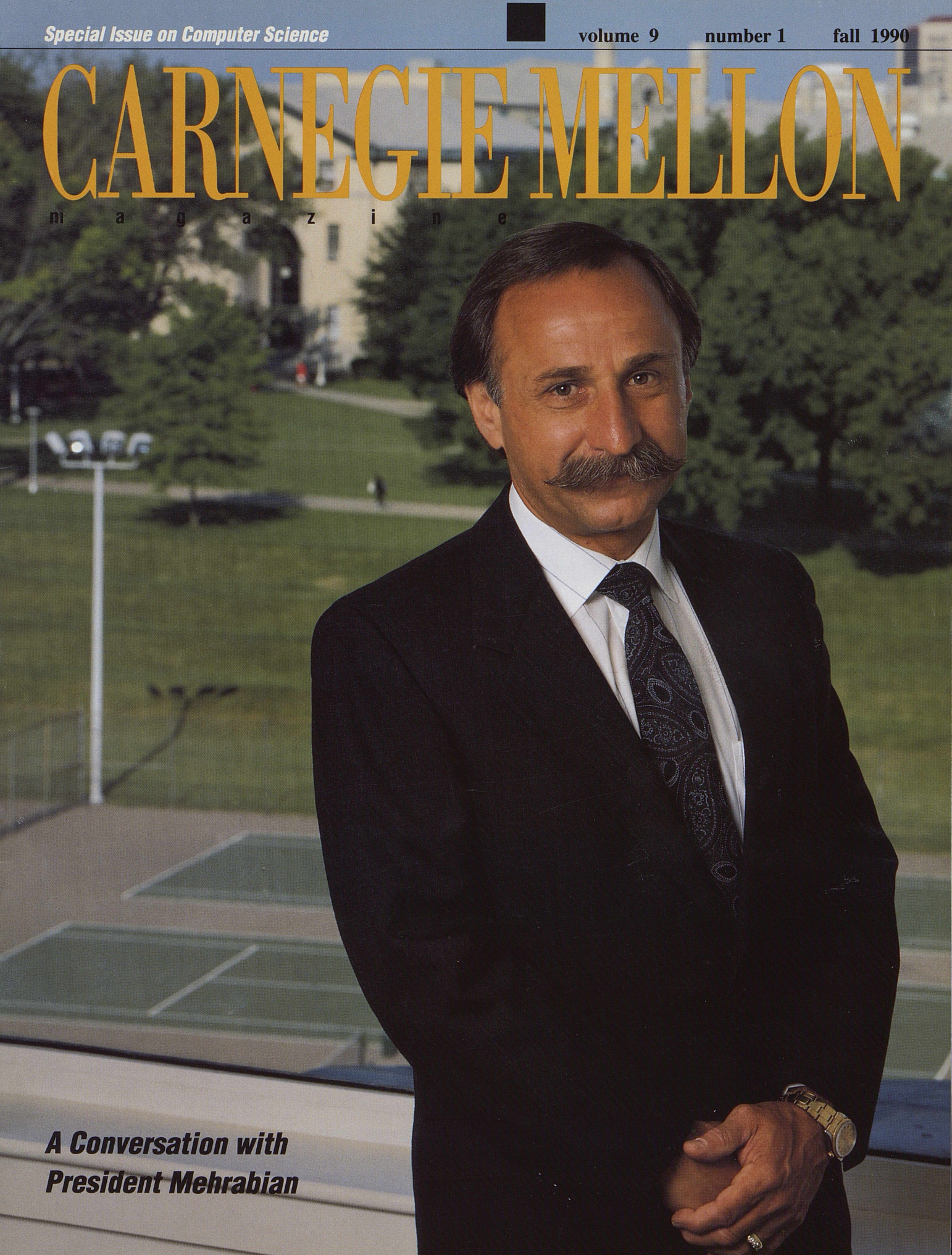
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volume 9 number 1 fall 1990

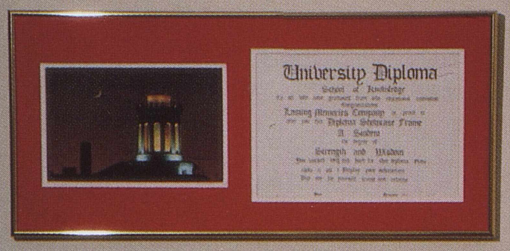
CARNEGIE MELLON

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A Conversation with President Mehrabian

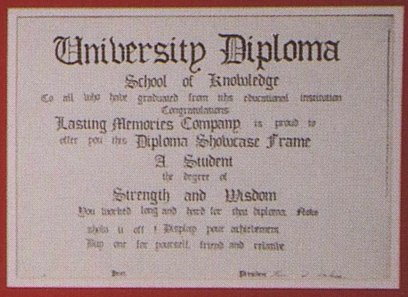
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CARNEGIE MELLON

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The Alumni Association selects nine alumni and a university board member for honors.



Even the best and the brightest sometimes misspell "Phoenix," Alumni Award winner Daniel L. Weller (E'51) discovered during a visit to campus.

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President Robert Mehrabian photographed by Bill Redic in the top floor lounge of Resnik Hall, west wing of the new dormitory. Doherty Hall and the tennis courts are shown in the background.

CARNEGIE MELLON
magazine

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POSTMASTER, Send address changes to:
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Carnegie Mellon University
Warner Hall 5
Pittsburgh, Pa. 15213

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Back in 1981, someone delivered a computer terminal to my office. I looked askance at it and continued to pound away on my high-tech electric typewriter. For three months, the gray box stared blankly at me. Then I started to play with it.

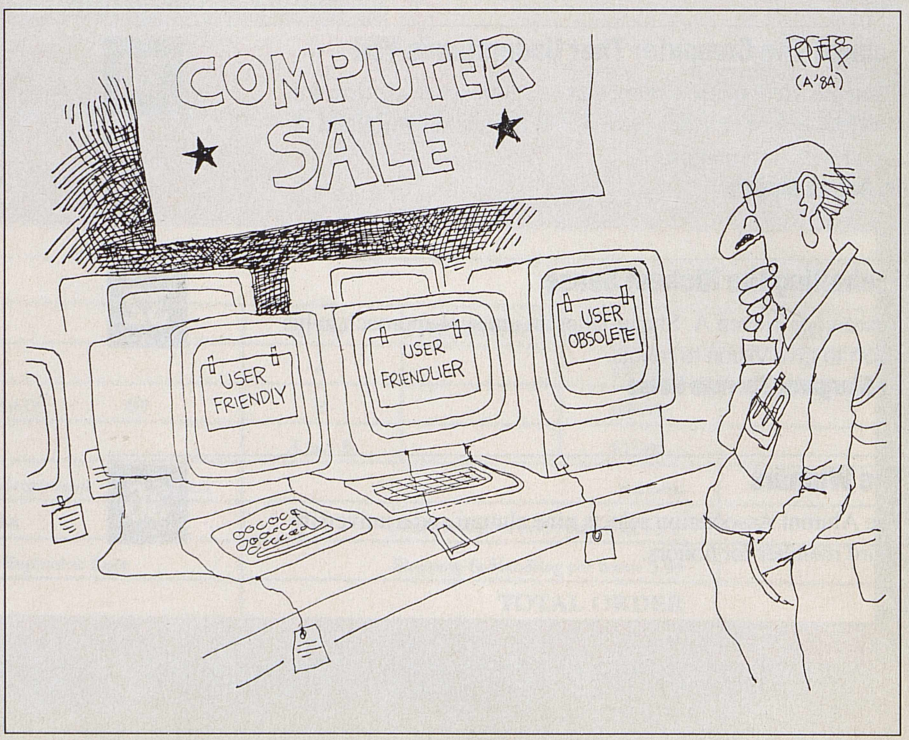
Nine years, an IBM personal computer and several Macs later, I'm a convert. I still view computer messages from across campus as a miracle. (As far as that goes, I still view the telephone as a miracle, and television is absolutely beyond comprehension.) Now, I'm excited and brave enough to think about exploring computer networks that reach beyond Carnegie Mellon. I'm thrilled with computer mail or any mail for that matter. I'm grateful for stories that writers bring in on disk. We don't have to retype. We can avoid more errors.

Carnegie Mellon Magazine, rather belatedly, has started to put itself together using desktop publishing techniques. Writing, editing, layout, design take place on Macs. We still find comfort in yellow legal pads and pencils, however, at least at the outset. Like Carnegie Mellon, which long ago took a "byte" from the computer apple, we wouldn't dream of going back to the old ways. Now our scorn is reserved for typewriters and "dinosaur" computers that just don't move fast enough.

This issue celebrates computer science—specifically the 25-year-old Computer Science Department, which has grown into the School of Computer Science. Some outsiders claim it's the best in the world. We're not going to argue. We've tried to focus on some of the most significant projects and achievements of the school—the world's most rapid computers; computers that hear, understand and respond to the human voice; a lab dedicated to creating vision for machines so they can do such things as look around Mars or a contaminated nuclear reactor.

Meanwhile, Robert Mehrabian, Carnegie Mellon's new president, came to town. We thought you'd want to hear more about him, so we added pages to the magazine. You're now reading the largest issue of Carnegie Mellon Magazine ever produced.

On another note, we've printed a piece of non-computer science news: addition of a bagpiping major to the Music Department—the first in the world. We're pleased with the appropriateness of that decision and find it just as exciting as the university's creation of a big robotic bug for exploring Mars. See News, etc. for both items, as well as other things we like to brag about. —*AC*



55

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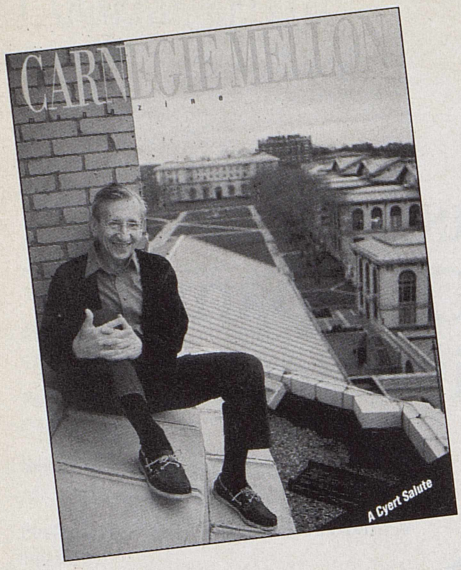
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About the Cyert issue

What a great issue of the Carnegie Mellon Magazine [summer 1990]; and the photo on the cover by Bill Redic deserves some kind of award. It's just great! Congratulations.

William Block
Pittsburgh, Pa.

The writer is publisher of the Pittsburgh Post-Gazette. Ed.

Don't downgrade Tech

I enjoyed Roy McHugh's article in the summer issue concerning Dr. Cyert, except for one quotation: "All in all, Carnegie Mellon has come a long way under Cyert—'from a regional technical college to a nationally respected university and leading research center,' as Carnegie Mellon Emeritus Professor Ludwig F. Schaefer writes...."

Schaefer apparently feels it necessary to downgrade the past in order to celebrate the present. Carnegie Tech was an internationally respected educational institution well before Cyert arrived in 1948—not merely a "regional technical college."

Dr. Cyert assumed the presidency of a fine school and worked hard and skillfully to keep it such. This was no mean feat in these times, and we are properly very grateful to him.

William A. Reich E'38
Glen Arbor, Mich.

A Stever fan

I graduated from Carnegie Mellon before Dr. Stever or Dr. Cyert became president, so my comments are not those of a former student during their tenure. The article "Richard M. Cyert: Topping out on Top" in the summer issue attempted to show how good a president Dr. Cyert has been. I have no qualms about the conclusion, but that article and several others in the past have endeavored to prove their case by stating that Dr. Stever was a poor administrator. Perhaps he was, but that does not build a case for Dr. Cyert. In fact, it weakens the argument by lowering the qualifications of the person Dr. Cyert is being compared to.

The late 1960s and early 1970s were trying times for many universities, and many private universities lost money. Dr. Stever was president when Carnegie Institute of Technology and Mellon Institute merged [1967], and balancing budgets after major mergers can be difficult. He may be the only Carnegie Mellon president who did not retire or go back to teaching. I would think Carnegie Mellon would be proud of a president who became director of the National Science Foundation.

Dan Punzak E'65
Springfield, Ill.

Dr. H. Guyford Stever, who headed Carnegie Tech from 1965 to 1971, is not without his fans. Arthur A. Hamerschlag, first president of the institution, left office—on the verge of a nervous breakdown in 1922—to work as an engineering consultant. Ed.

The fair-chance factor

The short piece about "Rich, richer; poor, poorer" [summer 1990] isn't news anymore. Business papers, magazines and journals have been making that observation for some time.

It is distressing that we aren't doing anything about the condition. Even the universities aren't doing anything.

What can I do to help get a project started to write a business computer game the objective of which is to increase wealth and curtail poverty as a compound but inseparable goal? Only those of us who understand how the free enterprise system works can help the 23.3 percent of children under three who were born into poverty. Equal opportunity without a fair chance is meaningless.

R. E. Alexander E'48
Erie, Pa.

Kudos plus

Here's one for your proofreader ["Rex Yee (IA'88) has a patent approved for his mechanical design for power *breaks*"—summer 1990]. Like power lunches, power ties and power suits? "Perfect" is a hard word! Congratulations on a great university magazine.

Carl Newton
Raleigh, N.C.

Andy and the dance

The letter from Bennard Perlman (A'49) about his 1948 sketch of Andy Warhol in your summer issue reminded me of the enclosed page from the 1949 Thistle. Those of us on the Thistle staff were unaware at the time how truly advanced Carnegie Institute of Technology was in terms of nondiscrimination; nor were we aware now much we had missed by not participating in the Modern Dance Club.

John F. Biewener E'50
South Sutton, N.H.

No question, Andrew Warhola (A'49) was a pacesetter. See him and other members of the Modern Dance Club on opposite page. Ed.

Airport III

In your summer 1990 issue, Irene Waichler Pasinski (A'45) named Carnegie Mellon alumni involved in the design and graphics for the addition to the Greater Pittsburgh International Airport. She forgot to mention the most important one [from the] Class of 1958.

The director of aviation of Allegheny County has to oversee the day by day operation of the Allegheny County Airport and the Greater Pittsburgh International Airport. He had to prepare guidelines for the architects, soil engineers, highway engineers, structural engineers, electrical engineers, electronic engineers, plumbing engineers, heating, ventilating and air conditioning engineers. [He] coordinates federal, state, county and private financing (and leasing of future space).

In his "spare time," he had to pull together the frequently conflicting requirements and personalites of: all the architects and engineers mentioned above; U.S. Civil Aeronautics Administration; U.S. Civil Aviation Board; U.S. Air Force; U.S. Air Force Reserves; Air National Guard; Pennsylvania Aviation Commission; County Commissioners; County Police; F.B.I.; airlines; State Highway Department; County Highway Department; public utilities: Alcosan, natural gas, water, electric, telephone and telegraph companies.

The County Commissioners have [also] made him director of airport area development. He must convince individuals, partnerships and corporations to develop all sorts of things along the new spine highway.

My hat is off to my long time friend and fellow architect Stephen Alexander George (A'58).

Howard S. Shelmire Jr. A'40
Pittsburgh, Pa.

Clearly, there are enough alumni working at the airport to establish an Aviation Clan. Thanks for giving credit where it's obviously due. Ed.

A lonely outpost

In the summer issue of your excellent magazine, Thomas Schwartz (HS'77) noted that US News & World Report failed to recognize the excellence of Carnegie Mellon. However, I recently read an article in The Economist, an English weekly, in which Carnegie Mellon is characterized as "a lonely outpost of education in the region."

While this is not exactly national recognition, it is, nevertheless, a welcome compliment from a major British publication. Keep up the good work.

William J. Lewis E'50
Cincinnati, Ohio

Gross generalizations

Cheer up, Natalie Leavenworth (A'82)! In your letter in the spring issue, you insinuate that hypocrisy is an evil not to be tolerated. With this I agree. May I enlighten you to the fact that the right-to-life advocates I have observed are expressing moral outrage, not merely "anger and hatred." Rather than desiring to "punish and control women," they object to the legalized destruction of babies, fetuses, pre-humans, or whatever synonym you choose. Please avoid making gross generalizations regarding those who understand that, even when utilizing the secular humanist Maslow's Hierarchy of Needs model, a fetus' need to live outranks his or her mother's desire for self-actualization.

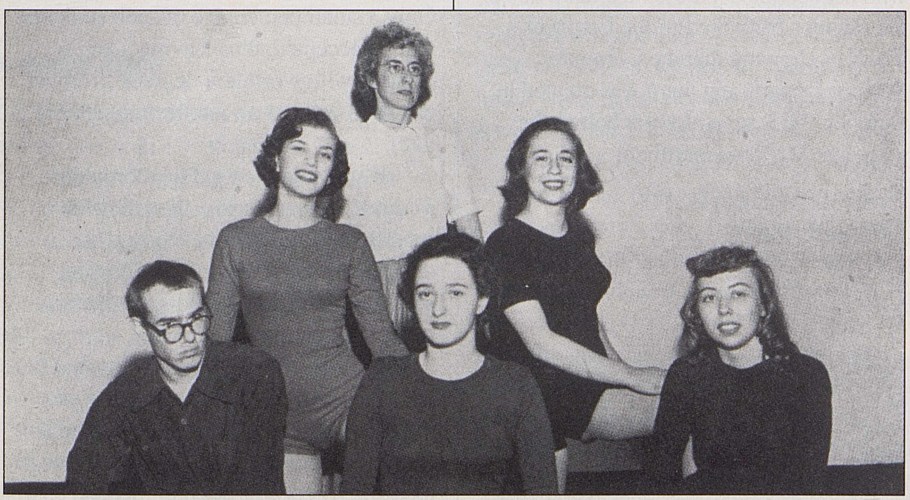
More good news! In response to your call for integrity of action, this, too, I have observed on both a popular and a personal level. Just today I received a plea from Joan Andrews, jailed two years simply for her nationally recognized peaceful protest against abortion, requesting assistance for women and their older children during and after crisis pregnancies. Locally my very own mother and father support the pro-life movement and remain in contact with their adopted and foster children for whom they cared in their own home.

I hope this information increases your respect for the pro-life movement, as you said it would!

Jamie Adams A'83
Pittsburgh, Pa.

Pro-life profile

I was surprised to read Natalie Leavenworth's letter in the spring issue. As an advocate of unborn children's rights, I have consistently found fellow pro-lifers to be among the most caring people I have



Modern Dance Club members in the 1949 Thistle are: front, Andrew Warhola (A'49), Analee Gelman Stone (MM'50), Jean Kneidler Jones (A'49); middle, Patsy Dittler Fihn (MM'52), Barbara Block Teller (MM'52); back, Dorothy M. Kanrich, physical education instructor and women's intramural supervisor. The cutline reads: "Every woman registered at the Carnegie Institute of Technology is eligible for membership in the Modern Dance Club if she has participated in a Modern Dance class at Tech or if she has done previous work in modern dance. Membership is by invitation only. The program of the club is designed for those interested in technique of expression in movement and in seeing how other professional and amateur groups express themselves. The students work on improvement of body technique and on devices which contribute to dance composition."

ever known. While at Carnegie Mellon I was a volunteer at Lifeline, a crisis pregnancy center, which provides counseling, pregnancy tests, free baby clothes and social service agency referrals, and at Mom's House, which provides free day care for children of unwed mothers who are still in school. Another member of the Carnegie Mellon right-to-life group housed mothers during their pregnancies.

