.

■ ***Is there anything you dislike about the bill?***
One negative is that if foreign investment in a joint venture exceeds 30%, the venture would not be relieved of the threat of treble damages. Another negative is that even though the joint ventures could be 100% American, if they are located offshore they would not be protected. ■

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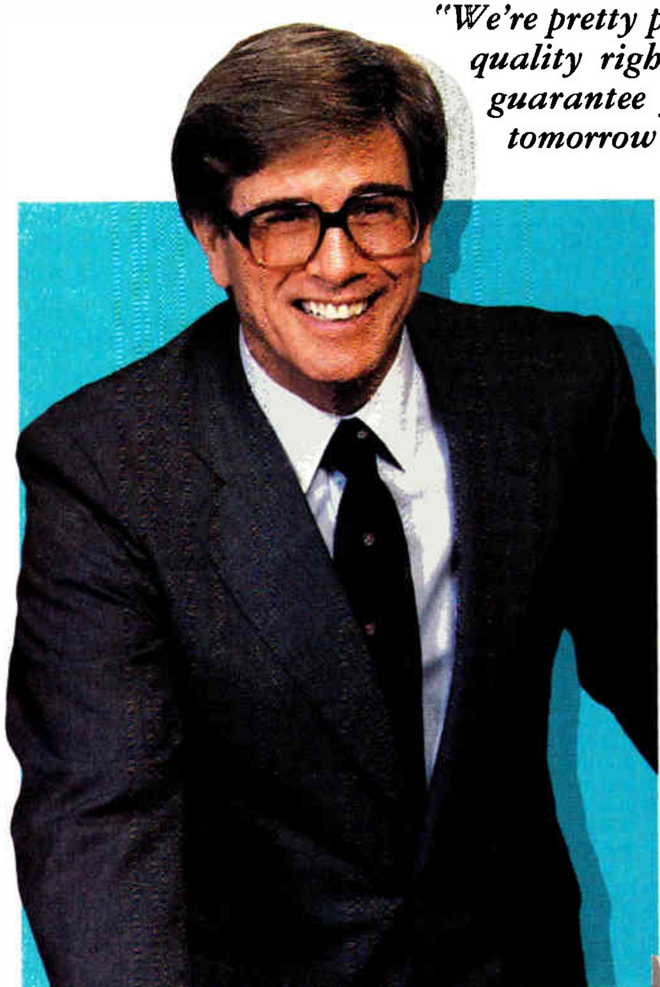

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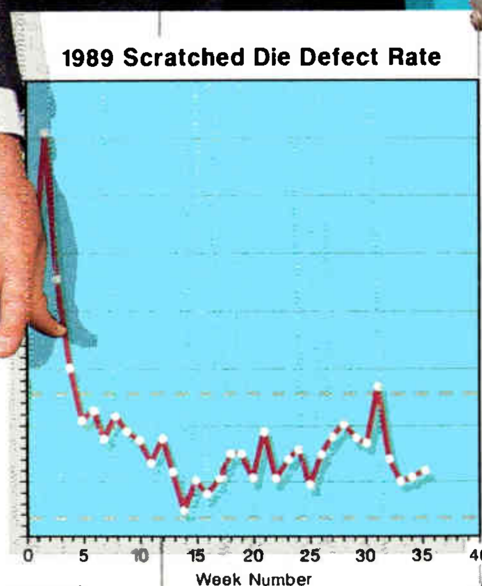
"We're not satisfied. . . probably never will be. But we know we're making progress, because we've made the investments in the people, training, and procedures we need to measure progress, and make improvements happen."



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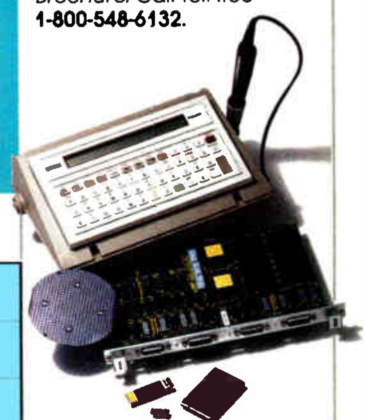

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CIRCLE 202

THE INDUSTRY THAT BEGAN IN AMERICA STILL OFFERS OPPORTUNITIES, BUT SOME OF THE REALITIES HAVE CHANGED

After the Fall: The New Venture Capitalist

BY EMILE GEISENHEIMER AND PETER IMPERIALE

It has become fashionable to believe that the U. S., which spawned the age of electronics, can no longer compete in the industries it created. Critics moan that the industry has grown older, slower, and less vital.

This sense of defeatism is infuriating. For the U. S., the game is far from over. Certainly, the U. S. economy today is much more affected by what takes place in other parts of the world. The rules of the game have changed. The industry has gotten older, more competitive, considerably more expensive, and global. Certain segments of the electronics industry have matured. But many more remain untapped and offer immense potential.

In the 1970s and early 1980s, small bands of investors teamed with pioneering entrepreneurs to create success stories such as Intel Corp. and Apple Computer Inc. In those heady days, almost every good idea could find support from venture capitalists.

The handfuls of money available for early, dedicated investing grew into vast pools of dollars from major institutions eager to participate in the industry's extraordinary successes. By the mid-1980s, institutional investing began to dominate the venture capital industry, and with it came a new style of investing. As money surged into venture capital, the number of firms increased. The early venture capital culture gave way to the influx of less experienced, more financially focused investors. The venture capital industry found itself with more money and people chasing relatively fewer deals.

The scale of each investment grew by a factor of four or five, and expectations grew accordingly. The fundamentals of building companies were frequently overlooked by investors who demanded dazzling returns in two to three years—half the time it took earlier investments to deliver. The focus on products rather than fundamentals led to goals that were often unmet.

EMILE GEISENHEIMER
PETER IMPERIALE

GENERAL PARTNERS
NAZEM AND CO.

■ PRIOR TO JOINING NAZEM AND CO., EMILE GEISENHEIMER WAS PRESIDENT AND CHIEF EXECUTIVE OFFICER OF PHILIPS ELECTRONIC INSTRUMENTS INC. HE HAS ALSO BEEN A MANAGEMENT CONSULTANT WITH CRESAP, MCCORMACK AND PAGET.

■ PETER IMPERIALE FORMERLY DIRECTED XEROX CORP.'S VENTURE CAPITAL PROGRAM. HE HAS ALSO BEEN A VICE PRESIDENT FOR WARBURG PARIBAS AND BECKER, AN INVESTMENT BANKING FIRM.

Now, the venture industry is returning to the fundamentals. Venture capitalists still bet on people, on technologies with the potential to fundamentally change how we work, on companies with the ability to lead their markets, and on industries where we can add value and see substantial growth. The major difference between today's solutions and those of 20 years ago lies in today's realities.

One of the most significant new realities is the global economy. No longer can a new venture become a major company by first leading in the U. S. and then following a few years later with beachheads in Asia and Europe. Momenta Corp., a next-generation personal computer company in which Nazem and Co. became the lead investor in September 1989, illustrates the approach we believe will be needed for the coming years. Momenta will be operating in the U. S., Europe, Japan, Taiwan, and Singapore when it debuts its first product. This will give Momenta the ability to raise capital where conditions are most promising. Each region will provide what it does best: U. S. engineers will do product definition and systems architecture; Japanese manufacturers will provide components, packaging, and initial fabrication; European designers will handle styling and ergonomics; and Taiwanese and Singaporean companies will undertake volume production.

Equally important is the ability to fund growth. In the past, venture capitalists invested money to bring a company's first product to market, confident that the initial public offering would pay for the cost of building a sales and marketing organization. But IPOs are no longer a predictable source of funding, and recent valuations have not matched those of the past. This has led some venture capital firms to fund new enterprises by utilizing global financial markets.

Momenta, for example, plans to help forge a new market. The company is building a next-generation personal computer, one that doesn't require a keyboard. From a financial perspective, its global strategy will allow Momenta to raise capital in Taiwan or Singapore, or wherever rates and valuations are most favorable.

Another significant development is

the concept of simultaneous upstream and downstream investment—what we call a value-added buyout. VBOs are critical to how we at Nazem and Co. view the future of venture capital groups. As venture capitalists, we will continue to invest in startups, but to those we will add VBOs.

The characteristics of good VBO candidates include their market share and critical mass, and the existence of end markets with strong underlying potential growth. VBO candidates are substantial players in their industries, but not necessarily the top players. Good candidates are fully developed, with established sales, marketing, service, manufacturing, and engineering resources—all strategic assets that are capital- and time-intensive.

Tegal Corp., a semiconductor manufacturing equipment company, is an investment of ours that fits this profile. Nazem, in conjunction with Tegal's management, recently purchased the company from Motorola Inc., where it had been a subsidiary.

VBO candidates frequently are nonessential subsidiaries of larger enterprises. These "stepchildren" often have underperformed the market leaders and can be acquired at attractive prices. What characterizes them is an underlying growth potential. We choose a VBO when we see a clear-cut strategy to convert the company into a growth company, capable of assuming leadership in its industry.

To that end, we recognize the need also to make seed-stage investments in complementary technologies. For example, Metrologix, another Nazem investment, was formed to develop a next-generation semiconductor inspection system, which will be sold through the same channels of distribution as Tegal's products. Nazem and Tegal together are seeking other acquisitions to enhance the company's product lines and technologies.

Before proceeding with a buyout, we ensure that the VBO candidate shares our long-term strategy for growth. The buyout investment path is strewn with the results of the other kind of buyout, where hostile takeovers have resulted in the turnover of entire management teams, and, ultimately, poor performance.

Our approach is based on a partnership, a shared vision on the part of a venture capital firm and the company's senior management. Often, the venture capital company will sponsor a management effort to buy out a company.

As long-time venture capitalists, we will never tire of creating new companies from ideas. But the realities of the 1990s create a different set of challenges—and opportunities—for which we feel venture capitalists are especially well suited.

Building growth companies from seed stage to maturity is increasingly difficult and costly. It requires a global strategy. In many industries, equity capital for the product-development stage represents only a small portion of the total capital needed to finance companies through the market-development stage and beyond.

Initial public offerings previously served as a major source of capital for companies at the market-development stage. But today, and perhaps for the foreseeable future, the market for initial public offerings is not as available or attractive a source of capital as it was in years past.