Leavenworth claims she would respect right-to-lifers' view more if she saw us trying to help. Considering that there are more crisis pregnancy centers in the U.S. than abortion clinics, I have to wonder if she's ever looked. She also claims that we think that life "ends at birth." Perhaps she could tell that to the children I cared for at Mom's House.

Finally I have to wonder, when the women who have been "helped" at the abortion clinic that Leavenworth "volunteers" at are having nightmares about the children they aborted, where are the "pro-choicers"? Perhaps groups like Women Exploited by Abortion would be able to help more women who have not yet had abortions if they weren't so busy trying to deal with the pain, anguish and guilt that their own abortions have caused them.

Michael Sheliga E'89
Notre Dame, Ind.

The real "first"

I enjoyed reading about Marilyn Taft Thomas' experience as a composition major in 1964-65 [spring 1990]. However, the article states that she was the first woman composition major.

In 1944, I was in Nikolai Lopatnikoff's first composition major program. This class also included Robert Skinkle (A'49) and Lester Trimble (A'48). All of us received our B.F.A. degrees. In 1949, I graduated in the first M.F.A. program in composition.

What I find of interest is not who was the first, but that 20 years may have passed before another woman was enrolled as a composition major!

Speaking of "firsts," in 1965 I began experimenting with and creating electronic music instruments, which I used for film scoring, recordings and other compositional projects. This year, the Fiske Museum of Musical Instruments opened a permanent exhibit that houses many of these instruments and recreates my studio, circa 1965-70.

Ruth S. White A'48
Malibu, Calif.

Not quite first

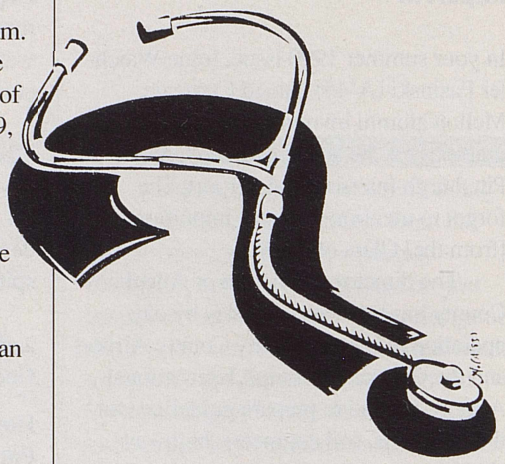
The last issue claimed that Carnegie Mellon had the first computer science department. One of my Software Engineering Institute colleagues, Norman E. Gibbs, a Purdue alumnus, challenged that claim. We contacted S. D. Conte, who headed the department, and he faxed the minutes from the Purdue Board of Trustees showing that the Computer Science Department there was created in October 1962, several years before the Carnegie Mellon department.

James E. Tomayko HS'71
Pittsburgh, Pa.

Correction/omission

About night school or evening school: Carnegie Mellon Magazine reported incorrectly that there is no longer night school offered at the university. In fact, it's back. Though it is not called "night school," courses are offered in the Graduate School of Industrial Administration and the School of Urban and Public Affairs. In addition, Annette M. Jacobson in the Chemical Engineering Department has taught master's students about colloids, polymers and surfaces for 20 years in an evening program carried out in cooperation with local industry.

The top photo on p. 28 of the summer issue was taken by Petra Fallaux.



Avoid premed programs

I disagree with "Want To Be a Doctor?" [Fall 1989], and Diane Dubinsky-Novick's (S'78) letter in the spring 1990 magazine. The most important aspect of my medical education was the undergraduate degree in electrical engineering earned at Carnegie Tech.

I have influenced many high school students wishing medical careers to seek undergraduate degrees in engineering or basic sciences. There are hundreds of thousands of premed students. There are relatively few physics and engineering majors applying to medical school. To seek a premed education is shortsighted. Only a small percentage of such students will be accepted, thus leaving a larger number with worthless degrees (from an employment, not an intellectual perspective).

If students successfully complete a course in engineering, then they have established their intellect and carry a degree respected not only by medical schools, but by law schools, business schools and industry.

The engineering undergraduate degree is a valuable stepping stone to graduate education or employment in any field. The premed degree is useful only to those lucky enough to enter medical school. The fundamental understanding of complex medical issues is enhanced by the analytical techniques learned by the undergraduate engineer.

Yes, engineering is certainly more difficult than a premed curriculum, but that is precisely what medical schools are looking for.

James Selevan E'70
Laguna Beach, Calif.

Ann Robinson, who is director of Carnegie Mellon's Health Professions Program, replies: "I am in total agreement with your philosophy. I regret that the article led you to believe that the university has a premed major. I wouldn't want my present position if I advised premed majors. At Carnegie Mellon we educate fine engineers, chemists, biologists, psychologists, computer scientists, technical writers, etc., who have the potential for excellent careers in their area of expertise, but who have the option of attending medical school. Our students will commonly lead their medical school classes when they enter their clinical years. Their skills in analytical thinking shine in clinical diagnosis. It is a pleasure advising and teaching our students. You can be proud of your alma mater. It is affording its students a top quality education. Perhaps more than any generation in modern times, our present graduates have a multitude of career opportunities available for their grasping." Ed.

A dismal place

Re: Dr. Cyert's reflections (spring 1990) and an article in The Pittsburgh Press, "Undergrads Teaching Communication Skills to Foreign Teaching Assistants." I arrived at Carnegie Mellon in September 1970 with a Catholic high school education and wardrobe. In an era of patched bell-bottoms and no bras, that made me stand out more than being a female in an overwhelmingly male college.

The campus was somewhat unkempt in those days, which seemed to go with the general look of the student body. Unkempt became filthy. The gray landscape was barely visible through windows that were never washed. Most of my classes were in Porter Hall, and I distinctly remember Dr. Edward M. Krokosky stopping in mid-sentence with an astonished look on his face. He had no time to warn me. A tile from the 20-foot ceiling came down, hitting me on the head. Not being the litigious type, I merely informed someone in Warner Hall, nursed the goose egg and added another check to my list: Coffee on the desktop? Gum on the seat? Loose ceiling tiles?

The residence halls were no better. The beautiful garden [in front of] Morewood no longer bloomed. The once graciously furnished main lobby was redecorated with boxy sofas and chairs, which soon found their way into students' rooms and off-campus apartments. Perhaps the shamelessness of the theft was a result of the loss of "the conscience of Morewood"— the resident moms. Besides their caretaker duties, they added that feeling that there are limits to behavior, that doing your own thing should include doing the right thing.

As for the teachers, foreign or not, many were difficult to understand. You became accustomed to the teaching assistant's accent. More frightening were the painfully shy profs who couldn't make eye contact or those who were simply not public speakers but scheduled into enormous lecture halls. Then again, there were those haughty types who, I thought, just wanted to bowl over as many students as possible. Why? Less papers to mark? To these professors, teaching was not their first love. They were at Carnegie Mellon for research, and it was a disservice to both parties to have them teach undergraduates.

In all, it was a dismal place to spend "the best years of my life." Now I see Dr. Cyert agrees in a way. Holding costs had no effect on attracting students. I suggest that as more areas of student life were compromised or eliminated, the less attachment and loyalty the students felt. The less maintained the campus, the less the alumni visited. My guess is that eventually giving suffers. That teaching assistants are now being coached in communication skills by the undergraduates is a vast improvement, long overdue, but still shy of solving the problem. Maybe the new president could work on that.

Betsy Horvath Kane E'74
Gibsonia, Pa.

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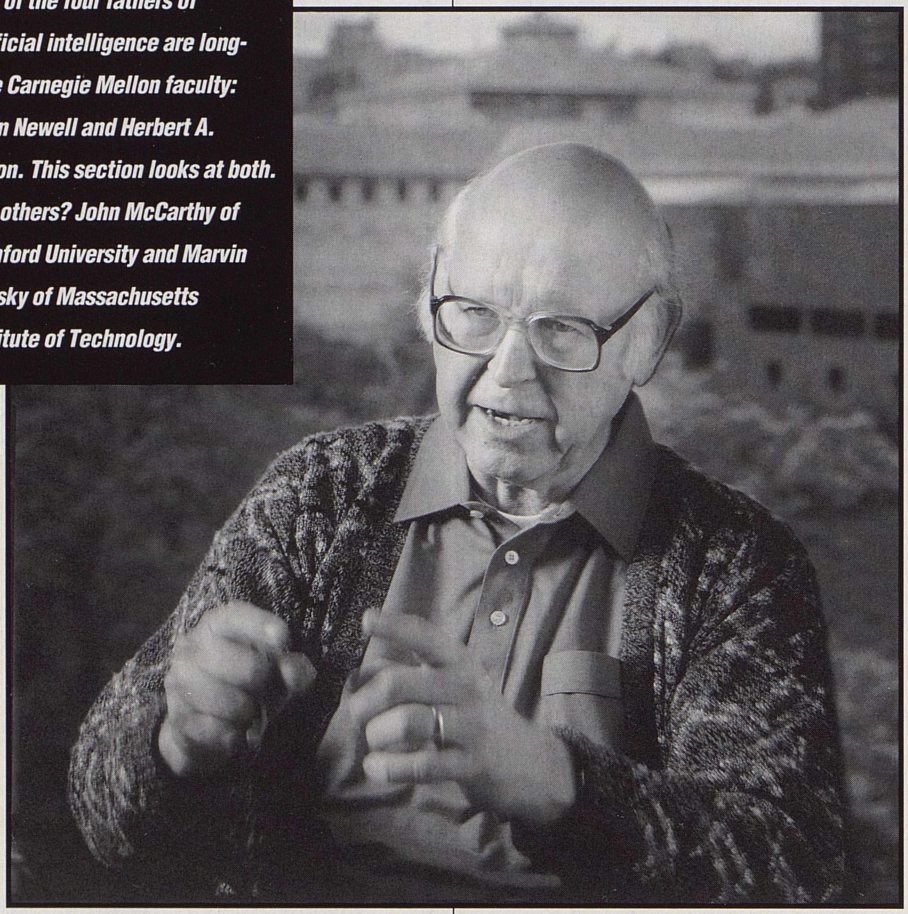
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Allen Newell:
no Delphic oracle

Two of the four fathers of artificial intelligence are longtime Carnegie Mellon faculty: Allen Newell and Herbert A. Simon. This section looks at both. The others? John McCarthy of Stanford University and Marvin Minsky of Massachusetts Institute of Technology.



Bill Redic

Allen Newell, shown in his conference room in Wean Hall, contends people were frightened of computers in the '60s and '70s, but now the machines are everywhere and less threatening. "They are not quite as familiar as a light switch," he says, "but they are getting close. We have come to take them for granted."

Carnegie Mellon Magazine: One of the aims of artificial intelligence, or AI, is to enable computers to "think," a word dictionaries define in a human context. What is your definition of "to think"?

Allen Newell: The operational definition the whole field uses is that if you have computer systems that engage in the same activities that humans engage in when they are behaving intelligently, then, the two come to be indistinguishable.

CMM: So can a computer think?

AN: If the computer continues to do things that correspond to the sorts of things that humans use intellectual activity for, over a broad enough range, you might as well talk about them as "thinking." Oftentimes, of course, people try to settle such an issue by talking about thinking as something that's defined for human beings and not defined for machines. That just avoids the issue. The question is not how we define things; the question turns out to be whether there are other kinds of devices in the world that exhibit all these activities and whether there might be ways in which they do it that make them radically different along other dimensions.

Humans have emotion, they have context, experience, they have all kinds of other things. And these are not the same things as thinking. We don't need definitions; we need interesting locations and occasions in which phenomena arise so we can study and discover and learn about them. We can get machines to play good chess, and then better chess, and then excellent chess. And then we've discovered something, and it doesn't much matter whether we call that "thinking" or not. It is an extremely difficult task, and we can understand the processes that humans use and the processes used by computers. It turns out that, in this case at least, the processes are quite different.

But there's another whole line to this. You can try to build computers that are not only smart, but which can do the other kinds of recognitional activities that we don't think of as smart—things that we all simply do, like comprehending language and interpreting visual themes and so forth. You can get into the issue of how to build theories of how humans do various tasks. Then we get into psychology. How humans think. How they understand. If it turns out—and it does—that some of the best theories on how people think and understand are of the same genre as the theories of how machines come to do these things, then we've come around by the back door and said, "Well, my theory of how humans think turns out to be the same way...in which machines engage in problem-solving activity."

CMM: Hubert Dreyfus has been one of AI's most vocal detractors over the years.

AN: Well, Hubert has a very curious relationship with the field. He's an official critic of it by now and has been a critic for over 20 years. He is closely identified with the field, goes to its conferences, gives talks about it. He is engaged in criticizing the AI field; he is not engaged in making technical contributions to it. However, it turns out that after about 15 years of criticism, he and his brother put out a book ["Mind over Machine: The Power of Human Intuition and Expertise in the Era of the Computer"] that was intended to be a positive contribution. It was about what computers could and couldn't do and was focused on the nature of expertise. I don't find the book very persuasive, actually.

CMM: Do you think that he makes valid points in general, or has he just positioned himself as a crusader against AI?

AN: There is, behind his criticism of AI, a basic philosophical ground position called phenomenology. Its premise is that a human being is, to begin with, in unarticulated contact with the world. So there is always a background relationship with the world. Then the person articulates various things, just as I'm articulating these thoughts to you now. And that articulation always comes out of the background; it can't exist all by itself.

Now you look at a computer. You open it up, and what you see there are lots of bits, so to speak, and you say, "Well, those bits represent all articulated knowledge." So a computer is the kind of thing that consists solely of articulated knowledge, whereas human beings and other organisms are in the world and their articulated knowledge emerges out of their background. Well, a computer can never have a background. A computer can never be like a human being in that sense. Considering all that, a computer has no chance, ever, of having the sort of background expertise—an implicit understanding of the world that comes from simply living. From that point of view—if you take it—then Dreyfus has a very legitimate thing to say.

I never felt that Hubert's technical criticisms were very strong.... But they grew out of this basic point of view, and at least in my own picture of this, everything depends upon how you assess articulation against unarticulated background, and whether you want to think of a computer as being all articulated. You could say, "A computer is just a logic machine. What is sitting in its memory is nothing but a bunch of expressions in a logic." Or you don't have to accept that. You can say, "How do you know that that's the case? Why is that the only model of what a computer is? Why do those mechanics have to be identified entirely with logic and articulation?"

CMM: There have been several cases in the news lately about high school students refusing to dissect frogs in biology classes because they can perform a simulated dissection on a computer and learn the same scientific principles. Can something like that replace real-life experience?

AN: In lots of ways, yes. In fact, that's a rather intricate question. There is a movement in science, and in chemistry in particular, to utilize simulations for experiments. The underlying laws are known well enough to permit that. If we say, "This student needs to go into a laboratory to find out what real chemical experimentation is about," and we have the student work with chemistry on a computer, is that now real chemistry or not? Society alters the situation so that computer-mediated experience actually becomes part of real experience. The nice, sharp division be-tween computers and "real" life blurs a bit.

Consider surgery, for instance. Many operational procedures now are done with the assistance of video. If a surgeon runs a catheter into a body and looks inside the vein, he is not actually looking inside the vein. Suppose that, to make it more clear, the image is enhanced by various algorithms. Clearly, this is not direct experience. It's about as artificial as doing a dissection on computer rather than on a real animal. Is it, therefore, not "real" experience? Can we move to a place where real experience comes to mean computer-mediated experience? It becomes not a substitute for the real experience, but the real experience itself. Just like eyeglasses, for me, have turned out to be the real experience, and somehow when I take them off, things don't look very real.

CMM: But what about people learning in such computerized environments?

AN: I was reading an article last night in The Journal of Educational Psychology in which some scientists reported that having people learn to spell by writing down the words tends to work very well. What the experiment showed was that if you have people type the words into the computer or assemble them with little tiles, you get very different results. You might think that any form of motor activity would work, but it turns out that writing the words out by hand was much more effective in helping people remember the spelling. So here's a little piece of empirical evidence that shows that, in this case at least, using a computer seems to inhibit learning.

Right this minute, I'm looking out the window, watching someone out there running a lawnmower, and that's artificial reality. That's not the way it was in 1870 or the 1400s. Manicured lawns are artificial. They're artificial in exactly the same way computers are.

CMM: Do you think society's growing dependence on computers is at all dangerous?

AN: Life is dangerous. All of the choices that we, as a world civilization, have made, are dangerous. The issue of converting the world to agriculture and thus clearing off the forests—that was dangerous. The issue of building steam plants was dangerous; we've seen a lot of indirect effects showing up later, like acid rain. Computerizing society is certainly dangerous, but it's no more dangerous than clearing the land—or genetic engineering, for that matter.

CMM: Could you make a prediction about the future of AI?

AN: There is something called the Delphi Technique, where experts try to predict or estimate some value or answer. You get a whole bunch of experts to estimate; you take their results, send them to back to everybody and get them all to revise their results. Out of the average of all that, you get a better estimate than you would by picking only one expert. There have been attempts to do Delphis for the future of AI, and I have refused to participate in them. The reason is—and it's actually a reason, not just a reluctance—that people end up asking things like, "When will there be little factotum robots running around cleaning our houses? When will automation take over the entire auto industry? When will all our legal services be done by machines?" But none of these are separate entities. They all depend on the improvement in our ability to program computers to be intelligent.

One thing I will say is that I don't see any limits to this. It is moving forward, like it or not. The progress we make is very much a function of how much societal energy we put into it. There is a great deal of effort in the computer field right now, but there are lots of other competing things. If you look at the growth of biology, my God! It is going at a fantastic rate. It's a matter of how many bright people decide that computers are the thing that absolutely fascinates them.

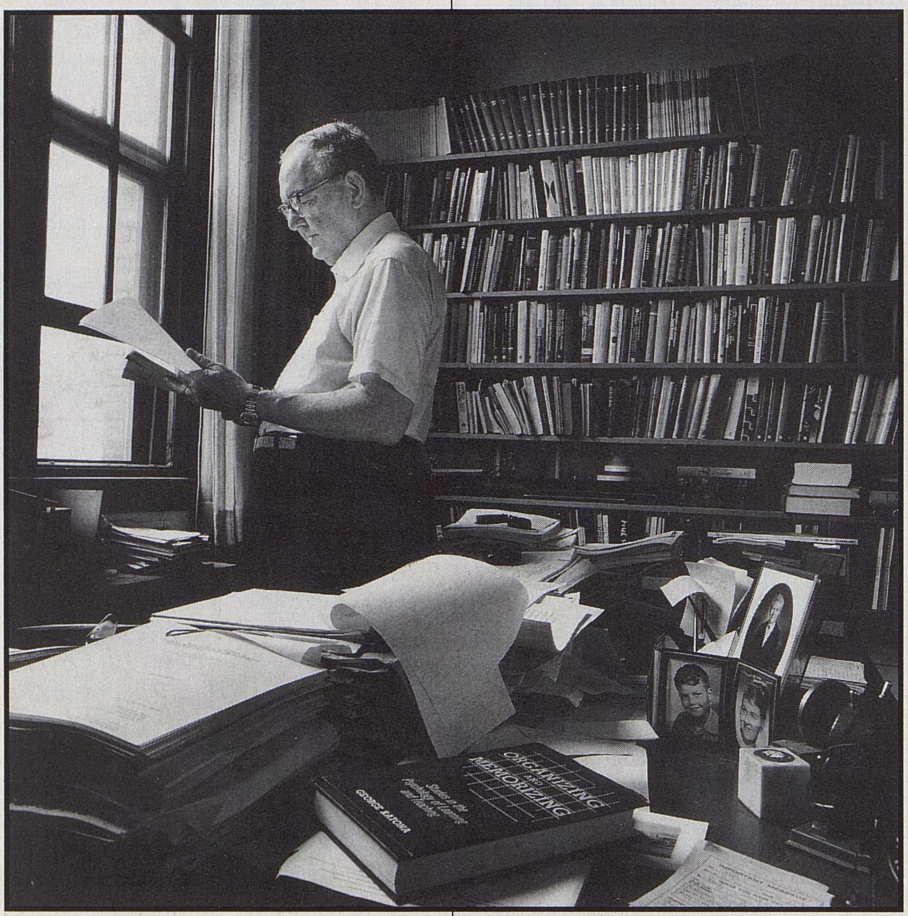
—Catherine Stroud Vodrey HS'85

Herbert A. Simon:
a man of many fields

When Herbert A. Simon won the Nobel Prize in 1978, Carnegie Mellon President Richard M. Cyert called him the one man who came closest to the Aristotelian ideal. Cyert described Simon as an economist, psychologist, political scientist, sociologist, philosopher and computer scientist.

At 73, however, Simon, prefers to think of himself as the "most conventional, middle class person you have ever seen in your life." A deceptively simple description, it is perhaps typical of Simon, who enjoys his great intelligence, but prefers to ignore the fame it brings to him. A large, graying man, who dresses simply and works in an unimposing office in Baker Hall, Simon in his character and interests seems as eclectic as his research.

Bill Redic



Herbert A. Simon, in his office in Baker Hall, startles people with the diversity of his interests. Known for his work in economics and artificial intelligence, he received a packet of information on author D. H. Lawrence during a recent interview. Just some background for a lecture at Berkeley on literary criticism from a cognitive point of view.

The common thread binding the man to the work is curiosity. "The number of disciplines with which he has been associated and the creativeness of even his minor efforts sometimes obscure the intellectual coherence of his major work," wrote former colleague James G. March of Stanford in a laudatory article in Science magazine after the Nobel win.

To the university and the world, Simon's level of achievement, then and now, is made all the stronger by his self-described sense of "personal intellectual adventure" and his contrasting opinion of himself as conventional and middle class. That adventure has been characterized by unconventional research, research which ties information and expertise from many disciplines together. Simon's ability to work in a number of fields simultaneously is perhaps the most impressive aspect of his work and his outreach. His seemingly infinite capacity to digest new information and reformulate it into cutting edge theory continues to astound many audiences.

More than 40 years of Simon's professional life has been spent at Carnegie Mellon, where he is the Richard King Mellon professor of computer science and psychology. His is a career marked by significant accomplishments. From 1939 to 1958, Simon focused on decision-making processes, particularly those in organizations. His concerns then shifted to human problem-solving and artificial intelligence, AI. The work in decision-making earned Simon the Nobel Prize for economics. The second block of work brought him recognition in the controversial, interdisciplinary field of AI. It also helped position Carnegie Mellon as a leader in computer science.

Simon still exudes a pride in his intelligence, the same sense of enthusiasm and thirst for knowledge he experienced when, as a child, he soon learned that he was smarter than his comrades and that became important to him.

Born in Milwaukee, Simon hailed from a lively middle class family, whose members were active in professional and civic affairs. Their interests and involvements sparked lively debates and spats. Simon traces the roots of his interest in decision-making to these experiences. A good listener, he often found himself in the position of hearing both sides of the story in family disputes. By the time he was 12, Simon had learned that quite reasonable and truthful people could perceive the same sets of events in remarkably different ways.

Simon continues to be a good listener with an unwavering interest in decision-making and human problem-solving. Early in his career at Carnegie Mellon, he joined with other researchers to study complex information processing, popularly known as "artificial intelligence." AI is the discipline concerned with programming computers to

do complex tasks that in the past have required human intelligence.

The roots of AI research date to the 1950s, and Simon remembers the autumn of 1955 as being particularly exciting. "We launched an enormous game plan that kept us busy for the next 20 years," he recalls. Underlying their work was the premise that the human mind, like a computer, is a system for manipulating symbols and for processing information.

"We knew it was an important scientific problem, and it seemed as exciting a problem as we could work on. It was related to what we were working on in human problem-solving and decision-making," he says.

By Dec. 15, 1955, he was able to fulfill his dream of discovery when by hand he developed a proof of Theorem 2.15 of the Principia Mathematica, Whitehead and Russell's classic work on logic, in such detail that he and his colleagues agreed the scheme was programmable and analagous to the steps a human would take to tackle the theorem. Because of that, Simon celebrates Dec. 15 as "the date when Al Newell, Cliff Shaw and I knew we had a program that simulated the process of human problem-solving."

The mere notion that the process could be translated to machine rocked the scientific community. Cognitive scientists like Simon were called the "black knights" of science. Others likened AI to the monster created by the fictional Dr. Frankenstein.

Simon stood his ground, despite the Pandora's Box of opinion he and his colleagues' research unleashed. With just a trace of irony, he contends that AI research might not have caused such an uproar if the stuffy moniker "complex information processing" had continued to be applied to it.

He also was troubled by the equation "machine equals computer." Simon disliked the connotation then and continues to dislike it today. "The minute you call something a machine, most people have an immediate reaction that they know exactly what it can and can't do.

"If, in the next sentence, you say 'My computer can think!' their reply is, 'It can't. You just said it was a machine.'"

Simon doesn't perceive continued advances in AI as being threatening to humans. In fact, he views his work as symbiotic and argues eloquently for the continuation of human association with computers. Stating that knowledge about the human mind can make an important contribution to human progress and awareness, in 1977 Simon wrote: "It is a belief of this kind that persuades researchers in artificial intelligence that their endeavor is an important and exciting...intellectual adventure.

"We have lots of different attitudes, but in one of our attitudes as human beings, we make up a romantic tale about ourselves," Simon explains. "Falling in love is mysterious, thinking is mysterious...and so we create great words like 'creativity.' 'Creativity' is thinking; it just happens to be thinking that leads to results that we think are great."

The idea that human thinking, as a process, may not be mysterious is problematic to some. "Some people get very upset," Simon acknowledges. "They get upset because, somehow or other, challenging the uniqueness of human beings bothers them. They get upset for the same reasons people got upset about Darwin and Copernicus. If you think it is terribly important that human beings should be completely different from anything else on the face of the earth, well then you probably ought to be upset."

The successes that resulted from the work of Simon and his peers in the field of AI eventually quelled some of the hostility about AI. That's important to Simon, who still seems to experience a twinge of regret about the time frame he placed on four predictions about AI during a meeting of the Operations Research Society of America in 1957.

Simon predicted that within 10 years: a chess program would be written that could defeat the world-champion chess player; a computer would discover and prove a significant mathematic theorem; a computer would compose some aesthetically valuable music; and most psychology theories would take the form of computer programs.

"Today," he says, "I don't think it is necessary to try to make [the work being done in the field] tangible by predictions. He also adds that while the 10-year time limit didn't pan out, "we haven't done badly on the predictions.

"First, there are only about 200 people in the world who can now beat a computer at chess. Second, some mathematical theorems have been discovered and proven by computers, although not a big, resounding one. Third, some aesthetically interesting music has been written by computer. And fourth, a large part of the psychological theorizing being done today is in fact in the form of computer programs."

Asked if he would consider making another prediction for AI, Simon shook his head but then paused to reconsider. "I'd say the chess prediction has another four years to run."

Today, Simon thinks of his research more in terms of cognitive science than AI because, he says, "most of my artificial intelligence work is aimed at understanding human intelligence. That's much different from just building machines to do useful things."

During his tenure at the university, awards and recognition have continued to be heaped on Simon—an honorary degree from Carnegie Mellon and the Pennsylvania Governor's Award for Excellence in Science during May, for example—but he seems uncomfortable with any reference to being a "living legend." Instead, he prefers to characterize himself as conventional. He adds, "I just try to look at things in new ways."

On the surface he is that conventional man. The Carnegie Mellon campus community is familiar with the sight of Simon, inconspicuously attired in a comfortable sweater, slacks and a plaid shirt, having lunch in the faculty dining room. He enjoys the outdoors and, on most days, makes the one-mile walk to work from his Squirrel Hill home to a simple office, decorated with computer-drawn sketches, in the Psychology Department. He admits to reading "whodunits" for pleasure, but adds that he reads "zillions" of books. When pressed, he will admit that some of those are in French, German, Swedish and Spanish. And he is learning to speak some Chinese.

Simon says he researches "for fun" and continues to revel in discovery. He talks enthusiastically about "Bacon," a computer program named after Sir Francis, which rediscovers, in a matter of minutes, scientific laws that took years to solve. He has a long-standing relation with scientists in China and recently worked on a Chinese secondary education program involving a new way of teaching math.

Simon enjoys being able to give advice when it falls within his work and research interests. But he prefers fundamental research over high-profile endeavors. "I'll let other people make the world run," he says, then laughs.

—Teresa Sokol

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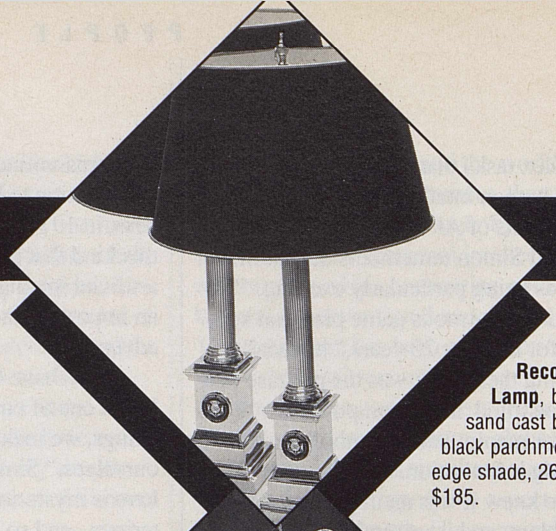
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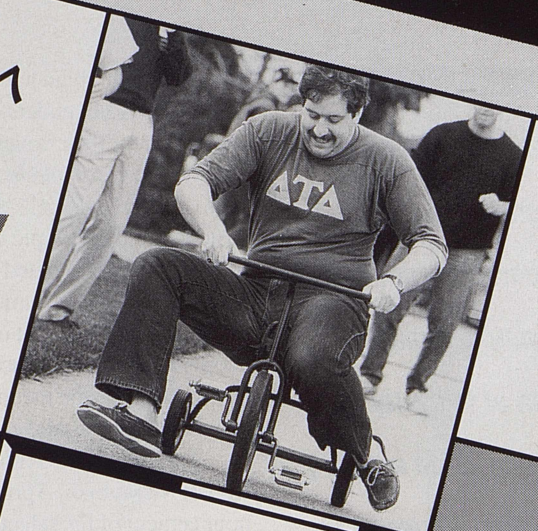
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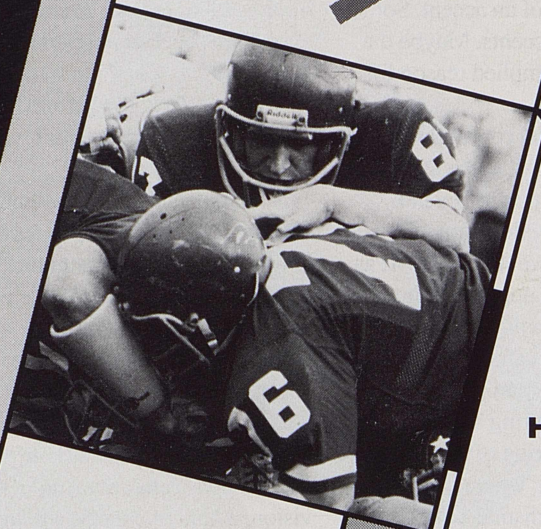
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A Conversation with

Robert A. Charpie (S'48), new Carnegie Mellon board chairman, describes Robert Mehrabian as "a man of vision, a man of energy, a man of integrity and a man who has a record of being successful at what he tries to do."

If Robert Mehrabian had an army—say, Mehrabian's Marauders—staunch pacifists would release their doves and join.

Why the instant allegiance? Maybe the easy compliments he's prone to. Maybe the basic respect for people regardless of rank. Maybe the clearly stated personal values. Maybe the sense of humor, the hearty laughter. Maybe the bit of an accent. Some people are suckers for accents. Maybe the moustache. Maybe the implied reason for wearing that moustache.

The Carnegie Mellon community met Robert Mehrabian, April 5, at the announcement of his selection as seventh president of Carnegie Mellon University in a jammed Skibo Ballroom. He came off as an obvious peacemaker, appointing internal candidates for the presidency to his interim advisory committee. He came across even stronger as a reasonable man intent on working with all sides during an interview in his temporary, sweltering office on the top floor of Warner Hall, where the air-conditioning is notoriously dismal and the glare from the mid-day sun made lights unnecessary. But this man, whose favorite verb is "energize," whose associates already characterize as "intense," makes his own light.

Born in Tehran, Iran, July 31, 1941 of Armenian parents, Mehrabian (rhymes with Arabian) spent his first 17 years there—as part of an extremely small Christian community surrounded by Muslims. He has one brother, Albert, a psychology professor at the University of California at Los Angeles. His parents now live in Santa Monica. The first language he spoke was Armenian. At school, he learned subjects in Armenian, English and Persian.

Perhaps that early environment of mixed cultures gave him one of his most noticeable qualities: a desire to see any question examined from many points of view. He's not likely to make snap decisions. But he's anxious enough to enjoy the "fun" of forming an institution not to talk a proposition to death.

He spent his senior year of high school at the demanding Phillips Exeter Academy, a New Hampshire prep school, his initial introduction to U.S. culture. Language hindered him at first, but he caught on enough to succeed in science and mathematics courses taught at a college-sophomore level. Asked what kind of student he was, he replies, "I thought I was reasonably good." Then he laughs.

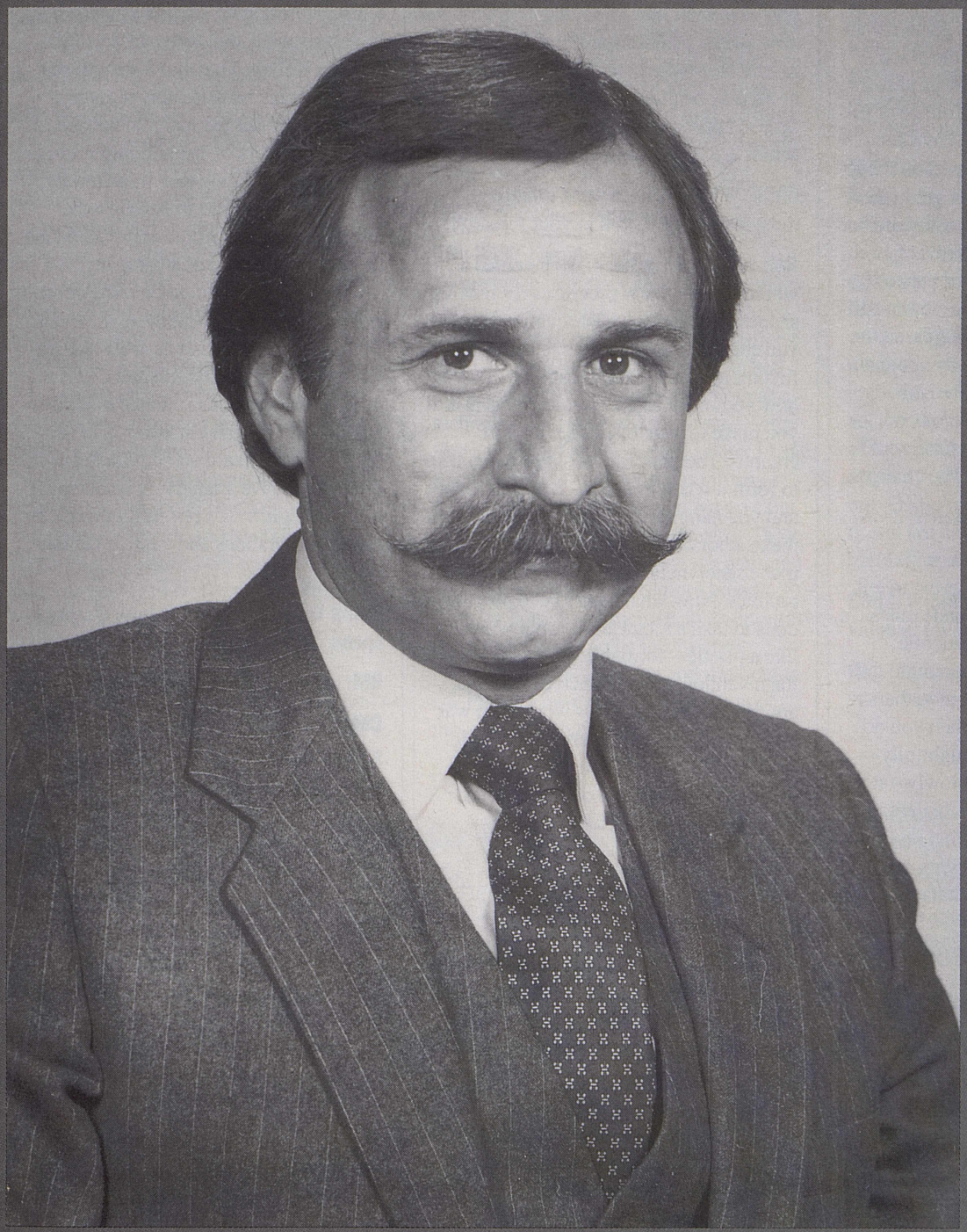
No one calls Robert Mehrabian "Bob." The explanation is simple enough: "Robert" is what he was called at home. "Bob" was not a nickname among Armenians.

Selected by a committee of trustees, faculty, students and staff after a 12-month search and a winnowing of 500 names to 35 candidates, Mehrabian was described by Robert A. Charpie (S'48), new Carnegie Mellon board chairman, as "a man of vision, a man of energy, a man of integrity and a man who has a record of being successful at what he tries to do." See Mehrabian's entry in American Men & Women of Science on p. 19. It tells what he has accomplished since earning bachelor's and doctor's degrees from Massachusetts Institute of Technology in 1964 and 1968.

He'll be the first to admit, he can't walk on water, but contends his co-workers can do "a lot of the things that make the salt in the water increase and make it easier for me to walk on it." He's only half-kidding. Following is a partial transcript of an interview with Robert Mehrabian, Carnegie Mellon's first foreign-born president, a characteristic he shares with founder Andrew Carnegie.

Continued on p. 16

President Robert Mehrabian



Carnegie Mellon Magazine: What do you enjoy about being dean [at the University of California at Santa Barbara]?