VBOs can be used as a channel for new products and technologies at a far lower cost than it would take a new company to build that kind of infrastructure on its own. This is particularly true in the emerging global economy, where the cost of establishing and building an international sales presence is immense.

Venture capitalists are ideally suited to recognize and evaluate possible new products and technologies, to make parallel investments, or to acquire new product lines. They understand how to build companies and are well positioned to help an "underperforming" company reposition itself for growth, to understand how to raise a company's sights (as well as its prospects), and to augment and build a management team that is capable of carrying out its envisioned plan.

For those of us who have had the privilege of being involved with the electronics industry since its inception, the fundamentals have not changed—only the realities are new. The electronics industry, and with it the venture capital industry, has gotten older and (we'd like to think) wiser. But regardless of the challenges and the risks, the opportunities are still there. ■

THE BACK PAGES

PRESIDENT CARTER AND HIS MULTITUDE OF CHALLENGERS ARE NOT FALLING ALL OVER THEMSELVES TO EXPLAIN TO THEIR FELLOW AMERICANS WHY SILICON MAY HAVE AS IMPORTANT A ROLE IN THE ECONOMY AS GRAIN SALES TO THE SOVIETS. ILLINOIS SEN. ADLAI STEVENSON WAS THE ONLY LEGISLATOR TO TURN OUT FOR MID-JANUARY HEARINGS THAT SEEK TO SHAPE A NATIONAL POLICY ON TRADE IN ELECTRONICS AND OTHER HIGH TECHNOLOGIES. "ISSUES LIKE THESE UNFORTUNATELY LACK THE SEX APPEAL OF AN EMBARGO ON GRAIN SALES TO RUSSIA," SAID ONE STEVENSON STAFFER, "AND NEVER GET BROAD MEDIA COVERAGE."

ELECTRONICS, JAN. 31, 1980

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CIRCLE 251

ELECTRONICS STOCKS ARE SHOWING SIGNS OF LIFE AFTER A DISMAL 1985-90 PERFORMANCE

Happy Days Again?

BY MARK PARR

In the early 1980s, owning electronics stocks was almost like being in heaven. Computer and component stocks doubled, tripled, split, and then doubled again between 1980 and the end of 1983. The advent of the personal computer and the Reagan Administration's defense buildup were the primary forces driving this surge.

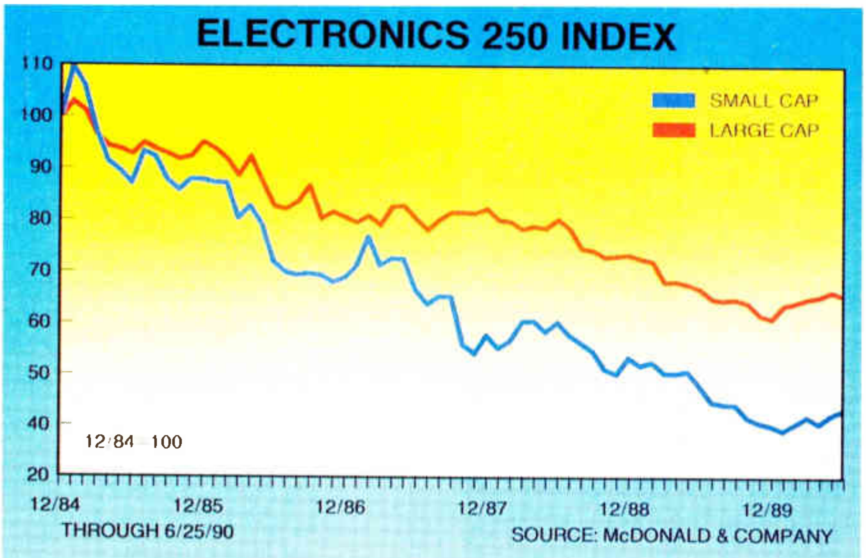
However, the euphoria of the early 1980s turned into the most severe recession ever seen in electronics. Stocks began a tailspin in 1983 that few have recovered from to this day. Several factors contributed to this slide, including an unsustainable outlook for PC growth, successful Far Eastern competition in commodity chips, a maturing computer hardware market, the dramatic slowdown in defense spending growth, and a slowdown in capital spending for communications equipment. There are signs, though, that better days are ahead.

One of the main reasons for the relatively lackluster stock performance of the past few years will surprise technologists.

MARK PARR

VICE PRESIDENT
McDONALD & CO.

■ AN ANALYST FOR THE CLEVELAND-BASED INVESTMENT FIRM McDONALD & CO., MARK PARR HAS BEEN FOLLOWING ELECTRONICS-INDUSTRY COMPONENT AND DISTRIBUTION COMPANIES FOR MORE THAN EIGHT YEARS. HE PREPARES THE MONTHLY *ELECTRONICS* INDEX, A STATISTICAL UPDATE OF THE INDUSTRY.



Large-cap companies (those with $500 million or more in capitalization) have done slightly better since 1984 than their small-cap brethren.

They view the migration from mainframes to the desktop as desirable and inevitable progress. But financial analysts believe distributed computing makes it difficult for the computer companies to maintain historical earnings growth. The reason: the commodity nature of margins associated with large, proprietary systems that locked a customer into a single brand. Further, software advances began to significantly lag hardware computing capabilities, making it unnecessary to grab each new increment of computing power as it became available.

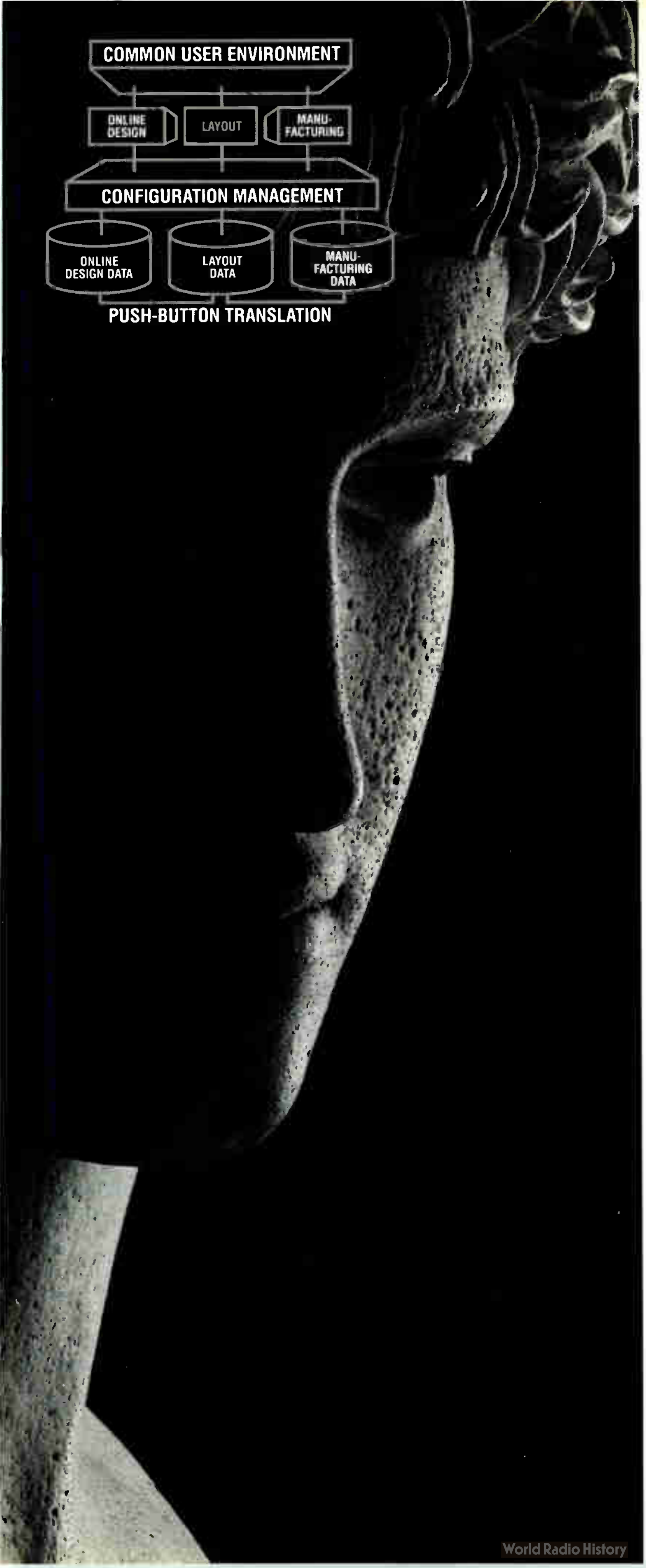
Several additional factors created even more pain for smaller electronics stocks. A booming hostile-takeover environment marked by highly leveraged transactions created a structural change in how investors viewed value. As traditional money managers found themselves increasingly playing the takeover game in stock selection, the need for liquidity to move in and out of stocks quickly increased dramatically. Concurrently, a strong demand for "index funds" of all sorts further increased the disparity between small and large companies.

The result: it was difficult to make money by investing in electronics between 1985 and 1990. With the exception of the larger communication-equipment companies (market capitalization over $500 million), virtually every major category dramatically underperformed the stock market over this period.

As we enter the new decade, several factors suggest that a new beginning is under way. The hostile-takeover phenomenon has waned in concert with increasing scrutiny of bank lending practices and the demise of the company that created junk bond financing, Drexel Burnham Lambert. This alone is allowing investors to return to more traditional ways of determining the value of individual stocks. Also, just as the PC and the Reagan defense buildup drove up demand in the early 1980s, we are once again seeing dynamic growth in new markets.

In particular, automotive electronics is finally coming of age. Ten years ago, the average car housed a paltry $50 in electronic content. Today, the number is closer to $500, suggesting a worldwide market greater than $15 billion. This market is growing at 15% annually even though car production will grow at only

(Continued on p. 154)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Quality: Hamilton/Avnet's Never-ending Process of Understanding Customers' Expectations

—Guy Hayden
Vice President & Director
of Quality Assurance

Unlike other distributors, Hamilton/Avnet believes that quality is not just the manufacturers' responsibility. The company credits this distinction to its employees—people who have made a commitment to quality and sustained a dedication to service.

Guy Hayden, vice president and director of quality assurance, is one of these people.

Q: What sets Hamilton/Avnet apart from other distributors?

At Hamilton/Avnet, we are constantly finding new, innovative ways to increase the quality of our products and services.

In fact, just last year we held our first annual, supplier quality conference to strengthen communications with our suppliers and improve customer service. The event was subsequently termed by Electronic Buyers' News as, "one of the top distribution events of 1989."

Q: How has this commitment to quality been implemented?

Quality has always been a tradition at Hamilton/Avnet. In fact, since our inception over 30 years ago, the company has maintained a quality control department.

We were also the first national distributor to earn Intel's certification of our value-added distribution center—a hard earned effort that we are very proud of.

We're now in the process of implementing a company-wide quality management program to further improve quality in every facet of our business.

At Hamilton/Avnet, we're working to provide superior products and service. For details, call toll free, ***1 (800) 442-6458.***

Hamilton Avnet
ELECTRONICS
AN AVNET COMPANY
People Dedicated to Service. Committed to Quality

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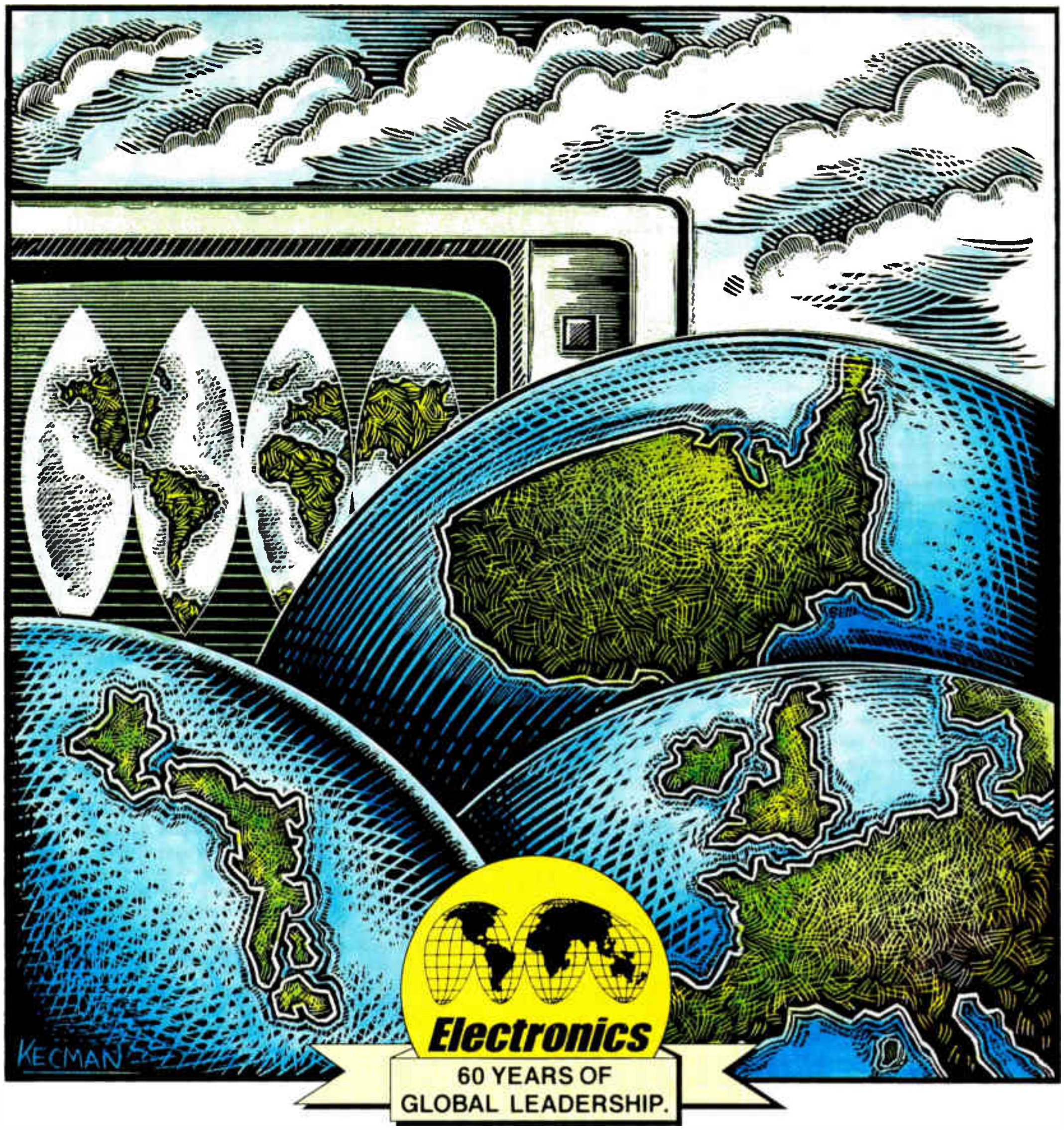

ONE WORLD, ONE INDUSTRY

THE LAST DECADE OF THE 20TH CENTURY WILL SEE THE GLOBALIZATION OF THE ELECTRONICS INDUSTRY ACCELERATE, WITH THE APPEARANCE ON THE SCENE OF A UNITED EUROPE PROVIDING MORE FUEL FOR THE PROCESS.

BUT THE BIG QUESTIONS FOR COMPANIES IN THE U. S. AND JAPAN WILL STILL CENTER ON THE STRUGGLE FOR TECHNOLOGICAL SUPREMACY AND DOMINATION OF MARKETS THROUGHOUT THE WORLD.

Making Technology Work for People

'TECHNOLOGY EXISTS TO INCREASE THE HAPPINESS OF ALL MANKIND; ELECTRONICS IS NO EXCEPTION' BY AKIO TANII

In front of Matsushita Electric headquarters in Osaka, Japan, stand the busts of 10 famous scientists and engineers. In the center of the group, in the highest position, is the full-size statue of Thomas A. Edison, holding an incandescent lightbulb in his hand. In the first issue of *Electronics* in April 1930, Edison was asked how vacuum tubes would best serve humanity. "The applications are almost infinite for these kinds of tubes," he responded. "They open a field for research in physics, chemistry, electricity, heat and light, beyond imagination."

If we substitute the word "electronics" for "tubes" in Edison's quote, his words describe perfectly how our industry will develop in the 1990s and into the next century. It's a tribute to the foresight of *Electronics* that 60 years ago, your pages carried such durable and insightful comments by the father of the electronics industry.

The electronics industry has undergone remarkable development in the past 60 years. Its progress has been a product of a continuous stream of technological innovation and breakthroughs. In particular, recent years have seen technological innovation and progress at an increasingly rapid rate, from basic technology, materials, and components to the array of finished products that incorporate these devices. There has been nothing but impressive progress. And I believe that these developments have done more than a little to improve the lives of people from all over the world.

When we consider the exciting and historic changes that took place on the world stage last year, it's clear that electronic products played both direct and indirect roles. For example, it's safe to say the very recent peaceful revolutions that occurred in Eastern Europe were due, in part, to the role of television. The information that is conveyed through television and video media clearly has an impact on social change.

As we enter the 1990s, I believe this technological revolution will become even more pronounced and more dynamic. We'll see progress in microelectronics in the form of greater-density of integrated circuits, more digitalization, and, very definitely, more information-intensive features in products.

In addition, people's living standards will continue to improve, as consumer tastes for home electronics products diversify. In response to this change in consumer tastes, engineers will rapidly develop a wider variety of products that are more intelligent and organized into larger product systems.

At present, information and communications technologies are mostly applied in the office and on the factory floor. However, in the 1990s, these technologies will be incorporated in products for the average person in the home as well.

Even today, computers, for all their promise, leave something to be desired in terms of ease of operation for the general user. But further development of these technologies will hasten the arrival of information-processing equipment that is both easier to use and more closely matches human thinking processes.

This process will not be limited to information-processing equipment alone. Home appliances and other electronics products as well as industrial electronics will also be designed with the user interface as the first priority, opening the way for the evolution of a more human-oriented work and home environment.

I believe that our goals must include the making of products that will contribute to the development of culture and society throughout the world. This doesn't mean technology for technology's sake, but rather development that will lead to technologies that are easy for people to use. This is in accord with the fundamental thinking of Matsushita Electric, the very basis on which the company founded by the late Konosuke Matsushita in 1918 has succeeded over the years. Matsushita,

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AKIO TANII

PRESIDENT
MATSUSHITA ELECTRIC INDUSTRIAL CO.

■ TANII, 62, HAS BEEN WITH MATSUSHITA SINCE 1956. IN 1966 HE WAS NAMED FACTORY MANAGER IN THE TAPE RECORDER DIVISION, BECOMING DIRECTOR OF THE DIVISION IN 1970. HE WAS NAMED COMPANY PRESIDENT IN 1986. HE WAS CHAIRMAN OF THE ELECTRONIC INUSTRIES ASSOCIATION OF JAPAN LAST YEAR.

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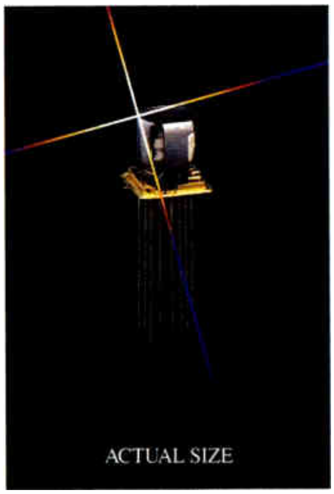

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CIRCLE 191

who died last year, inspired our company motto: "Human electronics."

Along with progress in technological innovation, the electronics business has achieved a global scale. And those who are the final beneficiaries of the progress made in electronics, the customers, continue to increase in number around the world.

In order for the industry to develop further, healthy competition is necessary. At the same time, looking at events around the world, we seem to be entering a period of cooperation and harmony. This harmony, too, will be an essential element for progress in the future.