Robert Mehrabian: I love being dean. But first and foremost, I'm a faculty member. I have a lot of post-doctoral fellows who do research with me. I teach graduate students. They do research with me— M.S. and Ph.D. students. I have probably one of the largest research groups on that campus. Almost 20 or so people who work with me directly. Being dean has been a lot of fun in Santa Barbara because it's given me an opportunity to really change the place. We've recruited about 65 new professors in the last five years for the College of Engineering and, consequently, have been able to have a significant impact on the institution. We've started a new graduate department—the Materials Department. And I have a lot of autonomy in terms of resources, direction-setting for the college. We've built one building. We've leased another off campus. We've increased the number of graduate students by about 40 percent in the college, increased our research funding by a factor of six or seven. When you look at the totality of that, that's what's been fun. The changes.

CMM: Have you made mistakes as dean?

RM: Everybody makes mistakes. I've made my share, but I'm not going to tell you about them. Sure, I've made mistakes, but nothing serious. In an academic institution, I believe it's important to get balanced advice from the faculty, the students and the staff, and when you do that and approach things thoughtfully—that doesn't mean you do it slowly—it's unlikely that one would make a major mistake. That doesn't mean that one can't be innovative or forward-looking or have outreach programs, it's just that one should seek some advice other than one's own or just input from one spokesperson for a new program. There are usually champions for everything in an institution. The first time they approach you, one shouldn't just take that as the only input.

CMM: What do you find most difficult in managing people?

RM: (Pause) I don't find it difficult to manage people because I don't consider what I do with people managing them. I think that the most important thing is to establish a relationship of trust with people that you work with and to treat them—when they sit across the table from you—in the same way that you'd want to be treated if you were sitting in their chairs.

CMM: Sounds great, speaking from the other side of the table.

RM: It works. You know when you look at somebody, and they're talking to you and you hear what they're saying to you, if you now switch positions and see if you want to hear that—the news may be bad, the news may be good—the question is how do you approach the person, how conscious are you of their humanness?

CMM: What has been most important, most rewarding to you in your research?

RM: Well, a while back, we invented a whole series of new processes for making shapes from metals. Historically, the way you can make a shape from a metal is by first melting it and then casting it. This is how you make bronze statues. This is how you make turbine blades for aircraft engines. The next way to shape a metal is to form it when it's solid. You heat it up, and you hammer at it. This is the way you make a horseshoe. And the same way you make sheet metal for aircraft skins, automobiles. Now what hasn't been possible to do is to take a metal and form it when it's like a plastic—formable, like putty. And the invention we—a bunch of students, another professor and I—worked on was how to make metals behave like plastic. And that was a lot of fun because it evolved into a number of commercial processes and an alternate method of making shapes.

CMM: What is most important to you personally?

RM: Personally? My wife, my family, their health. To have a full life, not one-dimensional, and to have a reasonably successful career while doing the above.

CMM: Are you still involved with your research company, Superconductor Technologies Inc., in Santa Barbara?

RM: It's not a research company. A group of investors and a couple of faculty—Nobel Prize winner Bob Schrieffer; he's well known for the theory of superconductivity—wanted to start a new company in the area of high temperature superconductors, which are new materials that have been developed in the past three years. Historically, superconductors have an operating temperature of about 20 degrees Kelvin or lower, which was a rather low temperature. About three years ago, new high temperature superconductors were discovered that had transition temperatures, at which point they lost their resistance, that were at 95 to 100 degrees Kelvin. That was a very important discovery because now it made it possible to make the material behave as superconductors by using liquid nitrogen, which is a 77-degree Kelvin material. Anyway, when these materials were discovered, some people approached me to see if we could start a company, not just to do research but to develop devices and make products with these materials. That company now is relatively successful. It has a very distinguished CEO, a person who previously started and built up a major company in lasers. I'm on their advisory board and on the board of directors. I have a relatively small share of the company. It's primarily owned by major corporations and venture capitalists.

CMM: How do you relax; how do you spend your weekends?

RM: Don't I look relaxed to you?

CMM: Actually you do look relaxed. It's a good image.

RM: Image? I don't go for image. This is it. We live on a ranch, a small ranch. We have horses. My wife is actually a very accomplished trainer. So, she rides her horses. I ride sometimes, not often. I play tennis. I have my own court so I play a lot. I don't know if I'll have one here, probably not. I exercise. We go on short trips around our own area. It's a beautiful area we live in [Santa Ynez]. We take in a concert now and again and do all the things other people do. We socialize a little bit.

CMM: Do you ride western [or English style]?

RM: We all ride western. I'm not a very good rider. Actually, my wife trains the horses, breaks them, and when they're safe, I get on them.

CMM: Does she buy young horses?

RM: We usually breed our own horses, or she'll get some from her family ranch; they'll bring them down. But she breaks them when they're young. I inherited three horses when we got married. I was a young professor then.

CMM: I can see why you had to be a president. Why did you want to be president, besides paying for the horses?

RM: Well, I actually didn't want to be president. The thing is I didn't want to be president of just any institution. I never put my name in for these types of appointments. I was nominated several times for different positions, but at some point or another when they contacted me, I didn't participate. So I never thought of being a president of an institution. Any institution. Carnegie Mellon is different in that it's unique. I think there's a fit between the institution and my own interests and whatever talents I have. It has everything—technology, good science, magnificent arts and drama and strong humanities and social sciences—for example, a tremendous Psychology Department. It has a very unique balance that's not enjoyed by the rest of our high technology schools. I can't think of another institution that combines all the unique talents that exist on this campus. For example, Drama. I don't think you'd find a high-tech school, at least not many, with a drama department like ours. While engineering and the sciences are areas that I'm most knowledgeable in, the uniqueness of combining these with humanities and social sciences and the arts makes this a very enjoyable place to work.

CMM: Steven Muller, retiring president of Johns Hopkins, said, "When you look for a president, you're looking for somebody who can walk on water"—a scholar, fundraiser, cheerleader, manager. How do you rate yourself in those departments? Who walks on water?

RM: Oh, nobody. Certainly not I. Different people have different strengths. No one person can have all the necessary talents. The important thing is to recognize what one's strengths are and make sure that one complements those with the people that one surrounds oneself with. Like any other activity, any other enterprise, it is critical to have the best people running the institution and not try to run the institution by oneself. I know there are some outstanding people here already. And it's important to get them to do a lot of the things that make the salt in the water increase and make it easier for me to walk on it. I think I have certain talents, and I'll try and work on those. And I will get people that are more talented in other areas to complement what I can do.

CMM: What are your talents?

RM: Well, I believe I have personal competence in certain areas of technology. I certainly know the directions that have been helpful to me in other organizations that I've been involved in. I've also had a lot of interaction with industry, both as a technologist as well as an adviser—sometimes in manufacturing. And I think I have a sense of what some of our companies need in terms of training that we give our students. So I have certain views on those issues. I also have some views regarding the need to train students more broadly. They're going to participate in an environment that's going to be information-intensive, global in nature and multicultural. I think I have some appreciation of those issues. I have managed budgets before, both in the government and at universities, so I have some understanding of the budget. On the other hand, I don't know all the complexities of the budget at CMU. I'm just learning. I also think that this position, like any other position, is intensive in human interaction. And I believe I have a reasonable approach to dealing with other people. I believe that's very important for this job. Sensitivity to other people's needs and aspirations is important. It's something that one has to be cognizant of all the time.

CMM: When you look at the end product of a university education, what is the ideal graduate, what qualities—intellectual and otherwise—does that person have as a result of his/her university education?

RM: There are different answers to that...but underlying those is a common denominator of being able to read other people's thoughts, being able to communicate with other people, being sensitive to other views than one's own, being able to solve problems and deal with ambiguity—rather than yes and no. Basically, being able to enjoy life while making a contribution to society. And I think most of us forget a lot of the equations or formulas that we learn in class. The things that you learn in the university, in education, that are the most useful are those that you're left with when you forget everything else.

CMM: It took me 20 years to realize the value of taking 30 credits of philosophy.

RM: Philosophy can be very frustrating. I started as a philosophy major. It's a

MEHRABIAN, ROBERT, b Tehran, Iran, July 31, 41; US citizen; m 77. RAPID SOLIDIFICATION, MATERIAL PROCESSING. *Educ:* Mass Inst Technol, BS, 64, PhD(metall), 68. *Prof Exp:* From asst prof to assoc prof metall & mat sci, Mass Inst Technol, 72-75; from assoc prof to prof, Univ Ill, Urbana, 75-79, adj prof metall, 75-79; chief metall, Nat Bur Standards, Dept Com, 80-82, dir, Ctr Mat Sci, 82-83; DEAN, COL ENG, UNIV CALIF, SANTA BARBARA, 83- *Concurrent Pos:* Consult, Rheocast Corp, 74-, Army Mat & Mech Res Ctr, 75-, Univ Space Res Admin, 75-, United Technol, 76-, Sandia Labs, 76- & Phrasor Technol, 77-; mem, Nat Mat Adv Bd Amorphous & Metastable Mat, 78. *Honors & Awards:* George Kimball Burgess Mem Lectr, Washington, DC, 80; Henry Marion Howe Medal, Am Soc Metals, 83. *Mem:* Nat Acad Eng; Am Inst Metall Engrs; Am Soc Metals; Am Ceramic Soc; Am Welding Soc; Am Soc Testing & Mat; AAAS. *Res:* Foundry solidification, powder metallurgy, metal matrix composites and refining of alloy scrap; co-inventor of rheocasting and several associated processes. *Mailing Add:* Col Eng Univ Calif Santa Barbara CA 93106

President Mehrabian's entry in American Men & Women of Science.

wonderful field. There are not always very clear answers. There are a lot of questions. It's a way of thinking.

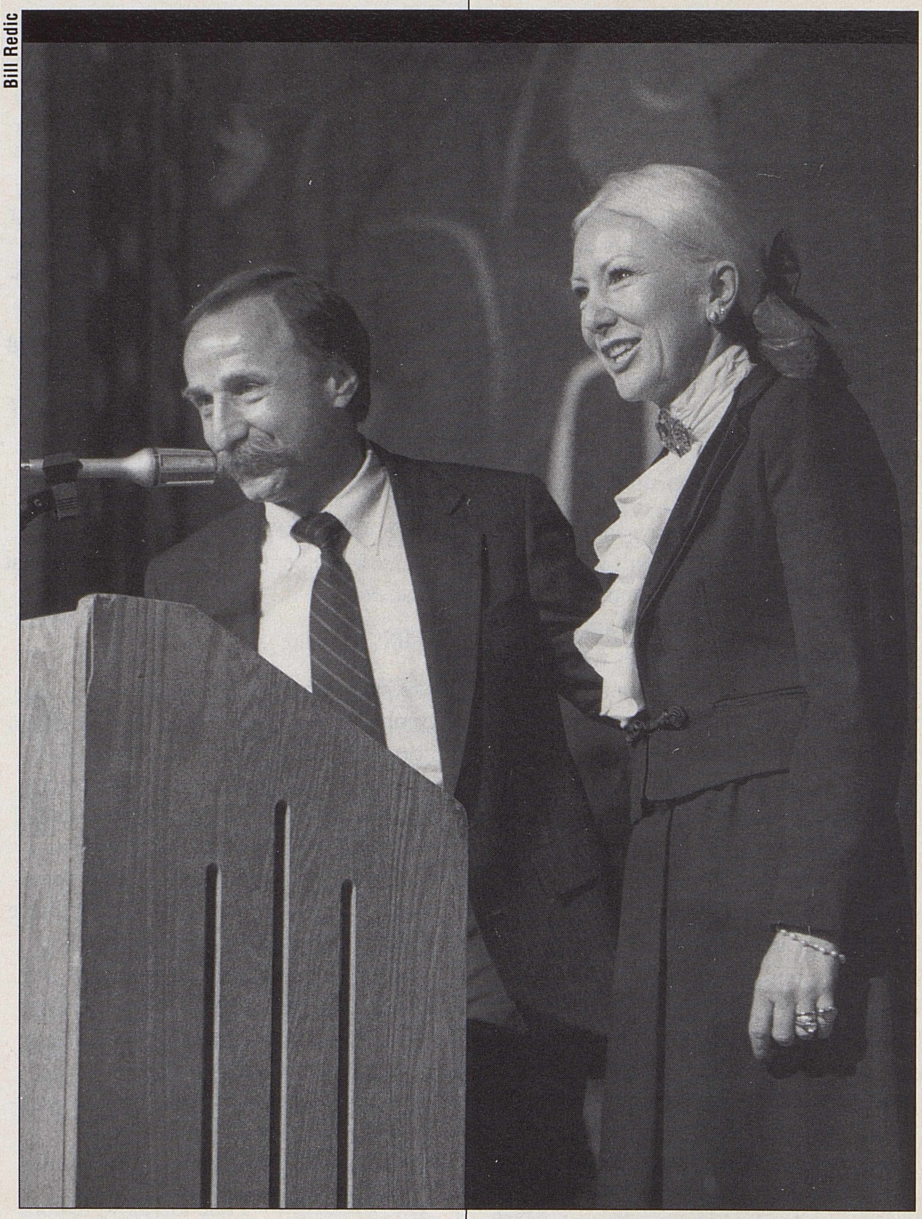
CMM: Have universities given up on the idea of transmitting a core of knowledge to students and stress instead learning how to learn or learning a specific profession? Are there basics we want students to have?

RM: Sure we do. But the problem that we've run into is in specific areas of education; the demand for intensive learning in that area has gotten to a point where we don't have much time left to educate our students broadly. In engineering there's an accreditation board [that] basically determines how many courses students should take in each subject area in order to graduate. Now, when you get through satisfying all of these requirements that are needed if you are going to be an accredited school, it doesn't leave a whole lot of time for electives. The other issue is how do you distribute those electives. It's my aim to encourage taking a hard look at that across this campus as other campuses have done. There's some of that going on now both in the college of engineering and other colleges, but I'd like to see if we can look at our goal—the broadening of our education. And by that I don't mean just engineers learning about other cultures, other social issues or the arts. I'm also looking at whether the people in humanities are learning about issues that are of technological relevance. I think it's important to reexamine the fundamental educational needs of our students in a world that they're going to live in. And that's an issue that you can't just do once a year or once every three years or once every five years. It's an issue that always has to be at the forefront.

CMM: Do you expect to make curriculum changes?

RM: I expect to emphasize undergraduate education with the same intensity that we've emphasized research. That doesn't mean that I'm going to deemphasize research. I just think that we can bring the same energy to our undergraduate education. No president makes changes in curriculum. I'm going to ask the colleges

Bill Redic



Robert Mehrabian introduces his wife, Victoria, to faculty and staff at the announcement of his selection as seventh president of Carnegie Mellon University. A teacher in bilingual education in English and Spanish, Victoria Mehrabian is also an accomplished horsewoman and served as vice president of the California Cattlewomen's Association.

and the Faculty Senate to address these issues in cooperation with one another. There are already some very strong programs and initiatives underway. I'm going to encourage these activities and try to bring some coherency among them across the campus. We also need to have somebody on this campus who wakes up every morning and has as his or her primary objective the education of our undergraduates. Other schools have people like that. Sometimes they're called deans of undergraduate education or associate provosts for undergraduate education. We don't have that. I'm also going to seek the faculty's advice on this issue. And I'm going to seek the students' advice. I believe the alumni would appreciate that. I'm told that the alumni, most of them, feel that they had a really good education at CMU, but that they didn't necessarily enjoy their stay here all that much. Well, there's a quality of life issue that goes beyond the educational aspect of which courses they take. What happens out of class? Do they have a place to gather, to interact? Are there a lot of international and cultural issues brought to campus? At any given time we have about 1,000 visitors from across the world. We should have some activities that relate and actually exploit that resource. The students are complaining, for example, about the state of the Greek houses. I think we should take a look at those things. I think we should emphasize some of the issues that are important to the students and to their quality of life, and I believe on this issue we need to get a lot of input from the students. I've already started doing that.

CMM: Do you see a gap between the image and reality of Carnegie Mellon?

RM: I think the image is a strong technical school. And it is. What is not well known about Carnegie Mellon is the fact that there's also a very strong fine arts school and a humanities and social sciences school.

CMM: In what way is Carnegie Mellon not a traditional university?

RM: It displays a lot more flexibility than traditional universities do. There aren't strong impediments to interaction between departments as you find in traditional universities. I think the style here is to be flexible, be innovative, be creative. And you can see that in the tremendous strides that the university has made in research in the recent past. I think in that way, it's much more energetic and flexible than traditional universities.

CMM: Are you planning to institute a sabbatical program for faculty? I was surprised to find out we didn't have one.

RM:. So was I.

CMM: You were planning on one in seven years?

RM: No. Actually, I have never had a sabbatical leave. I'm due, but you shouldn't pay the bill. I left MIT before I accumulated significant sabbatical leave. I left Illinois after four years. I have almost a year or more of accumulated, full-pay sabbatical at Santa Barbara, which I'm walking away from, which is fine. In my case I've changed jobs, changed my interests over a period of time. Sabbaticals are really a method of getting away from what you're doing, intellectually energizing yourself. It's happened to me by just moving to another job. Let's come back to the sabbatical policy. I was surprised we didn't have one, but as I took a hard look at your budgets, I began to appreciate why you don't have one. The campus resources, as they are, are rather strained. They're very strained actually. A sabbatical program would be very costly. That doesn't mean we shouldn't have one. It's just that to have one, we have to create the resources to be able to afford one. Right now as I look at the budgets, I'm worrying about how to make sure that people we already have on board receive the support that they need while they're on campus. I'm going to look into it, but it's not an easy problem to address. I'm not pessimistic about it.

CMM: What about the current building plans?

RM: The University Center. Absolutely. In the capital campaign as we have it today, there are a number of buildings specified. That includes the University Center, the Graduate School of Industrial Administration building, a performance center or an arts building, an electronic materials technology building, renovation of chemistry labs and modification and renovation of the gymnasium. That's in the present capital campaign. On the other hand, all the money is not there. Not even nearly there. And I've talked to the trustees committee responsible for the campaign, and I've also talked to the deans and the faculty representatives. It's probably going to be my posture to keep those buildings as the first phase of what we need to do. More importantly, expectations have been built up. And I'm very sensitive to those. So we are going to keep that list. Within that we have to prioritize in terms of funds that we can raise and of funds that are available. Brick-and-mortar funds have turned out to be the most difficult for this campus to raise. The University Center, I'm absolutely committed to. The GSIA building, we're close to finishing the campaign. We're still short, but plans have been developed. I'm going to really emphasize building a performance center. I think this campus needs it, it deserves it and I think the community will appreciate having it.

CMM: The drama alumni will canonize you.

RM: I'd rather they help me make the building a possibility.

CMM: Anticipate any change in emphasis on computing?

RM: No, I don't because I'm still learning what you have. This campus is known worldwide for its strength in computing, for information transfer, for the Software Engineering Institute, for everything that you've done. I'm still learning what it all is. It's exciting. I don't think one should build new initiatives by deemphasizing successes. I think one should continue one's successes and selectively pick new areas for emphasis. For example, I'd like to see if we can put some renewed emphasis on the College of Fine Arts. That's the jewel that makes us very,
very unique.

CMM: Do you expect to expand it, make it more available to more students?

RM: No. I have no inclination to expand any area of the campus. I'm thinking always about improvements rather than quantity. I

think the issue is: can we bring more resources to that area? I just went, for example, through the studios where they do some of the artwork. I used to teach courses in casting and glassblowing for people who were in both the sciences and the arts. I started a course like that at MIT. Studios are never clean because of the kind of work done there, but they don't have to be in the state they're in right now. I mean that's not right. I'm not saying every area is like that. It's just that that's the only one that I happened to walk through because I was looking for some lab space for my own research. I think there are things we can do there. These are not super-expensive activities. There's some emphasis we can put on improving the quality of life for the students in those areas, as well as encouraging other people to participate and take advantage of this major opportunity that exists for them on this campus.

CMM: With cutbacks in defense spending, do you have plans for filling the gap?

RM: That's a baggage that I carry now. We have a lot of defense money in Santa Barbara. We also have National Science Foundation money, but I have a lot of defense money even in my own research. It's all basic money directed toward building new materials for a new shuttle (a high-speed aerospace plane). The problem is that as the defense budgets become constricted, we have to find alternate areas to work on. Frankly, an institution like Carnegie Mellon is fortunate in that regard. There are important problems that need to be addressed in the environmental area—risk and safety, for example, and nuclear and chemical safety. There are important issues that deal with construction, highways, urban renewal, information systems, high-definition television and manufacturing competitiveness. And there aren't that many people in the country who are leaders in technology, who can work on those problems successfully. And we have a strong cadre of those people here. And as the emphasis shifts to these new areas, we can be very competitive. What is more important is that we shouldn't wait till somebody in Washington shifts emphasis. We should be participants in identifying opportunities, working on new problems, being spokespeople for addressing these issues—that are technological or scientific in nature—and then be participants in solving the problems.

CMM: Do you see a source of funding then from businesses, industries interested in these problems?

RM: Also from other agencies of the government who have to address these issues. Take hazardous waste. It's a major problem in the nation. We're going to have to address it sometime. Why not us? I'm not suggesting I'll tell the faculty what they should do, but there are going to be opportunities for new areas of research, and it's not too early to start looking. And, by the way, I don't think defense is going to go away altogether. I think our people are always going to want a sense of security that is going to be necessary even though the world is changing and it's less hostile. There's going to be some steady level of need.

CMM: How do you expect to address the question of increasing the number of African-American, Hispanic and women students on campus?

RM: First, I don't know what our statistics are on underrepresented minorities, which are just the people you mentioned. I can only tell you I'm going to look into that and be very conscious of it and see how we can improve our situation. I can only give you my record on that. In the California system, there are 17 minority engineering programs throughout the universities.... Every year they're ranked on the basis of the quality of the programs and the retention of students. In those areas our program in Santa Barbara was ranked first this past year.

CMM: So you know how to do it. There are models.

RM: I don't know if I know how to do it. I've done it once in a specific area. There are models, but there's also an issue of sensitivity. There's an issue of trying to see what the problem is and finding some solutions in collaboration with other people and energizing the community to help do it. No one person is going to do it, but you can affect the directions.

CMM: Do you consider yourself a religious person?

RM: No, I'm not overly religious. I consider morality to be important, but I'm not overly religious.

CMM: What would you expect your relationship with alumni to be?

RM: Help.

CMM: "Help" is better than "give."

RM: No, no. You don't always have to go to the alumni for money. I think the alumni have a perspective on this institution that's probably in a lot of ways more balanced than the rest of us who are participants. They've been here; now they've gone out; and they're taking a much more objective look at the institution and how it's been important and how it's affected their careers and their lives. I think they can participate in forming the future direction of the university. I really need alumni help on this. We need to energize the alumni. I can't do this by myself. The faculty can't. Neither can the students or the staff. We need to bring the alumni in and get them much more involved in our campus activities. They can participate both in terms of being on the board, by coming here, visiting with us, talking to our students, talking to the faculty, talking to the administration. I want them involved. Frankly, we have to have them involved. Their participation is going to be key to our success.

CMM: About the moustache?

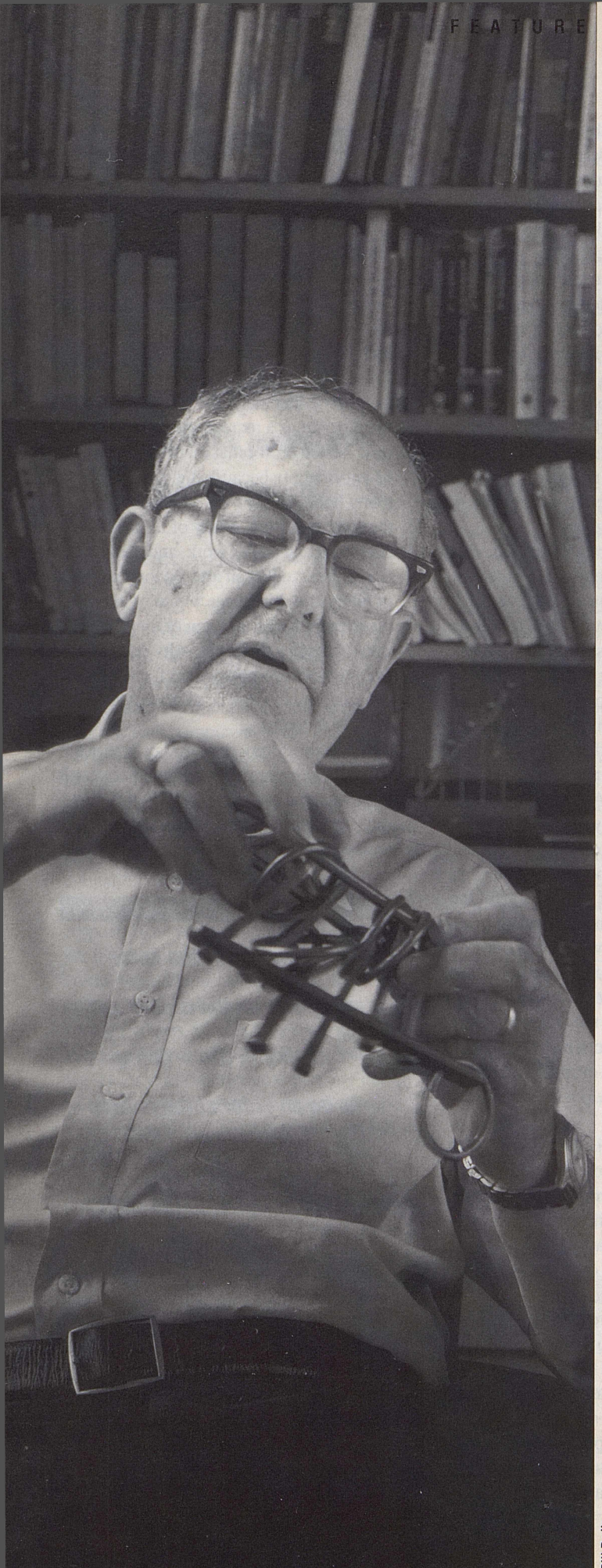
RM: Nah, you're not going to ask that. I've had it since 1963.

CMM: What made you do it?

RM: I don't know. It was there, and it stayed. My grandfather on my mother's side had one. And my grandmother always said I was more like him than anybody else in the family. I never thought about it much. I've kind of gotten used to it. I don't notice it; everybody else does.

By Herbert A. Simon

Putting Computers in Perspective



Bill Redic

Herbert A. Simon is hard at work on the Chinese Ring Puzzle. It's for people who like to solve hard puzzles, he says. It helps in his research on problem solving.

I have lived in a computer-intensive environment for about 20 years now, and the thing that impresses me most about it is how similar it is to the environment that I lived in before computers. Obviously, some things are very different. It is very different to use a word processor and have almost painless manuscript revisions instead of retyping every time you thought something was terribly wrong with it. There are all sorts of ways in which productivity is increased. But what is really important about a workplace are the skills you use in it and the interactions you have with other human beings.

There are some workplaces where introducing computing or automatic devices does change interaction among human beings. For example, automation is making the traditional assembly line obsolete, particularly the hand assembly line where somebody stands all day and does one thing. It is becoming obsolete because those tasks can be efficiently automated in the workplace. If you look at the workplace in general, however, you find no dramatic changes in the average skill levels in the working population. Some studies record slight increases in skill demands, and some studies report that jobs have been a little bit routinized. Nothing very dramatic. And you find that there are not dramatic changes in the kinds of human interaction in the workplace in spite of fancy things like mail systems and electronic communication of all sorts. The number of hours people spend interacting with other people in something like our School of Computer Science or a clerical office that's highly automated is probably not very different from that number before computers.

Many of us have seen Charlie Chaplin's famous film "Modern Times," in which a poor little man runs around trying to escape from the machinery in a factory. That image has become a symbol of some of the attitudes or anxieties we have about machines and industrialization. But in most of the computerized workplaces that I look at, the machines are well in hand; they're

well under human control. And again we should not just predict whether it is going to continue to be this way; we should arrange our affairs and how we go about automating and computerizing so that it will continue to be that way. There are still a lot of people around; we still outnumber computers a little bit. Maybe we can keep that true for quite a long while.

Charlie Chaplin's "Modern Times" has become a symbol of some of the attitudes or anxieties we have about machines and industrialization.

One might argue that much of the change in the office or the workplace is changes in the mind. Any new technology or other change can be treated either as a threat or as a challenge. A secretary can look at the new word processor and say, "How am I ever going to deal with all these terrible things I have to learn?" Or the secretary can say, "That looks like a lot of fun: there's not going to be as much straight typing on this job as there was on the previous job." A lot of the reaction to technology is a matter of how we view it. And how we view it is considerably a matter of whether we think we are in charge of the technology or the technology is in charge of us. In thinking about this we have to ask, who is in charge? We have to ask, how can we organize our society so that we will be in charge? So that we will feel that this is an adventure we're having and not something that is being done to us.

A lot of recent attention has focused on the effects of computers in the home and at leisure. Of course, the most visible aspect has been the great boom in personal computers in the home and in all kinds of fun and games. Almost everybody probably has some basis for interpreting and understanding what kind of an impact this is going to have on our homes. How important will it be that in a few years your computer can deliver to you information that is equivalent to the old Sears Roebuck catalog? How fundamental a difference will it make in your life if you access to the Sears catalog or access to the World Almanac or access to other data banks? How often do you use data banks? How often do you go to a library in order to get some information other than the information you need for school and education? Schools are rather special places in the demands they make on information. So I think it's an open question of whether the American home becomes a very different place when it is saturated with computers.

Now mind, there will be some computer addicts. Any society has a certain amount of anxiety, and certain people have more than their quota of it. It is well known to psychiatrists that if people have a little bit of floating anxiety, one of the soothing things to do with it is to find some kind of task with a fairly quick feedback or knowledge of results. There are all sorts of good therapies we can have in our homes. At one time people were soothed by playing the piano: you can do it by playing chess, you can do it by playing on your home computer. There are all sorts of hobbies useful for that purpose that you can become addicted to. And so we have in our society today some computer addicts. A clinical psychologist at Carnegie Mellon some years ago told me that, yes, there were computer addicts, but the population of chess addicts had dropped off. One assumes that there was a certain amount of substitution.

My own guess is that the impact of the home computer on the nature and quality of life is going to be an order of magnitude less significant than that of the telephone, the radio, the TV and the VCR. Those are the other lively things around the house with which the computer is going to have to compete and is competing. And two things are not clear: Who's going to win the competition? And what does it matter after all? Radio, television and VCR are completely passive devices. Other people do things and, if it amuses you, you sit and watch them or listen to them. Maybe it is just snobbishness, but it is hard to believe that passivity is all good in more than moderate amounts. The home computer has the virtue at least of being a potentially active device. Of course, you can find all sorts of mindless things to do with it, but it is a potentially active device. Maybe it has some of the same beneficial advantages that playing a round of golf has instead of sitting home and watching whatever you watch.

On the other hand, I think it is very rash to suppose that the home computer is going to take over as a recreational and leisure-time device or, for that matter, as a source of information, because it is not clear how many hours of our lives we want to spend in that active posture. Many of us have pretty strenuous and active work, and some people find it great to just sit around for a couple of hours and drink beer with or without pictures flickering in front of them. So I think that after its first novelty value wears off, the home computer is in for very tough competition as a device to occupy our time and our thoughts.

The most important things in almost any person's environment are other people. That was true before we had high technology, and that is true as we gain a high technology. People have also always been

The impact of the home computer on the nature and quality of life is going to be an order of magnitude less significant than that of the telephone, the radio, the TV and the VCR.

a little bit in love with their artifacts. People fall in love with sailboats, they fall in love with motorcycles, and I'm sure at one time they fell in love with stone axes. People have always gotten pleasure out of using artifacts well. They have gotten pleasure out of making artifacts. But the real love affair of human beings tends to be with other

The real love affair of human beings tends to be with other human beings, and I do not see that a high-tech society is any different in that respect from a low-tech society.

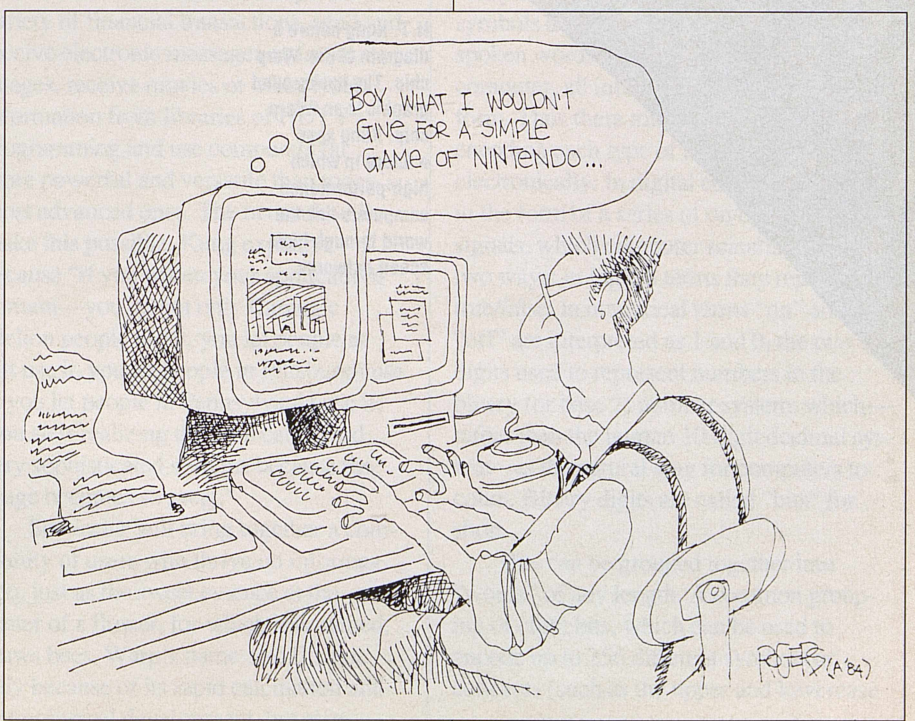
human beings, and I do not see that a high-tech society is any different in that respect from a low-tech society.

Now consider education. There is an experiment, which many of us find very exciting, going on at Carnegie Mellon. This is an experiment in saturating the campus with computers—offering ourselves up, as it were, as experimental subjects to see what those computers do to our lives. Or, more constructively, to see how imaginative we can be in using those computers to make our lives and our education more productive, more enjoyable and more worthwhile in every respect. Now when one thinks of computers in relation to education, one thinks of computer-aided instruction. And of course, if computers are to pay their way on this campus, if the whole experiment is to be worthwhile, it will only be because we do some of our mental exercising in interaction with this device. So computer-aided instruction is terribly important. But if this experiment is to succeed, we're going to have to mean something by computer-aided instruction very different from what it has meant over the past 30 years. For the past 30 years, computer-aided instruction—there are notable exceptions to this, but let me talk about the mainstream—has largely meant computerizing drill and practice exercises that could just as well be done with paper and pencil. Most computer-aided instruction does not, in fact, make any deep use of the superior capabilities that computers have to interact with the user and to engage in genuine problem-solving behavior with the user.

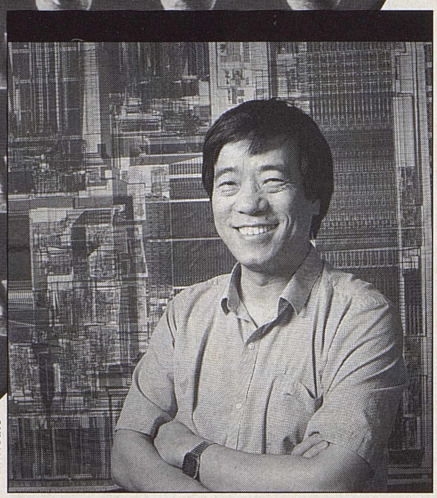
We will move beyond the kind of humdrum use of the computer that has characterized most computer-aided instruction in the past only by producing sophisticated software that uses the computer in more intelligent ways. And in order to do that we are going to have to understand a great deal more than we have understood in the past about how human beings learn, about how they interact with each other in a learning situation and about how they might interact with devices like computers if those computers were programmed to respond in more or less intelligent ways. That is really what the experiment is all about here, whether we can develop that kind of intelligence on the computer end of this system. Our enrollment policies take care of the intelligence on the human end of the system. I am worried about whether we are going to be clever enough and bright enough to make those computers work as a part of the educational experience here. If we succeed, it will be because we put a considerable effort into research on cognitive science, on understanding the human learning processes.

Over the past 25 years we have made enormous progress in understanding what goes on in the human head in terms of information processing, what goes on in the human head when human beings are solving problems, discovering concepts, thinking and using language. The task now is to develop that understanding further and to apply it to creating software that we on this campus and other campuses are going to want to use. That is a valuable goal. It is a valuable goal because we do not have any right to be satisfied with the way in which we carry on educational processes, not only here but anywhere in this world. Educating a new generation, which is society's continuing responsibility, takes 10 percent of our gross national product. And so, making that more effective, increasing the quality of what we are doing with those enormous resources, is certainly a very important goal for us. In engaging in this exciting experiment, Carnegie Mellon can make a very substantial contribution toward that goal.

Herbert A. Simon is Richard King Mellon university professor of computer science and psychology at Carnegie Mellon. The preceding is excerpted from "Computing and Change on Campus," edited by Carnegie Mellon professors Sara B. Kiesler and Lee S. Sproull. Reprinted with the permission of Cambridge University Press.



Faster



Bill Redic

H.T. Kung before a diagram of the Warp chip. The background graphic is an iWarp chip. Kung sees a future in which high-performance computers link the world through high-speed networks.

Computer scientists speak a language all their own, full of acronyms, allusions to science fiction and flights of whimsy. And why not? They work in an environment where last month's imagination is today's reality, where three years is a generation, where products five years old are obsolete and where half the fun is coining new words to describe the previously indescribable. Everything changes, to borrow an expression from "Star Trek" as computer scientists often do, at "warp speed."

So it was no wonder that a group of Carnegie Mellon computer scientists, developing a new concept in high performance computing systems in 1984 under the leadership of Professor H. T. Kung, chose to call their project "Warp." The project, which included the design and development of hardware, software and a new computer language to take advantage of the Warp machine's unique capabilities, progressed at a typically rapid computer science pace. By June 1985, the researchers had a laboratory prototype in operation; in February and June 1986, they received more advanced, commercial prototypes from General Electric and Honeywell. Extensive testing of the prototypes demonstrated their applicability, efficiency and ease of use for many types of scientific computing, but most particularly those related to signal and image processing—the translation of electronic signals, like those in radar, sonar or television, into images and, in some cases, the characterization or identification of objects in those images. The prototypes were successful in applications such as a simple form of vision for robot vehicle navigation, calculations for magnetic resonance imaging, and simulations of radar and sonar signal processing.