Technology exists to increase the happiness of all mankind, and electronics is no exception to the rule. In order to realize its potential to contribute to humanity, it is necessary that the electronics industry, too, progress with harmony and cooperation. ■

THE BACK PAGES

WORLDWIDE EXPORTS OF INTEGRATED CIRCUITS FROM JAPAN WILL EXCEED IMPORTS FOR THE FIRST TIME IN 1979. . . . DURING THE FIRST 11 MONTHS OF THE YEAR, JAPAN EXPORTED $402.7 MILLION WORTH OF DEVICES WHILE IMPORTING $381.8 MILLION WORTH.
ELECTRONICS, JAN. 17, 1980

THE DESIGN OF 64-K DYNAMIC RAMS GOT OFF TO AN EARLY START IN JAPAN, THROUGH AN ADJUNCT PROGRAM OF ITS RECENTLY CONCLUDED FOUR-YEAR, GOVERNMENT-SPONSORED PROGRAM FOR RESEARCH AND DEVELOPMENT OF VERY LARGE-SCALE INTEGRATION. BUT AT PRESENT THE JAPANESE APPEAR NO CLOSER THAN U. S. CHIP MAKERS TO VOLUME PRODUCTION OF 64-K RAMs.
ELECTRONICS, MAY 22, 1980

INTEGRATING COMPUTERS AND COMMUNICATIONS WILL REMAIN A MAJOR CHALLENGE

The Crucial Link

BY TADAHIRO SEKIMOTO

The progress of electronics technology in recent years has been truly remarkable, led by the integration of computers and communications. NEC Corp. advocated that technological trend with its C&C concept back in 1977. Since then, C&C has not remained simply a concept, but has materialized into a broad range of commercial systems for business applications and home uses.

Simply put, the progress in integrated circuits has been the key to the advancement of integrating computers and communications. And it is no exaggeration to say that the future progress of C&C hardware would depend largely upon the innovations in semiconductors and ICs that are still to come. Electronics manufacturers must step up research and development efforts in this field to meet the challenge of the coming decade.

Another factor that would bear growing importance in shaping the future of our industry is software. As we can see from the continuing shortage of software engineers in absolute numbers, the progress in software, as compared with that of hardware, is still not at all satisfactory.

Because it is software that determines the full realization of the potential of C&C systems, software development is of prime importance for systems suppliers. When a higher generation of C&C systems become available as a result of well-balanced progress in both hardware and software developments, we would be able to further expand the scope of our intelligent activities that characterize the nature of humankind. Software must become of prime importance in the electronics industry in the 1990s.

At the same time, as technology advances further toward the 21st century, technological cooperation beyond the boundaries of companies and nations becomes more and more important. I suggest that electronics manufacturers the world over share a spirit of another kind of C&C—"Competition & Cooperation"—and work together toward the development of a new frontier in technology. This competitive/cooperative strategy would be the way to bring about a future society full of human creativeness and intelligence. ■

TADAHIRO SEKIMOTO

PRESIDENT
NEC CORP.

■ SEKIMOTO, 64, JOINED NIPPON ELECTRIC CO. IN 1948 UPON HIS GRADUATION WITH A DEGREE IN PHYSICS FROM TOKYO UNIVERSITY—HE RECEIVED A DOCTORATE FROM THE SAME INSTITUTION IN 1962. IN 1965, AFTER BECOMING CHIEF OF THE BASIC RESEARCH DEPARTMENT IN THE COMMUNICATIONS LAB, HE JOINED COMSAT ON LOAN. IN 1967 HE RETURNED TO NEC AS HEAD OF THE COMMUNICATIONS LAB. IN 1972, SEKIMOTO WAS MADE GENERAL MANAGER OF THE TRANSMISSION DIVISION. HE BECAME A BOARD MEMBER IN 1974 AND PRESIDENT IN 1980. HE HAS BEEN HONORED BY THE JAPANESE EMPEROR AS WELL AS THE IEEE.

IT IS HOME TO 6 OF THE WORLD'S TOP 20 ELECTRONICS FIRMS AND WILL OWN 22% OF THE WORLD MARKET BY 1995

I Have Seen the Future, And It Is Europe

BY PASQUALE PISTORIO

Look at the future of the semiconductor sector from any point of view—geographic, industrial, or market—and you come up with the same picture: Europe, Europe, Europe. That's not to say that in every case Europe is going to dominate, but rather that the changing situation in Europe on all fronts will have a far greater significance on the world scene than we have experienced so far in the second half of this century.

Geographically, for instance, I do not believe that Europe can reach the same level as America or Japan. In fact,

PASQUALE PISTORIO

PRESIDENT AND CEO SGS-THOMSON MICROELECTRONICS GROUP

■ PISTORIO JOINED MOTOROLA INC. IN 1967, BECOMING DIRECTOR OF WORLD MARKETING. HE RETURNED TO ITALY AND SGS-THOMSON IN 1980.

I stick to what I publicly went on record as saying in November of last year: that is, the American industry, reacting to the pressures created by current Japanese dominance, will somehow regain its primacy. Of course, the Japanese will remain close on the U. S. industry's heels. I also see no reason to alter my view of the Korean potential—they will continue an intensive campaign to win greater market share but will remain in a distant fourth place on the world scene.

And Europe—well, it is here that things have changed notably in the short time since last November, above all in the way Europe perceives itself. There is a new realism and awareness in Europe that it has the infrastructure to play a much more decisive role on the world scene.

Today, in terms of electronics sales, Europe has six out of the world's top 20 companies—exactly as many as the Japanese. What's more, Europe is all the time becoming more able to serve its industry from its own resources.

Less than a decade ago, for example, Europe could not supply even 3% of its own memory requirements. Today it could, if required, meet 30% of its needs in DRAMs, 45% in SRAMS, and 48% in EPROMS. This on top of near self-sufficiency in important sectors like ICs for telecoms, power transistors, and consumer ICs.

And this is growth within a European market that is in itself taking a more realistic share of the overall world market. It is now confidently predicted that Europe will represent 22% of the total world market by 1995.

Of course, everyone is still forecasting that the world market as a whole will continue to grow, and, despite its now well-established cyclical nature, at a fast rate. So much so that our market analysis group is predicting that growth will be even better than what we have already seen in the 40 years or so since the birth of the transistor.

And life, as we all know, only begins at 40, especially, I believe, for the microelectronics sector.

Up to now, the industry has seen an average annual growth of 15%, which is certainly exceptional and which many experts have predicted is no longer sustainable. We see things differently. In fact, SGS-Thomson is confidently forecasting a compound market growth of 17% for the decade ending in 1992. And longer-term predictions are still positive, at least up to the end of the century.

With the continuing needs of the electronics industry, in particular of the personal computer industry, plus the explosion of mobile communications—cellular radio, for example—and the complete replacement of technologies and goods in the consumer sector (high-definition TV is just the tip of the iceberg), the industry is clearly going to have the diet and exercise it needs to stay healthy.

However, beyond these, relatively undeveloped sectors—especially in areas like machine tools, automotive, and domestic electronics—will provide the solid driving forces to power the semiconductor industry forward and to maintain, and even better, the high growth of its first four decades.

And, of course, Europe is better poised than most to take advantage of all these situations—the Eastern bloc potential in color TVs is just one example. There are right here on our continent 138 million new consumers (not counting the USSR) who don't have, in 90% of cases, a single television. And they're not all broke, either: the East Germans have seen their salaries increase by a factor of five overnight. That has also been the case with their savings, 170 billion Eastern marks.

Finally, from an industrial point of view, the trend will continue toward concentration and polarization. As a result of this, we will see at one extreme a small select group of broad-range worldwide companies, each with more than 5% share and together probably accounting for up to 80% of the total market. At the other end of the scale will be the 100 or so small companies, each with a market share of less than 0.5% and each serving a specific market niche. It will, at the same time, become very difficult for any company to create a stable position in the middle ground.

Here too, Europe is becoming a mover and shaker as its semiconductor manufacturers concentrate and move nearer to critical mass. In 1983 Europe did not have a single billion-dollar company; in fact, the first three together didn't even total $1.5 billion. Today the three top Europeans are well over a billion dollars each and two out of the top three are growing much faster than the market as a whole.

What's more, through pan-European projects like Jessi, these manufacturers are working closer together and forming technology and production alliances that are bringing them even further toward the super league. ∎

Europe Takes the Lead

BY ANDREW ROSENBAUM

With semiconductor sales slowing in the U. S., "Europe appears to be taking the leadership in terms of usage and growth in semiconductors," Carlo Longoni says. The SGS-Thomson Microelectronics board member points to Dataquest Inc. figures for the fourth quarter of 1989 and the first quarter of 1990 that show the U. S. at -2.5% in that period, with Europe growing at an 8% rate.

Longoni thinks that it is Europe's better industrial picture that accounts for the faster growth. "The American market for semiconductors is highly dependent on the computer industry, and that industry is slowing today," Longoni says. "Europe's industry is more oriented to a variety of industrial uses, like automobiles and telecommunications."

Because the European market provides such a strong environment for semicustom chips, SGS-Thomson has formed a separate semicustom subsidiary, called IST, based in Agrate Brianza, Italy, at the company headquarters. IST's semicustom chips are sold via the SGS-Thomson design centers, located in most major cities.

"These provide real-time contact for the client, and he can communicate his needs directly," says Longoni. "The design centers have been an effective marketing tool," he adds.

Of course, SGS-Thomson's presence in every European country makes a difference. "I believe we have an advantage in our familiarity with the European customer. That, combined with our local presence, enables us to get to know the customers' problems."

This is not duplicated in the U. S., says Longoni. "There is less customer differentiation. America has good concentration on computing and related equipment. Then there is telecom, but there is also AT&T. There is automotive, but the American automakers typically have their own production. There is military, but it is small. In Europe the spread is bigger; we have smaller companies but the differentiation for the customer is greater. Even the telecom market has different standards for each country. This forces us to be more flexible mentally, and we have to satisfy the customer with smaller quantities."

With all these advantages that Longoni perceives in Europe, what is the major difficulty of working there? "Language," says Longoni. ∎

CARLO LONGONI

BOARD MEMBER
SGS-THOMSON

■ IN ADDITION TO SERVING ON THE BOARD SINCE 1982, LONGONI IS VICE PRESIDENT FOR STRATEGIC MARKETING AND MARKETING AND SALES DIRECTOR, EUROPEAN REGION.