Than a Speeding Bullet

Prior to Warp, signal and image processing often required the design and development of special-purpose hardware for each application. Now electronic systems designers had an efficient, effective, general-purpose machine for those tasks. It was no wonder, then, that in April 1987, when General Electric delivered the first commercial Warp machine to Carnegie Mellon, it began marketing the product as "a giant step into the future."

On the computer science time scale, 1987 was a generation ago, and today, a new generation of the Warp machine, iWarp, has come onto the scene. In iWarp, the printed circuit boards of the original Warp machine have been replaced by 650,000-transistor integrated circuit chips developed in a cooperative effort between Carnegie Mellon and the Intel Corporation. The integrated circuits provide not only higher speed but new interconnection possibilities and vastly increased versatility and capability.

But even high-performance computers like iWarp are not sufficient for every application, so their users will often want to have access to information and capabilities found elsewhere. Thus Kung, who is Shell distinguished professor of computer science in the School of Computer Science, and his colleagues are also working on Nectar, a network computer architecture, to enable high-speed interchange of information between machines, even when they are separated by large distances. Nectar promises to place vast computer and information resources within reach of large numbers of users.

Nectar, Warp and You

But what does all of this rapid development mean to the ordinary person? Kung sees it playing a central role in the revolution in consumer telecommunication and information products. In his view, which is shared by most experts, the typical home of the relatively near future will have a high-definition television (HDTV) system with images as sharp and clear as high-quality photographs, a fax machine, a telephone so powerful that it ought to be called a telecommunicator and an affordable computer workstation of modest power, all connected to the outside world by a pair of thin fiber-optic cables.

From home or office, a person will be able to browse through catalogs, read electronic magazines, newspapers or books, order merchandise, carry out a variety of financial transactions, send and receive electronic messages or facsimile images, receive movies or other video information from libraries of HDTV programming and use computers far more powerful and versatile than today's most advanced ones. The network will make this possible, Kung explains, because "if you widen your applications domain—you let not only Carnegie Mellon people use it, you let people at Pitt use it, you let people in Pittsburgh use it, you let people in Pennsylvania use it. You start realizing that you can afford very sophisticated systems because the usage becomes so great."

So Nectar will bring together a community of users who thrive on information, just as the sweet essence at the center of a flower, for which it is named, draws bees. Warp's name also fits not only because of its rapid calculation and technological development, but also because the Warp machine, like the warp of a loom, can serve as the foundation of many designs. That, to Kung and his colleagues, is a more significant achievement than its speed alone. Understanding why requires a short lesson in computer vocabulary, followed by one in computer anatomy, or as computer scientists say, "computer architecture."

FLOPS to Nybbles

A computer is a programmable information processing machine. It takes in information from an input device, such as a keyboard or a camera, manipulates that information and produces information that it then sends to an output device, such as a video display tube. The manipulation takes place in a part of the computer known as a processor.

For a human, information can take many forms—letters on a page, graphs, symbols and diagrams, musical notes, spoken words and so forth—but in a computer, all information is in electronic form. Thus there must be a method of encoding each type of human information electronically. In digital computers, that is in the form of a series of on/off electrical signals, which computer scientists view in two ways: in logical terms they represent true/false; in numerical terms "on" and "off" are interpreted as 1 and 0, the two digits used to represent numbers in the binary (or base 2) number system, which—rather than the human 10-digit decimal system—is the natural way for computers to count. Binary digits are called "bits" for short.

Bits can be grouped together into "words" of any length. A common grouping of eight bits, which can be used to encode up to 256 different symbols or concepts (such as the upper and lowercase

alphabet plus numerals, punctuation marks and other special symbols used in writing English and foreign words), is called a "byte." Whimsical computer scientists sometimes call a half-byte a "nybble."

The processor performs certain operations on the information, such as adding or multiplying two numbers. An operation consists of carrying out one or more basic instructions. Each type of processor has its own set of instructions, and the number of possible instructions in that set is determined by the length of the instruction word. The speed of a processor is measured in the number of operations it can carry out per unit time. Since operations can vary in complexity, computer scientists compare processor speeds using a certain class of mathematical operations, called floating point operations, as a standard. FLoating-point Operations Per Second are called "FLOPS."

Since computers normally deal with vast amounts of information, they contain components in which information is stored, appropriately called "memory." Memory sizes are measured in thousands ("kilo-"), millions ("mega-"), or even billions ("giga-") of bits. Some data collections are so huge that they are measured in "terabits" (trillions of bits). Processor speeds are usually measured in megaflops, although gigaflops are already a reality for supercomputers. Transfer of information between one part of a computer and another or between two computers takes place at speeds measured in megabytes per second.

Different types of computer memory are designed for different purposes. "Internal memory" stores information that is most frequently needed and most frequently changes. It must be made of a material that switches quickly on and off, and it must be designed for rapid transfer of information between it and the processor; semiconductor integrated circuits (ICs) generally fulfill those requirements. Since ICs are comparatively expensive on a per-bit basis, larger amounts of information are stored in "mass storage" devices such as disk drives. These provide slower access to the information, but at a more reasonable cost per bit of memory. Finally, archival data, which tends to contain the greatest number of bits, is stored on an inexpensive computer-readable medium such as magnetic tape.

Processors, memories and input/output devices make up the hardware of a computer, but the sequence of processor instructions is the result of a program, or software, that someone wrote. Most software is written in a specialized language that looks like a cross between a human language such as English and algebra. So before software can be carried out, it must first be translated into fundamental instructions for the processor by another program called a compiler.

Computer Architecture: Anatomy is Destiny

Each type of computer requires its own compiler for two reasons. First, the result of compilation is instructions in the internal language of a particular processor. Second, although different computers may be based on the same processor, they may have very different architectures. A conventional computer, illustrated in Figure A on the next page, has a single processor, the so-called Central Processing Unit, connected to single internal memory and mass storage units whose sizes are selected according to the anticipated uses of the machine. In carrying out the instructions of a given piece of software, the processor will generally have to store and retrieve information from memory. The instructions produced by the compiler must take into account how much internal memory is available.

This computer carries out processor instructions serially, one after the other. Supercomputers, such as those at the Pittsburgh Supercomputing Center, have several processors that communicate through and are connected to a single, large internal memory (Figure B). The advantage of such an architecture is that most large computer calculations can be broken up into parts that can be distributed among the processors and carried out simultaneously, or "in parallel."

To understand the advantage of such an architecture, imagine that you had 10,000 test scores and 100 arithmetic experts. You could manage the computation of the average by dividing the list into sets of 100 numbers, giving each expert one set to add, then giving the 100 sums to one of the experts to add and finally divide by 10,000. With that arrangement, you could compute the average of 10,000 numbers in the time it would take one expert to perform 200 additions and one division. The calculation would be done in just over two percent of the time it would take a single arithmetician.

Or suppose you had the same set of test scores plus some additional data about each student, such as sex and age. Furthermore, suppose you wanted to compute a number of statistics: average, distribution of scores by sex, correlation of scores with age and so forth. You could assign a certain statistic to a different arithmetician, expecting each to work with a full set of data, or you could divide the data and the tasks in a variety of other ways. In any case, having multiple processors produces a great savings in computation time. The difficulty in using such an architecture to advantage lies in deciding how to partition the work. In a supercomputer, that decision is partially in the hands of the programmer, who must write the program in a way that reveals opportunities for parallelism, and partially in the compiler, which can act on those opportunities and assign parallel computations to different processors.

Achievements of Warp, Nectar

Unlike present supercomputers, which have a global memory shared by multiple processors, the Warp architecture, Figure C, has multiple processors, each with its own local memory, all connected to a central host computer. Each processor-memory unit is called a cell. The cells are arranged in a ring so that each one can exchange information with two neighbors. The great concerns in using such an architecture are synchronization and currency of information. When a problem is partitioned among the processors, the calculation usually requires that intermediate results from one cell (call it cell 1) be used by another (say cell 2). If the cells operate independently, as they must if local memory is to be advantageous, how

can you be sure that the number that cell 1 needs has been calculated and is still stored (not overwritten) in the memory of cell 2?

The answer is to take advantage of a concept, devised and studied by Kung and his students in the late 1970s and early 1980s, in which the individual cells operate independently until each completes its task, then pass messages to their neighbors containing information that will be needed in the next calculation period. Kung called this computer architectural concept "systolic," since its rhythm was reminiscent of a cyclic heartbeat and its message passing was analogous to the systolic, or pumping, phase of the cycle. Many computation problems, especially those in signal processing, are well-suited to partitioning among the cells in such an architecture. Each cell will require exactly or almost exactly the same amount of computation time during each step, and the number from cell 2 reaches cell 1 when it is needed.

The Warp architecture eliminated the need to build special-purpose signal processing computers for many applications, and iWarp is expected to be even more versatile. The iWarp architecture (Figure D) is similar to Warp except that the cells are connected in a two-dimensional grid instead of in a ring, something that can be conveniently done with iWarp's integrated circuits but which would create a tangle of wires with Warp's printed circuit boards.

In a Warp configuration, each systolic cycle brings two more cells within message transmission range. In an iWarp square configuration, after one cycle, four cells are in range, the second cycle adds eight more for a total of 12, the third cycle adds 12, bringing the total to 24, and so on. In addition, the length of the interconnections between cells are much shorter in iWarp, keeping down the delay time for signal transmission. Because of these advantages, iWarp has been designed not only as a systolic architecture but also to have the capability of passing large quantities of information between cells in very short times.

Computer architecture

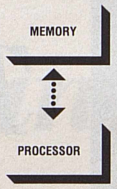


Figure A
A conventional computer with a single processor and a single memory. The processor carries out instructions sequentially.

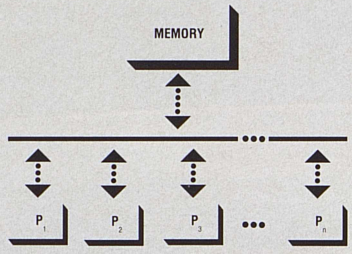


Figure B
A supercomputer, like the Cray Y-MP computer at the Pittsburgh Supercomputing Center, has multiple processors, which carry out instructions in parallel while communicating with a common memory.

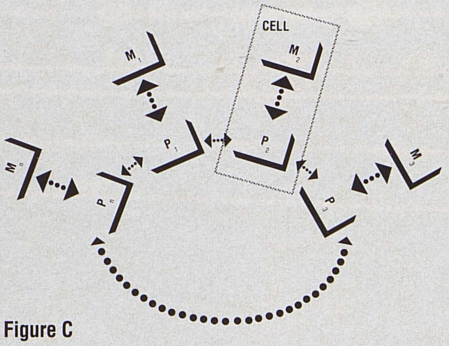


Figure C
Warp is made up of a set of cells, connected in a ring. Each cell is a processor with its own memory.

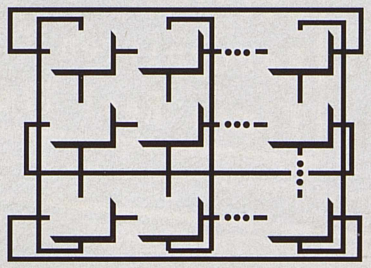


Figure D
iWarp, which takes its initial letter from its manufacturer, Intel Corporation, has an architecture that consists of a two-dimensional array of Warp cells, each of which is an integrated circuit. The connection scheme shown here is square, but others may follow a hexagonal or triangular arrangement.

Thus iWarp's designers expected that it could carry out many more applications than Warp, and prototype testing is proving them correct. As Kung says, "iWarp is different from other microprocessors in that it is supposed to be a building block, [out of which] you can form different special-purpose machines."

The most remarkable aspect of the Warp, iWarp and Nectar projects is the breadth of skills required to create them. More than 40 Carnegie Mellon researchers contributed to the development of the original concepts, the design and fabrication of the circuitry for prototype systems, and the implementation of extensive new software, including novel types of compilers.

Beyond iWarp

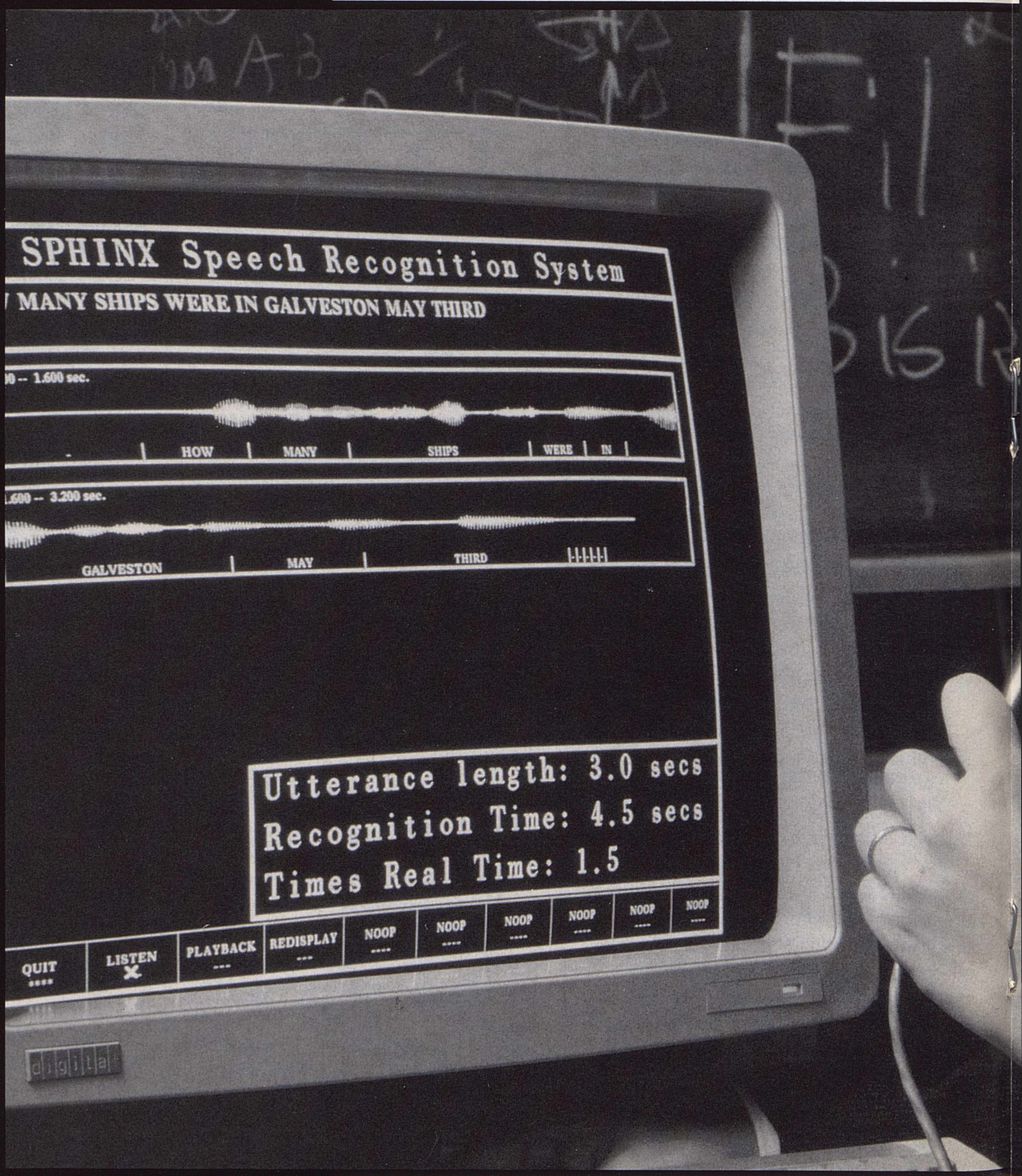
What lies beyond iWarp in the future? "General Electric has already proposed to put a whole bunch of iWarp [chips] on a wafer [of silicon]. It never ends," Kung says. He also expects to see "a few powerful building blocks. With them, you can build a whole bunch of different kinds of special purpose machines without paying a lot."

With supercomputers and iWarp-based special-purpose machines hooked up to the same Nectar network as individuals' personal computers and workstations, Kung sees no limit to what a person can do. His vision is of a future in which the most powerful computers and largest libraries will be within reach of every individual. "They should get everything on the network," he exults. "Just a pair of fibers going out; that's that. You can get the whole world!"

Physicist Alfred B. Bortz (S '66), who holds three degrees from Carnegie Mellon, is assistant director of the Data Storage Systems Center at Carnegie Mellon and senior research fellow in the Department of Engineering and Public Policy. He is also a free-lance writer. Franklin Watts will publish his children's book, "Superstuff! Materials That Have Changed Our Lives," this fall.

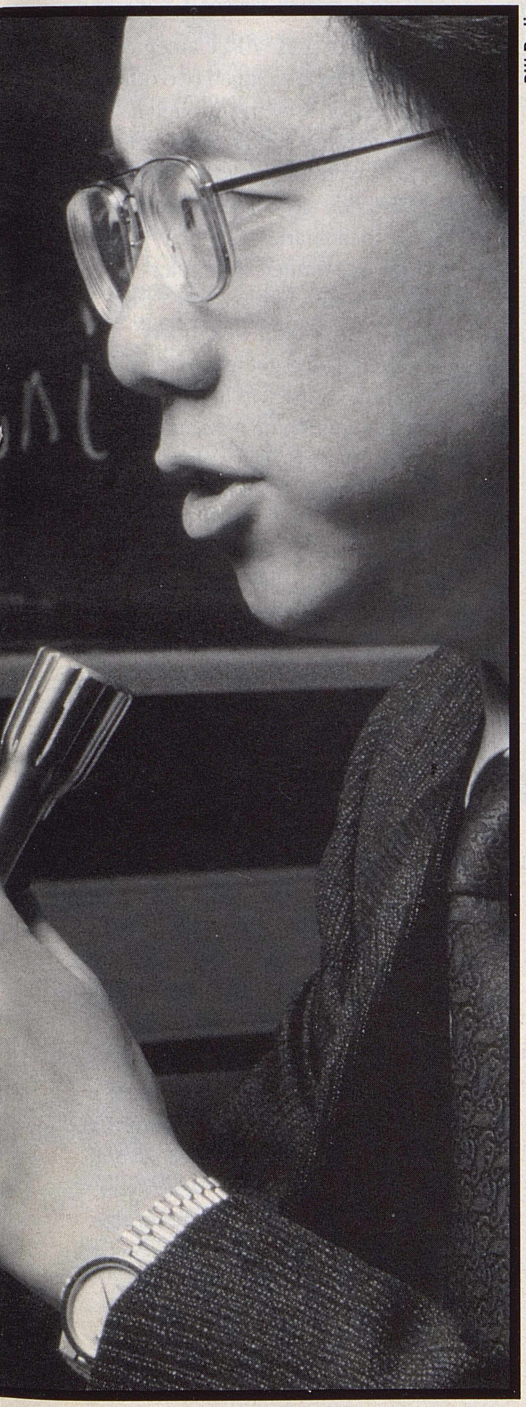
FEATURE By Adrian McCoy

Sphinx: The Computer



Kai-Fu Lee led the team of Carnegie Mellon researchers who developed a speech-recognition system that understands continuous speech from any number of different speakers.

That Understands You



Bill Redic

Computers that "hear" and "understand" the spoken word aren't just something in sci-fi books anymore. Ongoing research in speech recognition will ultimately affect everyone. In the next few decades, you could be doing your banking transactions and office tasks, such as storing or looking up information, with the help of computers that know what you're talking about.

Kai-Fu Lee, a research computer scientist at Carnegie Mellon, made significant strides in the field with the development of Sphinx, a voice recognition system that understands a set of questions and commands and is able to respond to them.

A Taiwan native, who did his undergraduate work at Columbia, Lee (S'88) struggled a year and a half to develop a working model of a data query system that would respond to spoken questions. He created such a system in 1988 in a project funded by a Defense Advanced Research Projects Agency (Darpa) contract and a National Science Foundation graduate fellowship.

Lee developed and tested Sphinx for a military application. The system can answer questions about the location, status and movements of Navy ships. Pentagon planners can quickly find information stored in the database.

"Naval officers can ask for locations and capabilities of ships," he says. "Under wartime situations, they might inquire about casualty reports and perhaps try different scenarios and placements of ships on a screen that shows the current deployment of naval resources."

But Sphinx can be adapted to many applications outside the military arena. "Basically, any database application would be very well suited for this," Lee says. "The recognition technology itself is really open-ended. You can build from the simplest digit recognizers to applications in database, spreadsheets and word processing, up to more ambitious things like taking dictation, aid for the handicapped or voice translation. There's a spectrum of products that can eventually come out of the research."

It's important to make a distinction between voice recognition and voice input technology. The latter is a sort of high-tech tape recorder that can remember what's being said. Unlike speech recognition, it won't understand what is said.

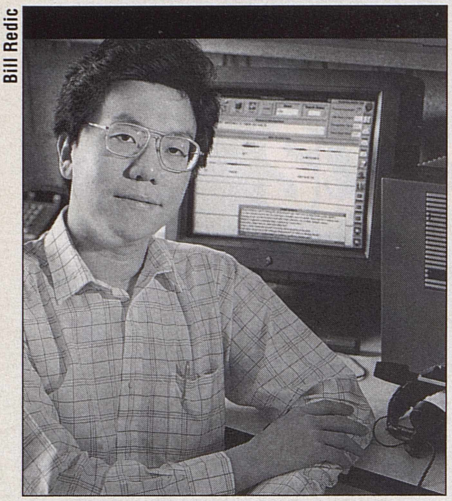
Sphinx was not the first word in speech recognition. There are a number of systems on the market with limited applications, such as AT&T's voice-activated dialing system for car phones—a safety feature that allows the driver to keep both hands on the wheel.

But Sphinx was a groundbreaker in speech recognition. It marked the first time such a system recognized continuous speech without requiring pauses between words and was, at the same time, speaker-independent, meaning that it doesn't matter who's talking to Sphinx. Most other systems had to be trained to recognize each voice. Sphinx was also highly accurate, and its development has moved the technology away from specialized and limited applications into a system that could work in a variety of scenarios and perform simple and complex functions.

Sphinx has a fairly large vocabulary of about 1,000 words, capable of forming 186 trillion sentences. There is also a prototype with a 5,000-word vocabulary, but it isn't a working model yet, Lee says.

The original Sphinx had a high accuracy rate— about 96 percent. In the past two years, the system has been refined and the error rate cut in half, making

Bill Redic



Because of research by Kai-Fu Lee, you may one day simply drive up to your banking machine, tell it your identification number and ask for money.

Sphinx on the mark about 98 percent of the time.

Lee's system works on a Sun Microsystems Inc. workstation, along with specialized hardware that samples and analyzes the speech. A speaker sits in front of the workstation and can read one of the recognized query sentences into a microphone. In a few seconds, Sphinx starts printing the speaker's question on the screen. Before the speaker even finishes, there are several words on screen. If Sphinx is connected to an application, a response will also be generated.

Sphinx processes the human voice by taking sound waves and converting them to electric voltage through a microphone. The sounds are digitized, or converted to a sequence of numbers. The goal, Lee explains, is to derive the most likely sequence of words created by the sequence of numbers.

The system considers a variety of factors: the proper grammatical structure of the sentence, pronunciation, when a sound occurs within the sentence, what sounds or words come before and after and how much emphasis is placed on the sound. Sphinx's "grammar" is a statistical measure of which words are most likely to follow one another.

Sphinx is built upon a statistical method known as Hidden Markov modeling—a powerful tool that analyzes voice input and selects the sound most likely to have produced it.

In order to make Sphinx speaker-independent, researchers used a wide sampling of voices to train the system. "That's a crucial factor in building successful learning systems," Lee says. Texas Instruments was the contractor for the data collection. The speakers included a range of accents—New England, Southern, Midwestern and even "Army brat," indicating people who move frequently and don't have a regional inflection. The speakers were 70 percent male and 30 percent female. Carnegie Mellon researchers continue to sample many additional voices in an effort to enhance the system's accuracy, so that it is able to understand different voices from different locations with different microphones in a variety of sentence formations.

In nearly three decades of study, progress in speech recognition has been slow. Earlier speech recognition systems were limited to individual words, or words set off by pauses. They had to be "trained" to recognize each speaker.

Raj Reddy, a university professor and director of the Robotics Institute at Carnegie Mellon, is a leading expert who has spent 25 years working in the field. Carnegie Mellon, in fact, started research in the area in 1969 when Reddy joined the faculty.

In the early to mid '70s, Carnegie Mellon researchers developed two other speech recognition systems through a Darpa grant—Harpy and Hearsay. "Both those systems were very interesting for their time," Reddy says. They also had 1,000-word vocabularies, but their performance was limited to simpler language functions and was more error-prone. Like Sphinx, both were query languages designed to get information from databases. Harpy was able to achieve 95 percent recognition on a document retrieval task. Hearsay was a more sophisticated program, but hampered by its slowness.

"What Lee did is extend the whole concept to speaker-independent systems, which had never been tried before," Reddy says. "It was a major advance for what we understood up to that point."

While Sphinx has been highly successful in overcoming the major hurdles speech recognition researchers faced, it wasn't without challenges. The same word can sound very different because of a number of factors: the speaker's tone of voice and accent and how quickly he or she is speaking. Where a word occurs in the sentence often affects the way it is said. For example, there are at least 50 different pronunciations for the word "the."

"One of the problems we encountered is that 1,000 words is a pretty awkward number," Lee says. Some applications can be successful with a limited set of several hundred words, he explains. "When you have 1,000, that's too many to memorize, but not large enough to say what you want.

"We're going toward both ends—limited tasks that we can get really great performance out of, as well as totally unlimited tasks where the user can say

anything he wants, including 'um' and 'uh,' or slam the door. That's the ultimate goal."

A system like Sphinx can open up computer accessibility to a new range of users.

"If we are able to make spoken communication a normal part of the computer interface, computers become much more available to people," says Alexander I. Rudnicky (HS'76), a systems scientist in Carnegie Mellon's School of Computer Science. Because speech is the most natural form of communication, as opposed to learning to type on a keyboard or manipulate a computer mouse, it could become the simplest and most accessible way for people and machines to interact.

Lee says it's reasonable to predict that most personal computers will someday have some sort of speech recognition capability.

"I think we could build a device with an unlimited vocabulary at, say, 80 percent accuracy within the next five to 10 years," he says.

One important development would be increased accessibility to computers for handicapped users. Hearing impaired people could use the system as a translator, without having to read lips. Blind users could receive responses printed in Braille. People without the use of their hands could work as easily as anyone else.

"For busy executives to use a translating telephone rather than a translator, if the system is not 100 percent accurate, they might just reject it," Lee says. "On the other hand, for handicapped people, if the system could transcribe 80 or 90 percent of the words correctly, it's very likely they could figure out the meaning anyway."

Lee and his colleagues also predict uses that could extend to just about everybody. We could call a number and ask an automated bank database what our balance is or order catalog merchandise. An airline traveler could request flight information and have a computer quickly narrow down the possibilities. An office worker could simply tell the machine to "Call so-and-so," instead of having to look up a number in a Rolodex and dial it. It could set up meetings, recording the appointment time or begging off if the time slot was taken. Physicians who spend time dictating lengthy patient medical histories wouldn't have to wait for someone to transcribe the information onto a record. Air traffic controllers or pilots who have to keep their eyes on a screen or do several things at once could benefit from being able to use voice commands.

As the use of voice mail becomes widespread, users could circumvent having to listen to several minutes of messages. Instead, they could simply review the messages on the screen for the information they really need.

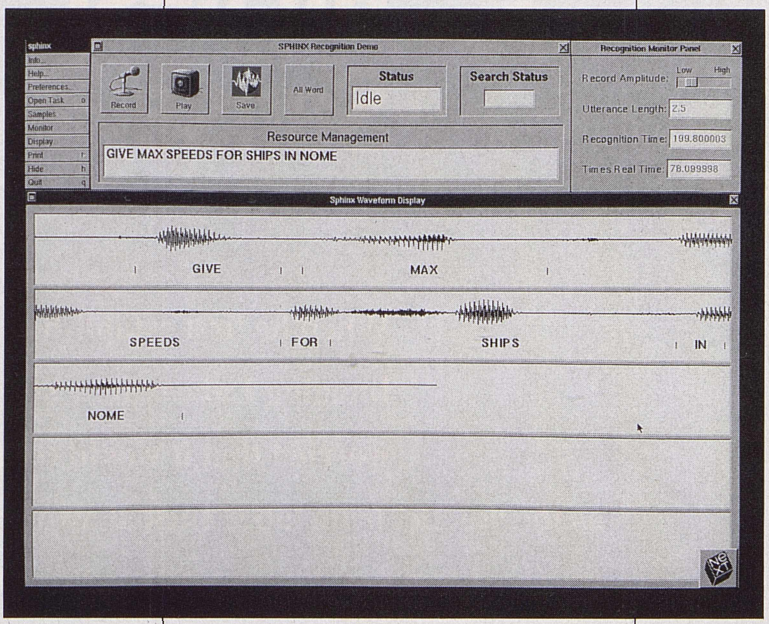
Business people who don't speak the same language could communicate by letting the system act as interpreter. Masaru Tomita, head of Carnegie Mellon's Center for Machine Translation, developed a system that can translate a doctor-patient exchange from Japanese to English.

Other Carnegie Mellon researchers are exploring different facets of voice recognition.

Sheryl R. Young, a research computer scientist, is developing ways for systems to understand a command within certain contexts, which eliminates many possibilities and speeds up the response process.

Rudnicky is looking at ways voice recognition can work in an office environment and make daily operations more efficient.

Wayne Ward, systems scientist, is working on an application for air travelers. It uses the official airline schedule guide as a database. The user can query the system for scheduling information. It marks the first time the system has been used with spontaneous speech, as opposed to reading grammatically correct sentences. The challenge was to have it understand spontaneous speech through the use of phrases rather than complete sentences and also make allowances for noise factors.



Sometimes Sphinx makes an error. For example, when asked to "Give max speeds for ships in Oakland," Sphinx heard, "Give max speeds for ships in Nome." It apparently linked the"n" from "in" to the"O" from "Oakland" and jumped to conclusions, just like people do.

Richard M. Stern, associate professor of electrical and computer engineering, is trying to make Sphinx microphone-independent. As it stands, the speaker now has to use a specific kind of headset microphone. A perfect voice recognition system is still a long way off.

"The interesting thing to remember is that people don't do perfect recognition," Reddy says. "They misunderstand and sometimes their mistakes turn out to be major problems. Computers aren't much different."

Adrian McCoy is a free-lance writer living in Pittsburgh.

Eyeballing the Richest Sense

Bill Redic



Steven A. Shafer in his dark room/laboratory in Wean Hall, where he uses toys, electric train sets and other shiny things to study how to give vision to robots.

When he first established the Calibrated Imaging Laboratory, Steven A. Shafer worried that it would come to be known as the "model train lab." Tucked away in a cabinet in the sparkling new laboratory is a large board with an entire narrow gauge train set-up that would make any 10-year-old leap with joy on Christmas morning. Not only does the lab's train have the usual tracks and tunnels, but it comes with interchangeable background

sets, which slip into the scene—a modern city, an old city, an industrial scene and oil refinery.

But the work that goes on in the lab is anything but child's play. Shafer (S'79), a senior research computer scientist, Takeo Kanade, co-director of the Robotics Institute, and a group of graduate students are investigating computer vision using high precision image data. Shafer's goal in the Calibrated Imaging Laboratory is "to develop a theory of vision that unifies the mathematics, the geometry, the optics" involved in the act of seeing. Not only does the train give researchers an opportunity to study objects in motion, but the different scenes provide an abundance of shapes, colors, patterns and surfaces to examine.

Why put all this effort into studying a scene that any person can eyeball and describe? Because robots need to see. Most researchers believe they must use clever tricks to produce robot vision. Shafer disagrees. By taking a radically different approach—one based on physics and mathematics—Shafer believes that very precise machine vision will be possible. "What makes the lab work," Shafer says, "is the conviction we have that one day we will be able to describe complex, real images with exhaustive mathematical descriptions." A human, for example, has no trouble looking at a room, describing shapes of objects in it, discussing what the shapes are made of. Shafer in wanting to do that in a mathematical way differs from most other researchers, who contend robot vision will be achieved through clever guesswork and rules of thumb.

"Vision is the richest of senses," he says. "It gives us information about things continuously, localized in space and at varying distances. The information it gives us is very fine—about surface properties, shape, size and distance. No other sense comes close to the richness it provides." But there is a cost to the quantity of information vision supplies, he says, and that is that there are so many variables, it is very difficult to study. And because it is difficult to study, it is difficult to reproduce in machines. "The values in an image are determined by a combination of many things," says Shafer. "We see an image and determine all the characteristics of the world that created this image." Reproducing that ability is the basic statement of the machine vision problem, according to Shafer. In the Calibrated Imaging Lab, he says, "we aim to uncover the mathematical truths that underlie both human and mechanical vision. The basic product we produce is ideas: the theories and equations of how something works."

To explain the complexity of the visual process, Shafer points to the equations governing light: There are so many parameters, so many unknowns, that there is no way to solve the equation. To accommodate this problem, some labs investigating machine vision have tried to limit the number of variables by using simple lighting or particular "known" objects. Other labs use a human model. But Shafer has still another approach—optical physics and geometry. "I'm interested in vision as a measurement of physical properties—surface, shape, material type, thickness, etc. Therefore we're concerned with physics, not biology or psychology." The physics involved in his work is basic laws of optics—the type studied in high school. But the ramifications of the optics, says Shafer, are very complex.

Researchers didn't investigate the physics of vision earlier because there was no real need to explore this area before the

By taking a radically different approach—one based on physics and mathematics—Shafer believes that very precise machine vision will be possible.

advent of robots. "Robotics provides a new impetus to study vision and the physics of appearance," he says. The reason for this may not be evident to non-scientists. Can't researchers just do what humans do? "People are very good at doing vision, but we don't know how we do it," says Shafer. And even if researchers did know how people see, machines just can't duplicate human vision. For one thing, the sensors in a television camera are very different than those in a human eye. A TV camera has a uniform coverage of little square sensors over the entire field of view. The human eye has sensors of a wide variety of sizes and shapes, densely packed in the center. The optics differ too. The parameters controlled in a camera are different than those in the human eye. Most importantly, human vision is a combination of simple tricks and a staggering interaction of phenomena so numerous that they all can't be listed—including color, texture, depth, motion, size, plus a judgmental factor.

Because Shafer believes that human vision can't be duplicated, he concentrates on the mathematics. "Machine vision can outperform human vision in precision by a tremendous factor," he says, "but it lacks the judgmental factor of human vision. The judgmental factor is related to the state of the art of artificial intelligence and is subject to change. Therefore, we work on articulating the mathematics that will stay the same."

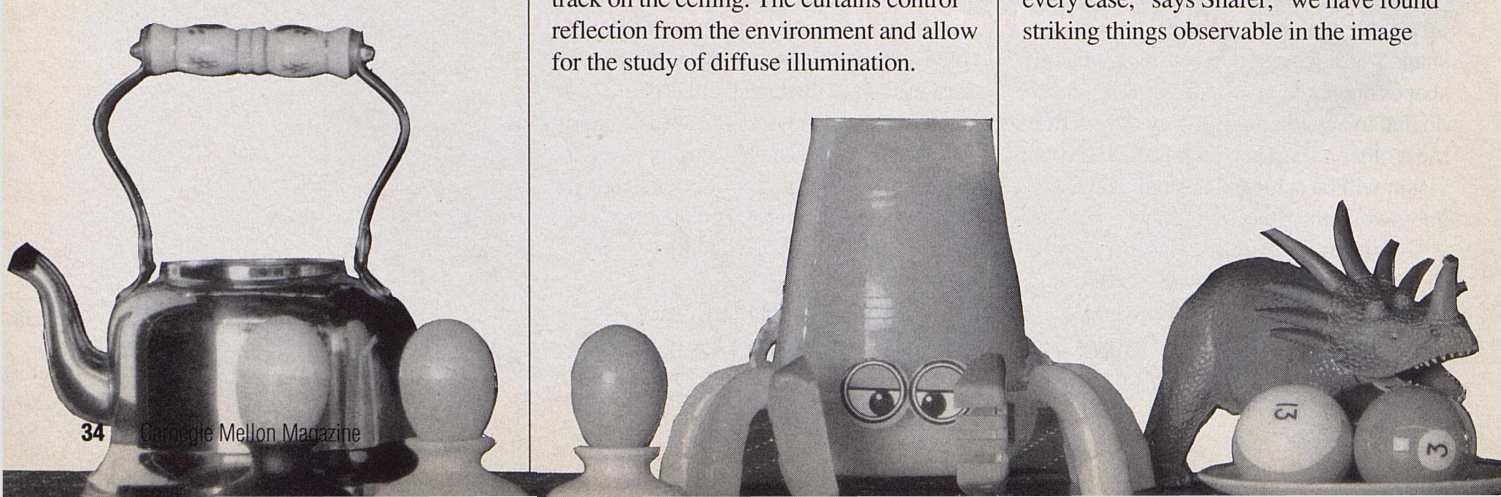
Shafer first became interested in the field of machine vision as an undergraduate at the University of Florida, where he enjoyed playing and creating computer games. He became interested in artificial intelligence and read papers on game playing. "All the papers were written by this one guy," says Shafer. "I thought, here's a guy who writes game programs and gets paid." But because he felt there wasn't room for many people in that field, Shafer shifted his interest to robotics, where he discovered that the number one problem is getting information into the machine. First solve the vision problem, then build a robot, he was told. "So that's my agenda," he says.

After earning a bachelor's degree in 1976, Shafer came to Carnegie Mellon and got a Ph.D. in the same field and joined the faculty. He established the lab in 1985, a year after he had first developed a theory of the relationship between color and highlights. The new lab was built and outfitted in the summer of 1989.

To carry out his research, Shafer has created a laboratory that can provide him with high precision image data by controlling lighting, position and measurement. Most of the machine vision community, he states, is comfortable with low precision commercial products for research. Shafer isn't. "We have high precision equipment that we calibrate in excruciating detail," he says. "We are one of many labs dealing in theories of machine vision, but we are one of very few that apply these theories to real images and add to the theory based on what we observe."