THE VIEW FROM PHILIPS IS OF A UNITED EUROPE THAT WILL PROVIDE MORE POWERFUL AMMUNITION TO COUNTER JAPANESE COMPANIES

Unfamiliar Markets And a Familiar Foe

BY JOHN GOSCH

As do their European counterparts, top executives at Philips International NV in Eindhoven, the Netherlands, focus on the Japanese incursion into European markets when they look at the next decade. Agreeing that the unified, barriers-free European Community and the new East European markets will stimulate future business, Hans P. Maas Geesteranus, deputy director in Philips's Corporate Regional Bureau, notes that "what will also affect us is the increasing influence of Japan in Europe."

However, the single-market EC, or Europe '92, will not only pep up economic activities, it will give the Europeans the opportunity to counter the Japanese more effectively, says Maas Geesteranus, who is also responsible for West European affairs. "If we do a proper job, then their influence can be made to decline" because of the greater economic entities that Europe '92 fosters.

Actually, technology is already getting a boost from EC-wide research and precompetitive development projects such as the European Strategic Program for Research and Development in Information Technologies (Esprit), the Joint European Submicron Silicon Initiative (Jessi), and the Basic Research in Industrial Technologies (Brite) program. A unified EC could bring firms closer together to work in such programs.

In many ways, doing business in a single-market EC with more than 320 million consumers will be easier than in a fragmented Europe, the Philips executive points out. That's because the Continent will be one with no trade barriers between countries, with mutually recognized industry standards—a region with harmonized value-added taxes and where goods and capital move freely across national borders.

Industry observers see the single-market lifting annual growth in electronics one to two percentage points above that for a divided West Europe. The spurt will come not only because of higher demand but also because the industry will have larger, more efficient production units with greater economies of scale than today.

As do their counterparts at other European companies, executives at Philips emphasize that outsiders need not fear a move toward protectionism, unjustified duties on non-EC goods, restrictions on foreign assembly plants, or, in short, a "Fortress Europe" impenetrable to foreigners. That isn't going to happen in light of most EC countries' strong exports to overseas markets. Protectionism and trade restrictions would only backfire. "Fair trade practices must be kept up," Maas Geesteranus says. "The EC simply must remain open to the whole world."

As for East Europe, just how much of a factor that region will be in 10 years "is a big question," says Ad van der Scheer, director of Philips's Corporate Regional Bureau East. "It's difficult to give general statements on East Europe as a whole because each country, or group of countries, will develop as an electronics market at a different pace," he says.

In analyzing the East, van der Scheer divides that area into four subregions: East Germany; central east Europe (Poland, Czechoslovakia, and Hungary); the Soviet Union; and the group of Bulgaria, Romania, and Albania.

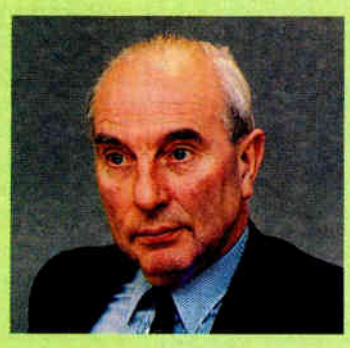
Considering East Germany first, the Philips director says that country "will go faster than the rest because it is almost part of West Germany." In fact, it is likely that unification could occur before the end of this year. Integrated into West Germany, what is now East Germany will soon be part of the EC and hence an open market just like other West European countries.

Next in the market development race are Poland, Czechoslovakia, and Hungary. "Being more or less democratically governed, their associations with the EC are closer than those of the remaining countries in the East," van der Scheer says. "Closer ties will promote trade and cooperation [with West European companies] as well as the flow of capital."

For its part, "the Soviet Union is hidden in a big cloud of dust," says van der Scheer. He hints that its market development depends on how fast—or whether—perestroika succeeds. Even in the face of this uncertainty, Philips is already seeking a working relationship with the Soviet Union on the theory that the foundation must be dug first.

As for the last group, Bulgaria, Romania, and Albania, "prospects of big business with these countries are more

HANS P. MAAS GEESTERANUS



DEPUTY DIRECTOR, CORPORATE REGIONAL BUREAU PHILIPS INTERNATIONAL NV

■ MAAS GEESTERANUS STARTED HIS CAREER AT PHILIPS IN 1958. AS THE DEPUTY DIRECTOR OF THE CORPORATE REGIONAL BUREAU, HIS AREA OF CONCERN IS WEST EUROPEAN AFFAIRS.

remote," the Philips executive observes. Aid from the West has not yet been formalized as Bulgaria, even after the June elections, has essentially remained a Communist country, Romania is plagued by internal tensions, and Albania's opening to the outside world is proceeding at a snail's pace.

Van der Scheer notes that the rate of the East's market development depends on how the countries develop politically. Once closer ties are established with the West, East European countries could turn into interesting markets and eventually become valuable partners capable of supplying high-quality parts and equipment to Western systems houses.

"They could even become competitors in some fields," van der Scheer predicts. But this competition would be limited, at least initially, to low-end standard parts such as passive devices like resistors and capacitors. In light bulbs, one of Philips's strengths, Hungary already is a competitor.

Among the resources Philips is devoting to seeding East European markets are time and perseverance. Patiently nurturing these markets for many years has led to sales exceeding $150 million so far for the Dutch company.

AD VAN DER SCHEER

DIRECTOR, REGIONAL BUREAU EAST PHILIPS INTERNATIONAL NV

■ VAN DER SCHEER JOINED PHILIPS IN 1960. IN 1988 HE TOOK OVER THE BUREAU OF SPECIAL REGIONS. HE COORDINATES EAST EUROPEAN ACTIVITIES.

By itself, that's not much. But business could jump substantially as a result of the ongoing policy of granting licenses, conducting management training courses, and investing in sales outlets and distribution networks in the East [*Electronics*, April 1990, p. 47]. ■

IT'S TIME TO USE ALL THE COMPUTING POWER TO CREATE NEW APPLICATIONS

Information Is the Key

BY ANDREW ROSENBAUM

For Bruno Lamborghini, the future of the European information technology industry is in the development of new applications, and the creation of new pan-European markets.

"We need a jump in the use of information technology," says Lamborghini, research and strategy director of Ing. C. Olivetti & Co. SpA and the current president of Eurobit, the European association of hardware producers. "We still use information technology almost entirely for traditional jobs, just as we originally did. We need to develop new applications to increase production, to improve the quality of education—there are many new market areas that we have not yet entered into. Now that there is plenty of computing power around for everyone, it is time we started putting information technology to work."

In Europe, Lamborghini sees the creation of pan-European markets as the principal forum for these new developments. "Europe '92 is the major factor. Eurobit hopes that the European Commission will someday take the role of [the Ministry of International Trade and

Industry] in Japan; information technology should coordinate and determine all industrial policy. The development of the Esprit research programs is a good first step, but there is much more to be done. Esprit and the other EC programs, while they have no major tangible results, have at least brought the various national industries into cooperative agreements, enabling them to surpass the fragmentary nationalistic attitudes."

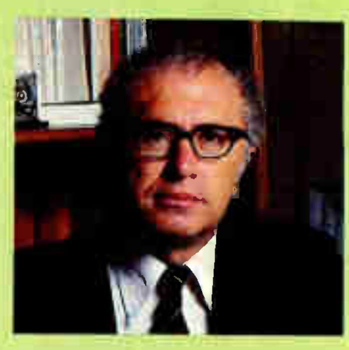
Were the EC able to take on a coordinating role, Lamborghini thinks, there is a great deal of work to be done. "We have strongly supported the efforts of the Commission to develop new programs in order to utilize information technology. A good example is the so-called 'European nervous system.' This is an attempt to create trans-European networks, telematic links among the administrations of different nations. In this way, the 12 different social security systems, the customs, the police, the fiscal administrations, could all be in real-time communication.

"When border controls, for example, are eliminated, the police of Scotland should be able to have access to a pan-European data bank that provides information on people who come in from the Continent. Customs procedures should become automatic. People who move from one country to another should be able to retain their social security contributions. It's easy to see the important opportunities that this process should present for the information technology industry."

Apart from the new markets created by public procurement, Lamborghini thinks that Europe can count on a generally brighter market picture than that of the U.S. "The U.S. market is saturated with all kinds of hardware. This explains why U.S. revenue growth is down to about 8.2%, as opposed to 12% in Europe.

"American industry will restructure,

BRUNO LAMBORGHINI



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just as ours is restructuring," continues Lamborghini. "But eventually, I think that the U. S. will have to adopt the kind of 'local content' requirements that Europe has recently put into place."

Lamborghini, who was instrumental in negotiating the recent European semiconductor floor-price agreement with Japan, believes that defense of the marketplace is essential. "Europe is a case in point," he adds. "We depend on the U. S. for 90% of our microprocessor requirements, while 90% of our memory requirements are fulfilled from Japan. I am convinced that Europe will regain some of its advantages in these areas through Jessi [the Joint European Silicon Structures Initiative] and by concerted trade policy.

"While the floor-price agreement with the Japanese has some disadvantages," he says, "it does show that Europe can negotiate effectively. It is stimulating some Japanese companies to think about the best way to sell in Europe. Often it pushes them to invest. That way we can count on local resources, even if they are controlled by Japanese or U. S. companies." ■

TRANSATLANTIC ALLIANCE WOULD PARCEL OUT R&D TO PREVENT DUPLICATION OF EFFORTS

Needed: Chip NATO

BY JOHN GOSCH

To Anton Peisl, a member of the board of management at Siemens AG, the confrontation with Japan is a bigger issue than Europe '92 and the opening to the East. His views on how the other two world electronics regions, the U. S. and West Europe, should react to the Far East competition are rather unconventional.

Projects like Sematech and Jessi, the Joint European Submicron Silicon Initiative, "are setting good signs but they are far from adequate for keeping the Japanese at bay," says Peisl, who is responsible for political economics and international relations at Siemens. Instead of such national or continent-wide endeavors, what's needed is "nothing less than a transatlantic alliance in microelectronics," he says—something like the military's North Atlantic Treaty Organization.

Such an alliance—it could be called NAMA, for North Atlantic Microelectronics Association—would link companies and institutions in Europe and North America. Heading it might be a general secretary or commission that would coordinate development work and prevent duplication. "We can no longer afford to have a number of companies developing the same thing, such as 64-Mbit DRAMs," Peisl says.

An economist and a strong advocate of free enterprise, Peisl concedes that his proposal could be criticized as overmanagement. But at least during the R&D phase, there must be some sort of international control over what companies on both sides of the Atlantic are doing, he says. "Once a product is ready, free-market forces should take over again."

The Siemens executive arrived at his idea after analyzing past Japanese practices and current scenarios.

In a way, Peisl admires how the Japanese have reached their goal of dominance. The vehicle is "an optimum combination of personal commitment to a task, big R&D spending, long hours, diligence, and perseverance," he says. This is coupled with an industrial policy, carried out by MITI—the Ministry of International Trade and Industry—that prevents wasted effort, narrowly focuses R&D expenditures, distributes risks and, in the end, achieves the best results.

This policy has led to Japan's superiority in many component sectors, particularly memories. The upshot: much equipment in use around the world today depends on crucial Japanese-made parts. "Such dependence is risky," Peisl says. By limiting or cutting off the flow of microelectronic devices to equipment makers abroad and favoring customers at home, Japanese suppliers could easily choke off foreign competition and put their industry in a better position on world markets.

Faced with this risk, "we must ask ourselves what to do," the Siemens executive says. Appeals to the Japanese to play fair and open their home markets to outside firms have had little effect—only 4.5% of Japan's needs for electrical and electronic products is imported, and some of that small amount even comes from Japanese plants located abroad.

Peisl's answer: "We must fight force with counterforce, and our weapon must be technological excellence. Only that way can we break the Japanese dominance." The free-market system, he says, will hardly bring a jump in technological excellence, because the price is too high even for a large company—it takes hundreds of millions of dollars to put up a factory for a new generation of high-density memories. The Sematechs and Jessis aren't big enough.

This, then, takes Peisl to his "NATO-in-microelectronics" idea, an effort that would go even be-

ANTON PEISL

MEMBER, BOARD OF MANAGEMENT SIEMENS AG

■ PEISL JOINED SIEMENS IN 1955. IN 1976 HE BECAME HEAD OF THE DATA AND INFORMATION SYSTEMS DIVISION, AND IN 1977 WAS NAMED A FULL MEMBER OF THE MANAGEMENT BOARD.

yond the new IBM-Siemens 64-Mbit-DRAM development project. The new transatlantic, MITI-like organization would abide by a policy ensuring that development work is coordinated, waste of funds avoided, and duplication of effort prevented. "Controlled reason" are the words Peisl uses in this context. Only that will generate the technological excellence that he says is necessary to keep Japan from swallowing up more markets in country after country.

For all his concern over Japan, Peisl hasn't lost sight of the other issues challenging Europe these days. As for the pace of technology, he does not see it quickening much in a no-barriers Europe '92. "National borders haven't prevented technology from forging ahead," he says, hinting that advances in electronics are as much a result of ingenuity and technical I. Q. as of R&D capacity. Even if it doesn't accelerate technology, a single-market EC will at best help make up some lag Europe may have in certain fields.

This will come as a result of the economies of scale and the concentration of R&D money that it will afford. The absence of customs barriers and common legal, fiscal, and monetary policies as well as unified standards will foster cooperative deals, joint ventures, and bigger economic entities and manufacturing facilities. That, in turn, will bring about greater economies of scale in production; this should give companies better returns on investments and possibly more funds for R&D. These, then, could be focused on areas in which Europe lags.

Turning to the subject of East Europe, Peisl believes that companies in the West should help make that region more competitive on world markets. "It's with industrially advanced, rather than poor, countries that business and trade thrives best because they have the purchasing power to buy equipment made by other advanced countries," he says. ■

AS FAB COSTS RISE, SO WILL DEVICE PRICES, SAYS TOSHIBA'S CEO, JOICHI AOI

An Upward Spiral

BY JONAH McLEOD

■ ***In the past 10 years, the cost of an IC-fabrication facility has risen to $500 million. How will companies continue to advance technology and still achieve a reasonable return on investment?***

In response to this exploding cost, semiconductor manufacturers first have to make every effort to keep the cost down, and we are asking plant and equipment contractors for their cooperation. Despite these efforts, we think it is inevitable that the capital investment required for these advanced devices will increase as we proceed to the next generation of chips.

We expect that this increase in capital-investment requirements will lead to a growth in the amount of joint manufacturing and development tie-ups among semiconductor manufacturers. We also anticipate that the huge cost of investment and R&D will in turn lead to higher prices. Consequently, we wish to obtain the understanding of our customers when we set the price of the devices at their appropriate levels.

We believe that from now on it will become very difficult to maintain the trend of a reduced "bit price" for successive generations of memory devices. It used to be the case that the price of each successive generation of memory chips would slide down to the level of the previous generation, which essentially meant that the bit price of the new generation would be one-quarter that of the previous generation. However, in the future it will be difficult to continue to match the 25% bit-price trend of the past.

In spite of this challenging environment, semiconductors are an essential building block for the coming highly advanced and intelligent society. Therefore, we will consistently make large investments in advanced semiconductors to continue to meet our customers' needs. We will make our utmost effort to secure an appropriate level of profitability for the level of our investment.

How has the information-processing revolution changed society at large?

Up until now, computer systems such as computer-integrated manufacturing, office automation, and computer-aided engineering have been mainly used on an organizational level. However, information processing of personal activity within an organization is now being realized through the use of powerful, low-cost personal computers. This personalization in computers brings high intellectual productivity to a designer and/or an engineer in meeting the diversified requirements of customers for customized products.

In the past, computers handled only numerical data, and only a small number of experts could enjoy the benefits of computers. However, with the personalization of information processing, computers have to be usable by noncomputer experts and will eventually have to handle multimedia data, such as image and audio data. For example, technological advances in the human-machine interface such as audio response, handwritten data input, and graphical user interfaces on the display screen are expected.

JOICHI AOI

PRESIDENT AND CEO
TOSHIBA CORP.

JOICHI AOI JOINED TOSHIBA IN 1948 RIGHT OUT OF TOKYO UNIVERSITY. HE HAS MANAGED THE INDUSTRIAL ELECTRIC, HEAVY APPARATUS, AND NUCLEAR ENERGY OPERATIONS. HE WAS NAMED TO THE TOP POST IN 1987.

In the 21st century, cultural characteristics of human beings that a computer cannot handle, such as sensibility, emotion, and intelligence, will be highly appreciated more than ever.

What new technologies should companies invest in to remain competitive in the next decade?

To effectively respond to the advanced-information society of the 1990s, Toshiba is continuing to promote the restructuring of its businesses to shift resources to high-growth areas, such as information and communications systems and semiconductor/electronic devices. Consequently, the company will emphasize R&D in a number of key technologies. Among them are ultrascale integration, distributed parallel processing and neurocomputers, personal information systems such as personal workstations, broadband ISDN, fiber optics, superconductivity, HDTV, and large-size color LCD displays. We will also promote R&D into the human-machine interface. ■

THANKS TO MICROLITHOGRAPHY, CHIPS ARE 60 TIMES DENSER AND 10 TIMES FASTER THAN THE DEVICES OF A DECADE AGO

Making Life Better With Microelectronics

BY KAZUO KIMBARA

There are three aspects to the progress of civilization. The first is the development of capabilities that far exceed those with which humans are naturally endowed. The second is the realization of systems that ever more closely mimic human capabilities. The third is the creation of amenities that improve the overall quality of life.

Microelectronics is contributing to all three of these aspects. Computers offer processing power well beyond the realm of the human mind. Neurocomputers and robots with artificial intelligence hold the promise of some day approximating the thought processes of man. Consumer electronics provides immeasurable improvements in people's lives.

Compared with their counterparts of a decade ago, today's microelectronic devices pack 60 times as many components into the same area and operate 10 times faster. Both of these improvements are the direct result of advances in microlithography.

Hitachi, for its part, is moving vigorously ahead with the development and production of dynamic random-access memories and other high-capacity memories with even higher speeds and densities. At present, we are using 0.8-μm process technology for the production of 4-Mbit DRAMs and 1-Mbit static RAMs. Devices that use 0.3-μm features to attain huge capacities barely imaginable just a few years ago are expected to move into mass production by the turn of the century.

In bipolar devices, increases in device capacity are further aggravating the trade-offs between heat generation and switching speed. Fortunately, however, biCMOS technology provides a way to circumvent this dilemma. Hitachi is using it for volume production of

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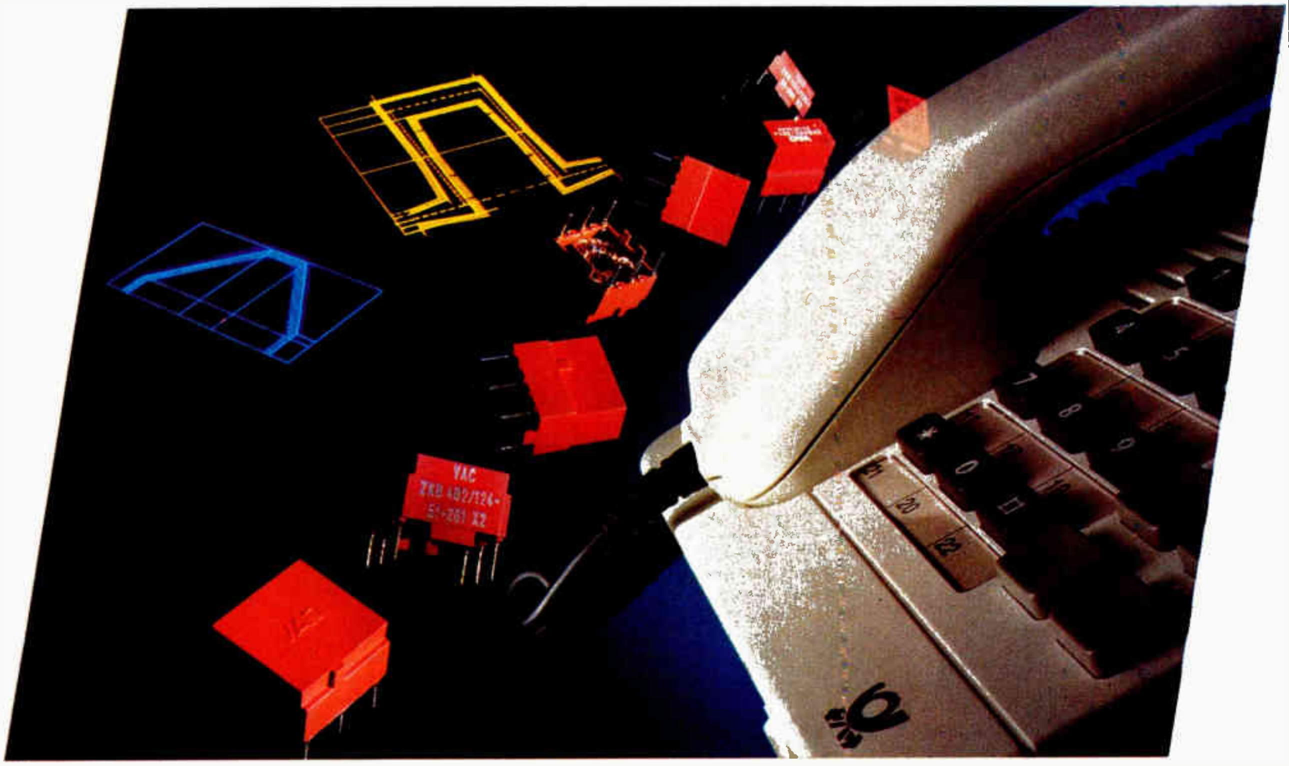

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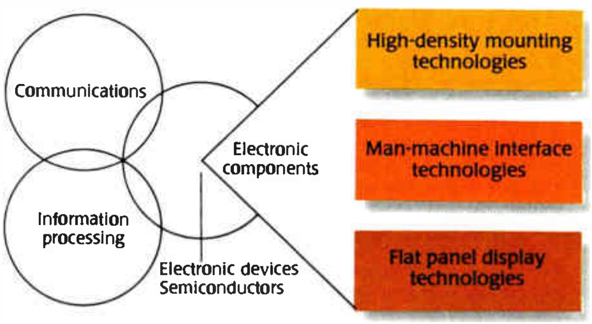

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While the operating speeds of today's chips already go far beyond human capabilities, the quest moves on toward still faster devices. For this, developers will have to look to nonsilicon materials. Hitachi is already pursuing aggressive research programs in connection with next-generation Josephson Junction and compound semiconductor devices. Using JJ devices, Hitachi's Central Research Laboratory recently developed a 4-bit processor with a gigahertz-class clock frequency that opens the way to a wide range of future possibilities.

Work is also progressing on ways to impart humanlike capabilities to various kinds of machines. Researchers at Hitachi are investigating such technologies as fuzzy control and neurochips, LSI devices modeled on the workings of the human brain.

Many new microelectronic devices have been introduced into consumer electronic equipment, leading to quantum performance improvements, particularly in telecommunications, facsimile transmissions, and audiovisual systems. Satellite communication is now benefiting from the use of GaAs 2-d microelectronic devices, while the best submarine cable systems employ semiconductor lasers. ■

ELECTRONICS IS THE LINCHPIN OF INDUSTRIAL HEALTH, SAYS A DUTCH EXECUTIVE

The Heart of the Matter

BY JONAH McLEOD

■ ***What is Europe's position in the world electronics market?***

Among the triad of Western Europe, the U. S., and Japan, Europe has the lowest consumption of electronic equipment as a percentage of gross domestic product. In addition, there exists a major imbalance of production and consumption of electronic products today, with Europe a net importer of electronic products. However, in the decade ahead, Europe will be determined in its policies and investments to even out this imbalance. Programs such as the Joint European Submicron Silicon Initiative are forerunners of others to come that will implement these necessary trends.

■ ***Why is it important to have a balance in the production and consumption of electronic products?***

There are three major trading blocs in the world today: the U. S., Europe, and Japan. Microelectronics is at the heart of all the other major industries—such as plastics, chemicals, and automotive—within these blocs. The bloc that controls microelectronics could eventually be able to control all the industries being driven. Each of these blocs wants a degree of independence in the strategic microelectronics technologies that advance all their other industries.

■ ***How will this type of balance be achieved?***

It must be achieved through balanced and equitable free trade. You have to have balance in critical technologies. The U. S. cannot be expected to produce all the grain and lumber for the rest of the world while Japan manufactures all the consumer electronics. This is what governments are trying to achieve through trade negotiations. At present, all the trading blocs are doing is building awareness of the problem. The U. S. and Japan are currently trying to achieve some form of a bilateral trade agreement that guarantees U. S. access to Japanese markets. However, because there are three trading blocs to be considered, there should be some form of trilateral discussion over balanced, equitable free trade. Europe, Japan, and the U. S. must be equal.

■ ***What other issues should be addressed in the trade debate among the three blocs?***

The other side of the trade imbalance to be considered is who has strategic control over end markets. Japan controls a large portion of the consumer electronics market—with a focus now on the emerging giant that is the home electronics market—at the same time that it's moving aggressively to control the computer and telecommunications markets.

The three individual trading blocs must decide to what extent one of them could control whole markets, and what markets are vital to each bloc. ■

ARTHUR H. DEL PRADO

PRESIDENT
ASM INTERNATIONAL NV

■ ARTHUR DEL PRADO FOUNDED ASM, A DUTCH MANUFACTURER OF CHIP-MAKING EQUIPMENT, IN 1968. TRAINED AS A CHEMICAL ENGINEER, HE HAS MORE THAN 25 YEARS IN THE CHIP BUSINESS.

ONE WORLD, ONE INDUSTRY

COMPUTING WILL GO ALMOST UNIVERSALLY PARALLEL

'A Colossal Leap'

BY PETER FLETCHER

Over the last 30 years, Sir Clive Sinclair has displayed an unrivaled talent for spotting new mass-market niches as well as devising ways of adapting leading-edge technologies to make his products perform better and at a lower price than rivals'. His pioneering calculators, audio equipment, and computers have stamped him as a visionary.

Now, a look into his crystal ball convinces Sir Clive that the dominant technology of the immediate future will be parallel computing. "Parallel processing is not a specialized business any longer," he says. "It is the future of all computing. Computing will go universally parallel in a few years—with dramatic results.

"There is going to be an absolutely colossal leap in the performance of computers in the next 20 years, because we suddenly have the most extraordinary combination of advances. There has been a step function in the speed at which processor chips can operate, while at the same time people are learning how to apply parallelism. Put the two developments together and we are going to see computers increasing in power by several orders of magnitude.

"In the past, most of the silicon was used for memory. Historically, memory has been cheaper per square meter than processing. But now that it's all silicon it all costs pretty much the same, so a sensible approach will be to have a larger proportion dedicated to processing power—then we will get machines that are stunning in performance compared with today's." We must also radically alter our way of perceiving computers, according to Sir Clive. "We must dispense with the past and start again. We should stop thinking of computers as pure machines and start with what we want them to do for us and work back from there. That's where I started. My goal is machines that behave intelligently." ■

CLIVE SINCLAIR

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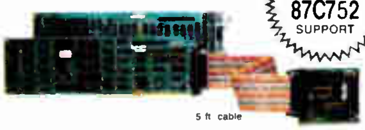

8051

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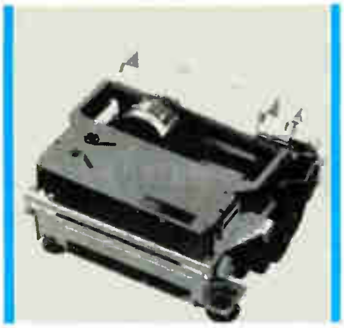

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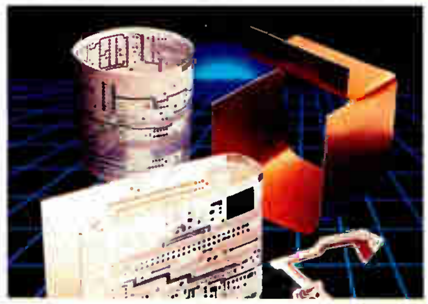

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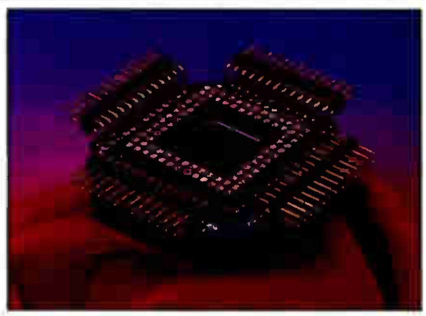

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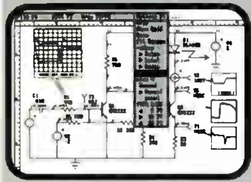

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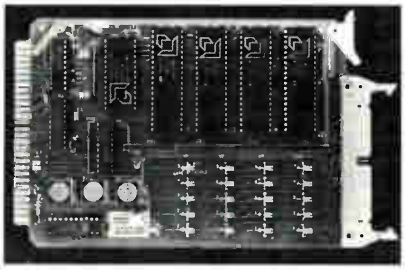

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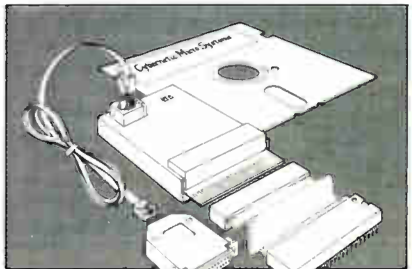

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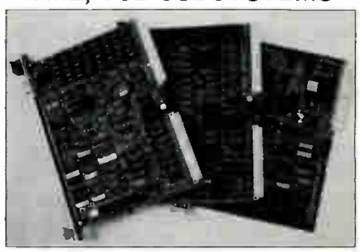

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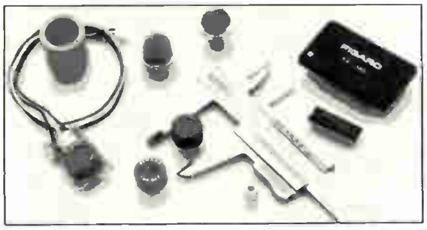

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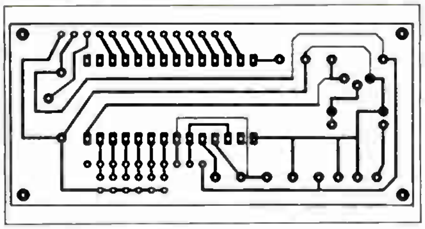

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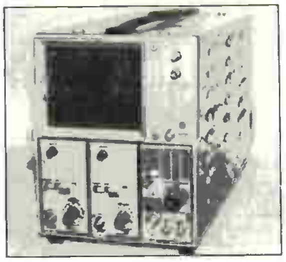

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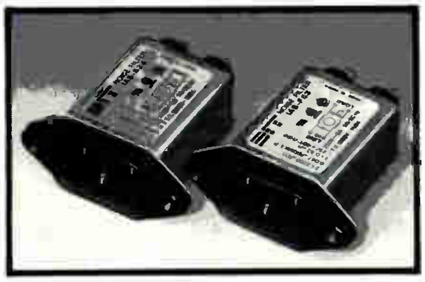

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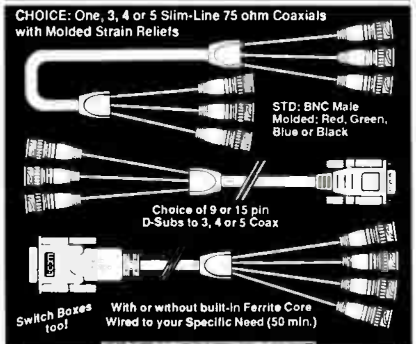

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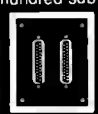

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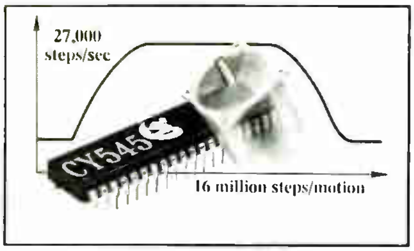

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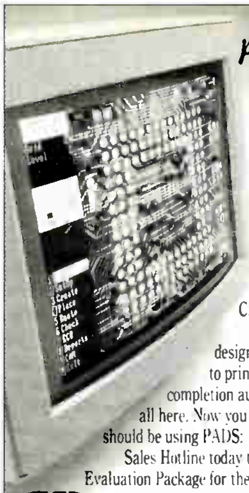

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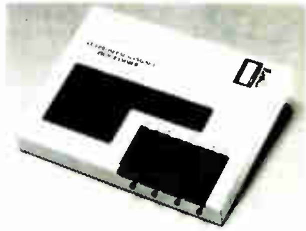

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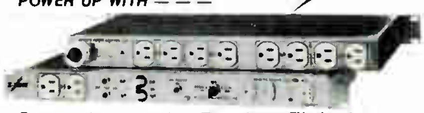

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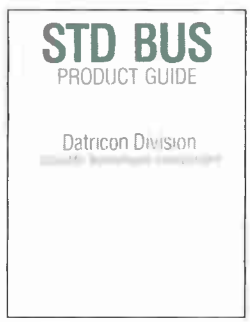

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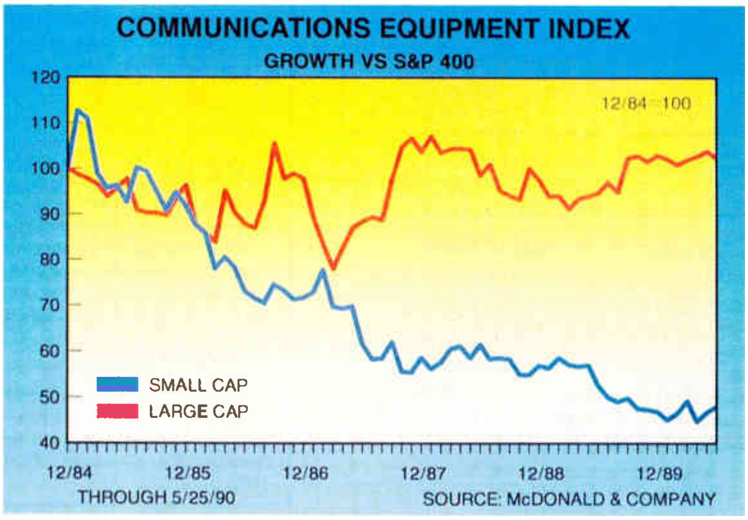
(Continued from p. 124)
2% to 3%. The large amount of captive electronics-manufacturing capacity at General Motors and Ford limit the market for domestic suppliers. However, European and Japanese manufacturers are not nearly as vertically integrated. Ironically, continuing market-share losses by the "Big Three" increase the overall available market for merchant electronics firms.

The data radio market is in its infancy, but has the potential to become as dynamic as the PC boom of the early 1980s. The key factors driving this emerging market are dramatic improvements in utilizing the limited amount of radio spectrum allocated by the Federal Communications Commission and the continuing miniaturization of electronic componentry. The PC/cellular phone/modem/pager on a wristwatch is still a little farfetched today, but a notebook-size unit with those features will undoubtedly be in production somewhere in the world well before 1995.

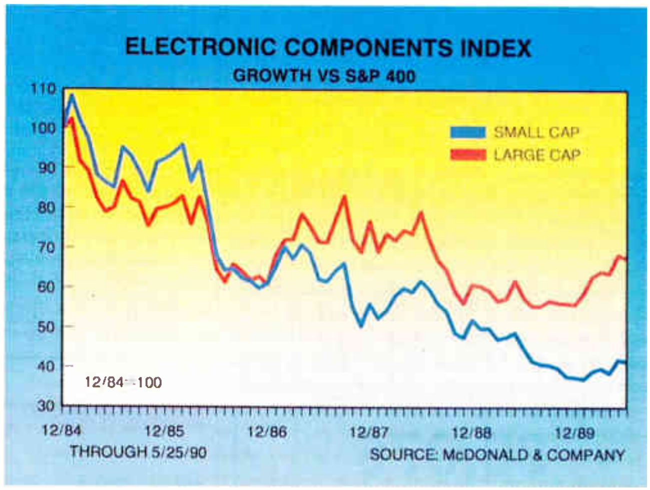
Since the beginning of this year, the stock market has begun to rediscover electronics stocks. Easing liquidity concerns, slightly better industry order patterns in the face of a weakening industrial sector, 10-year-low valuations, and the presence of major new growth markets are all important factors in this new beginning.

This isn't to say that the 1990s will be equally kind to all electronics companies. A dichotomy has emerged in the industry that will likely become more pronounced in the future. The overall growth of the industry has slowed due to the maturing of the computer-hardware market and the outlook for a prolonged period of slower defense spending.

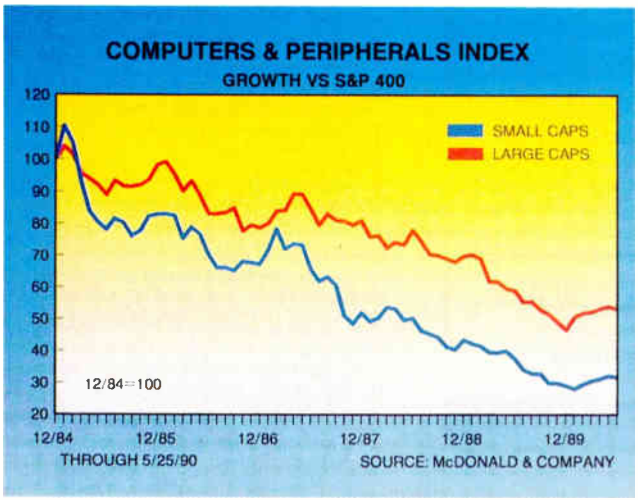
In connectors, for example, there are basically five firms that have strong balance sheets, good earnings, and exemplary management teams. Most other connector suppliers are just barely breaking even. The same conditions exist in semiconductors and other segments. Success comes to companies with the right culture, product positioning, and manufacturing expertise. Electronics companies that hope to survive and prosper into the next decade need all three. E



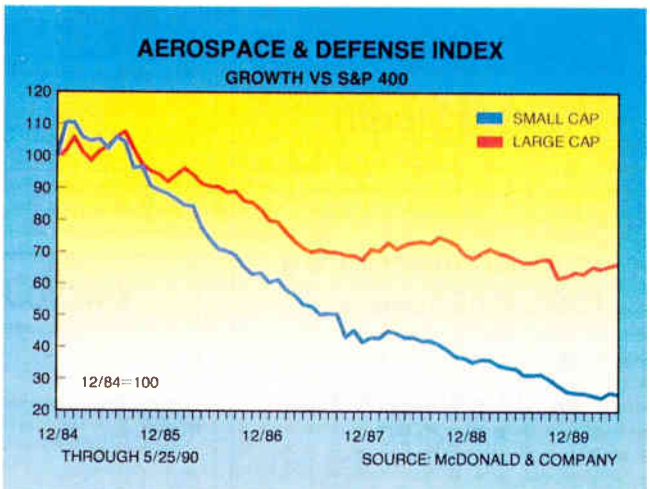
The disparity between large- and small-cap companies is especially pronounced in communications.



The pattern holds in components, where small-cap companies' performance has suffered.



Small-cap computer and peripheral companies turned in a particularly lackluster performance.



The worst-performing stocks by far were the small-cap aerospace and defense companies.

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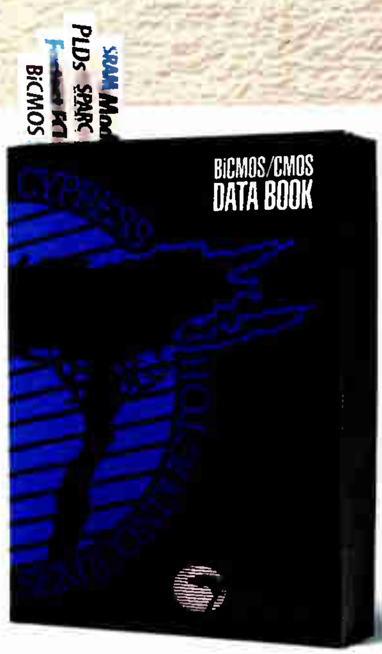

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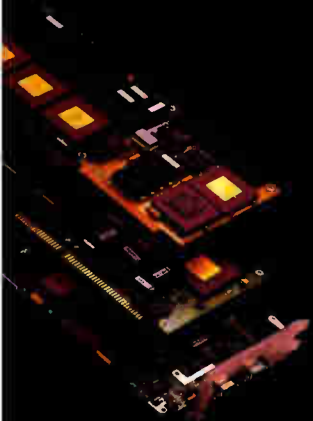

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