The lab resembles a combination photographer's studio, theater, high-tech study and school room. The heart of the lab is a high precision jig, holding a camera, a spectroradiometer and a pair of surveyors transits. Through the computer, the three can be interlinked, combining the image, with the spectral measurement and measurement of the distance of the object. A set of black velvet curtains hangs from a track on the ceiling. The curtains control reflection from the environment and allow for the study of diffuse illumination. Theater spotlights overhead diffuse illumination in three colors providing lighting control, which makes the area into a type of stage. Shafer places objects for study on an optical table. Along the tops of the cabinets, posters explain the features and work of the lab and look like mini-science fair projects. In addition to the train, the lab is equipped with toy blocks, a plastic sandbox toy in bright primary colors, a set of Fisher Price stacking colored rings, mugs, candlesticks, fabric swatches and a copper teapot—all providing a rich variety of shapes, surfaces, colors and textures to study.

A research project usually begins with some simple, old-fashioned musing. Someone will look at the environment and notice the shadows on the wall or the reflection of light off an object and try to capture the property of the observation in words. The next step is to formalize that understanding in mathematics by deriving parameters and equations that capture the essence of the phenomena. This step usually takes about a year, on and off, of thinking. The next year is devoted to refining the mathematics: doing a thorough literature search, often on some very obscure work. After this, researchers are ready for the first experiment to test their theories. At this point, the researchers look at all the assumptions on which the theory is based, try to set up the lab in a way that meets the assumptions, take pictures, then look at the pictures to see if they conform to the theory. If they have done a good job, then the first picture will show that the theory is correct. So far, that's been the experience in the lab—that the pictures confirm the theories—but there is still room for surprises. "In every case," says Shafer, "we have found striking things observable in the image

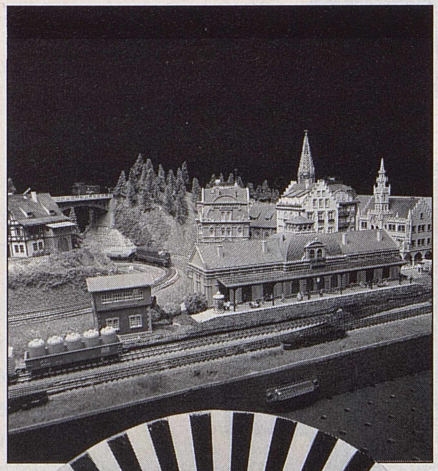


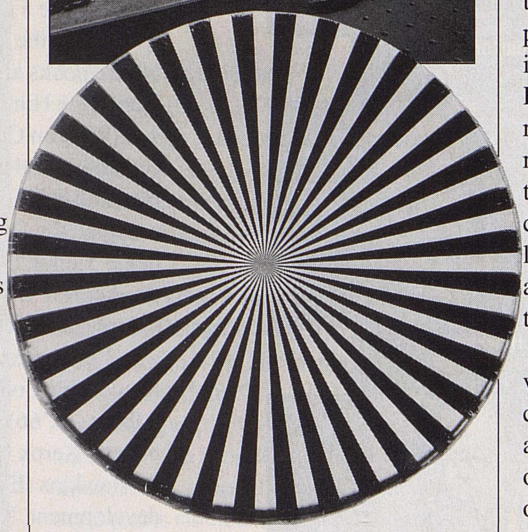
that our theory did not address. For example, when we looked at plastic objects we had a theory of the shininess and highlights on plastic objects. And when we looked at a real picture of many plastic objects, we found that another very important issue was the reflection between different objects, which we had not thought was very important. That's how we form our agenda for further research."

Through such measured, seemingly tedious steps, the research continues, theories expand and a program for the computer is created. Next, the program is tested and the results evaluated. "Sometimes the performance measure is very concrete," says Shafer, "but frequently the criteria are very subjective as we try to make sense of the data." When all this is done, the researcher is ready to start writing papers.

To date, the Calibrated Imaging Lab is best known for its work in color and highlights—how plastic and painted things reflect light and how they appear in an image. Researchers are also working on texture, motion and stereo and how visual properties change as camera positions change. One byproduct of recent research was a paper on how to measure performance capabilities of cameras in ways that are meaningful to researchers. Neither the vision community, nor the manufacturers have had this type of information available before.

While the Calibrated Imaging Lab is concerned with basic research, Shafer can foresee many useful applications for the theories developed in the lab. For example, there is a need for highly accurate vision in robots for handling hazardous wastes and working in hazardous environments. Next, high precision imaging would prove useful in outdoor land and undersea terrain analysis, including information gathered by aerial photography that would lead to map making. Also, visual inspection systems in industry and manufacturing would benefit from a much higher level of precision. In addition to the applications in robotics, the appearance theories developed in the lab—which are simply ways of thinking about the properties of materials that make them look the way they do—have attracted interest from interior designers and automobile paint manufacturers.





Top: One of several train settings that Steven A. Shafer uses to study vision.

Bottom: A focusing device.

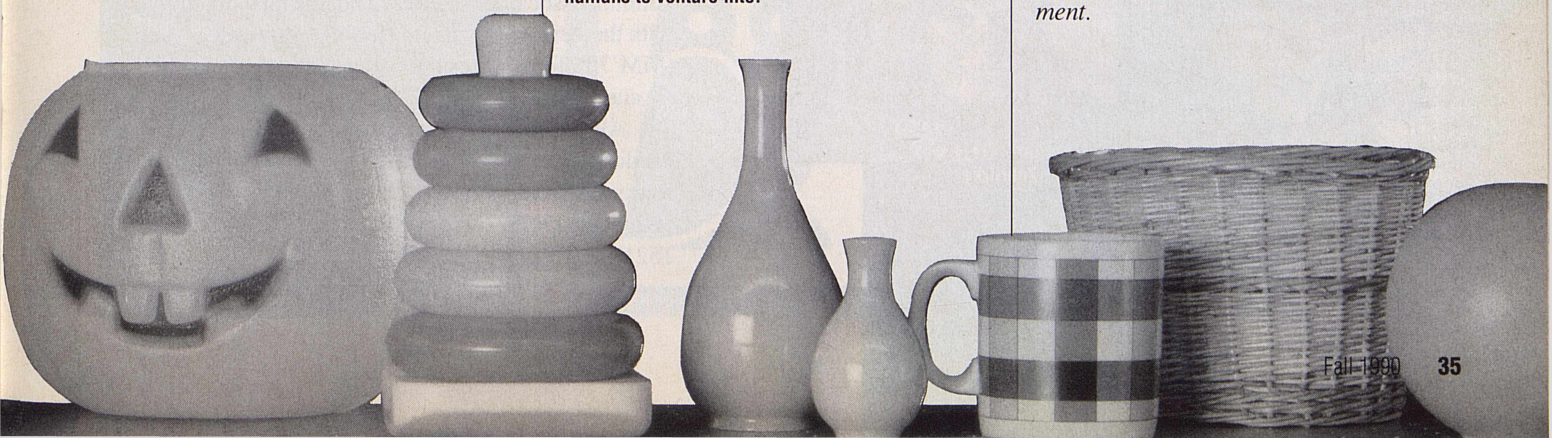
Below and opposite: Everyday objects used in vision research. Although his laboratory carries on basic research, Shafer expects to see machine vision applied to robots designed for work in areas too dangerous for humans to venture into.

While most of Shafer's time is devoted to research, he still occasionally plays computer games. His primary hobby, however, is caring for his English cocker spaniel, Hamlet. He also enjoys playing bridge and reading—mostly spy stories and history. His reading in history has led him to muse on the impact of science and technology on culture. "I enjoy reading about the way of life in former times," he says, "then thinking about and understanding how science and technology have changed our lives."

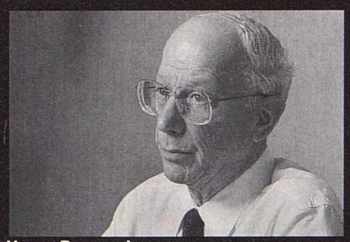
The impact of these new studies in vision has yet to be felt in the vision community, says Shafer. He wants to collect and unify all his information and research on vision in a book that gives an overview on the subject. According to Shafer, usually one student or researcher is doing work on a very small segment of the problem and doesn't have perspective on the overall issues. "I want to give the machine vision community an idea of how we could form a viable vision system based on physics and mathematics," he says. "I want to provide additional vocabulary and concepts that engineers will use in the future to put together specific vision systems."

Meanwhile, with the use of trains and children's blocks and toys, this serious basic research continues.

Margaret Thomas Kelso (A'87), a playwright and free-lance writer, is an instructor in Carnegie Mellon's Drama Department.



The Winners



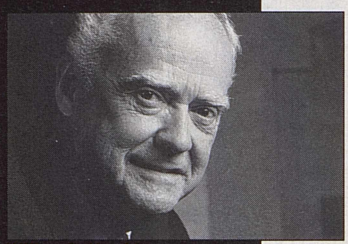
Henry Posner Jr.



William Goldsmith



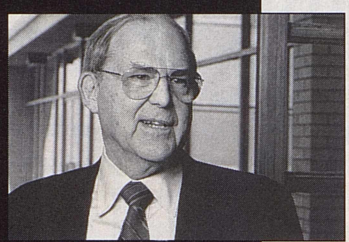
Paul A. Allaire



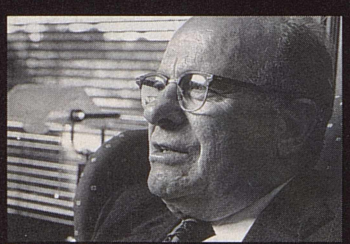
Wilton A. Hawkins



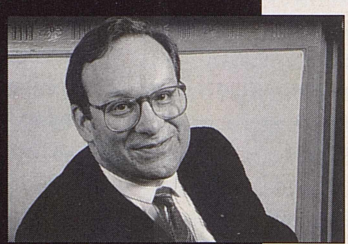
Emerson W. Pugh



John R. Thorne



Belknap Freeman



Tod S. Johnson



Daniel L. Weller



Hilary P. Zubritzky

Bill Redic

The Carnegie Mellon Alumni Association presented its annual awards at a banquet, May 19, in Skibo.

Henry Posner Jr., chairman of The Hawthorne Group Inc. in Pittsburgh, received the Distinguished Friend Award. A Carnegie Mellon trustee, Posner gave a gift of $1 million to the university for renovating the gymnasium. His family's collection of rare books and oriental and jade carvings is on loan at the Hunt Library.

William Goldsmith of Savannah, Ga., consultant and corporate director, and retired chairman and chief executive officer of Tubeco Inc. accepted the Distinguished Service Award. A Carnegie Mellon life trustee, Goldsmith (E'40) headed the Andrew Carnegie Society and the Alumni Association. He received a Service Award in 1986.

Recognized with Merit Awards for outstanding contributions in their fields were: Paul A. Allaire (IA'66), president and chief executive officer, Xerox Corp. in Stamford, Conn.; Wilton A. Hawkins (E'48), vice president, research and development, Norton Performance Plastics, and president, Chemplast Inc. in Wayne, N.J.; Emerson W. Pugh (S'51), research staff, T.J. Watson Research Center at IBM in Yorktown Heights, N.Y.; and John R. Thorne (IA'52), the David T. and Lindsay J. Morgenthaler professor of entrepreneurship at Carnegie Mellon's Graduate School of Industrial Administration, and chairman, The Enterprise Corp.

Accepting Service Awards for their work with alumni and university activities were: Belknap Freeman (E'40), former president and director of the board of the Alumni Association's Philadelphia Clan; Tod S. Johnson (AM'66), a member of Carnegie Mellon's Board of Trustees; Daniel L. Weller (E'51), a volunteer with the Carnegie Mellon Admissions Council, who has served on the Alumni Association executive board and worked with the Arizona Clan; and Hilary P. Zubritzky (MM'70), former president of the Pittsburgh Women's Clan.

All Carnegie Mellon alumni may nominate candidates for the annual awards. For nominating forms, contact Alumni Relations, Carnegie Mellon University, 5017 Forbes Ave., Pittsburgh, Pa. 15213.

More, More Verses
(Afterthought in a Giddy Key)

By Ann Hayes

Eight analysts, seven systems,
Seven days in the week:
Some peaceful co-existence?
Some kind of hide and seek?

Key punch is now old-fashioned
(Do you think they mix their drink?)
And on-line data entry's
A better way to think.

We've terminals provided
About the campus now,
Accounting, Stores, and Payroll
Are showing others how

To cast accounts, to sum up,
Make journal entries too,
Provide correct addresses,
Send each a W-2.

For pertinent information,
For student grades and bills,
Mailings to all alumni,
Developmental skills,

We schedule operations
(The time we're down we lose)
(Our Reliability Index
May actually confuse).

At Computation Center
(Frayed cable, bending pin)
(And IBM Consultants,
And Ampex too—come in)

Utilization Index
Makes Computation News,
And Usage Distribution
And Batch Throughput: excuse,

An error, the appendix,
Fortran Programmer's Guide.
Eight analysts, seven systems:
O how do they divide?

April 1974

Ann Hayes is a professor in Carnegie Mellon's English Department. Her most recent collection of poems, "Circle of the Earth," was published by Robert Barth, 14 Lucas St., Florence, Ky. 41042.

Some books recommended for general readership by School of Computer Science faculty:

"Algorithmics: The Spirit of Computing" by David Harel. Addison-Wesley, 1987. Good survey text of data structure and algorithms.

"Artificial Intelligence" by Earl B. Hunt. Academic Press, 1975. It's an old book and not often seen, but there's no hype here. It's not too technical to be frightening, but it's technical enough to be useful in really understanding what's going on.

"Common Lisp: A Gentle Introduction to Symbolic Computation" by David S. Touretzky (S'79). The Benjamin/Cummings Publishing Co., 1990.Many non-computer people have learned the rudiments of Lisp programming from this book. It has a friendly, non-threatening style and is suitable for anyone with a high school education.

"Computer Science: A Modern Introduction" by Les Goldschlager and Andrew Lister. Second edition. Prentice Hall, 1988.

"Computer Science: An Overview" by J. Glenn Brookshear. Second edition. Benjamin/Cummings Publishing Co., 1988. General survey text on all aspects of computer science— data structures, algorithms, software, hardware.

"Machines Who Think: A Personal Inquiry Into The History and Prospects of Artificial Intelligence" by Pamela McCorduck. W.H. Freeman, 1979. McCorduck is always clear.

"The Sciences of the Artificial" by Herbert A. Simon. Second edition. MIT Press, 1981. A classic.

"The TURING Omnibus: 61 Excursions in Computer Science" by A.K. Dewdney. Computer Science Press, 1989. A collection of papers drawn from the "Computer Recreations" column of Scientific American, which provides a tour of some fascinating aspects of the discipline of computer science. It requires some technical sophistication.

Taxwise Giving Tip:
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- an immediate charitable income tax deduction
- probable reduction of estate taxes
- satisfaction of providing support to Carnegie Mellon

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Carnegie Mellon University
Warner Hall 5th Floor
Pittsburgh, Pa. 15213
(412) 268-2018

Notable quotes

"It will be unconscionable, as a thinking nation, if we do not harness the potential of robotic technologies for employing previously unemployable persons with severe disabilities, for helping to keep our parents, our grandparents and, yes, ourselves out of institutions and in home environments, for helping to ease the burden and increase the productivity of care-giving and to help assuage a national shortage of labor in the service sector. The technology I am demonstrating here today gives witness to this untapped potential."
—K. G. Engelhardt, director, Center for Human Service Robotics, Mellon Institute, in House of Representatives Hearing, Sept. 25, 1989

"In business, as in much else, success comes mostly to those who approach each task with the passion of the scientist and the precision of the artist."
—Theodore Levitt, Harvard Business Review

"The D.O.D. is not the Red Cross."
—overheard in The Tartan Grill

"Clearly, computing in our society is too big to be left to the computer scientists. It is important to make computer options available to undergraduates in many departments, both within and without science and engineering."
—Herbert Simon in 1989 interview with Ludwig Schaefer, emeritus history professor and author of the unpublished history of the Stever and Cyert years

Managing info

US News & World Report surveyed the nation's deans and directors of master-of-business-administration programs to determine the top curriculums in management of information systems (computer networks). Carnegie Mellon's Graduate School of Industrial Administration was listed among the top five schools.

A bit of memory

Carnegie Mellon's first computer, which arrived in 1956, resulted from long and hard lobbying by George Leland Bach, dean of the Graduate School of Industrial Administration. An IBM 650, the computer dwelt in the business school's basement in a Computation Center with a budget of $53,000. Described as a "small, reliable machine offering the versatility of a stored program computer in a punched-card environment," the 650 had a magnetic drum capable of holding 2,000 bytes of information. That is about one half of a percent of the memory found in most contemporary personal computers. Only one operator could use it at a time. People worked on it 24 hours a day, seven days a week. IBM led computers sales with the 650. The corporation expected to sell 50. It sold 1,500. But by 1958, companies began marketing computer systems with transistors instead of the vacuum tubes found in the 650. The second generation of computers had arrived. In 1960, Carnegie Mellon upgraded to a Bendix G-20, which operated at speeds 150 times that of the 650.

The history machine

The Great American History Machine, an award-winning computer program, lets history students look at results of the U.S. census returns from 1840 to the present in every county in the country. They may also examine presidential election returns and explore patterns in history. The program was first used in a course titled "Pattern and Change in Nineteenth Century America," taught by David W. Miller and John Modell of the History Department. The program's features include the ability to zoom in on a particular region, split the computer screen and look at two maps. It aims at teaching a more analytical approach to historical evidence.

Out of the lab

Carnegie Mellon, Westinghouse Electric Corporation and RedZone Robotics Inc., a spinoff from Carnegie Mellon's Field Robotics Center, have formed CRW Robotics Partnership. The firm will develop robot technology for use in the nuclear service and nuclear waste markets. The Field Robotics Center will perform basic research. RedZone will work on concepts through the application stage, and Westinghouse will make commercial applications of the technology. "Universities have tremendous research capabilities," says Carnegie Mellon Provost Angel G. Jordan (E'59), "but traditionally they have had trouble transferring the results of their work to the field. CRW is a tool for getting university research out of the laboratory much more quickly." The company's first project involves creating an advanced computer vision and control system for Westinghouse's ROSA-3, which is used in servicing nuclear power plants.

Poolhall syndrome

Yesterday it was the poolhall. Today it's the video arcade. The clientele remain predominately male. In fact, the adult world of computing is dominated by males and largely passed on to the text generation by males, according to Sara Kiesler and Lee Sproull of Carnegie Mellon and Jacquelynne S. Eccles of the University of Michigan in their article "Poolhalls, Chips, and War Games: Women in the Culture of Computing," published in the the Psychology of Women Quarterly. The writers found that it is men who design video games, write the software, sell the machines and teach the courses. At the same time, many female students take a negative attitude toward computing. The researchers believe that computing is more than a set of skills and that it is embedded in a social system and the initial socialization to computing is important.

User friendly prescriptions

Old folks—and sometimes even young folks—have trouble with standard instructions they receive from hospitals and doctors. A list of "dos and don'ts" is sometimes difficult to read or understand. Patients aren't sure whether everything applies to them. The situation can result in a mere inconvenience or a major health risk. To address this problem Carnegie Mellon researchers David H. Fowler of the History Department and David Bourne of the Robotics Institute, along with Fred H. Rubin of Shadyside Hospital's Geriatric Assessment Unit, are developing a program of computer-generated, individualized care information packets for patients and their families. Fowler feels patients should receive personalized, printed instructions to supplement face-to-face advice from the doctor, clinic or hospital. Some people need this additional help because they can't remember all the instructions. The system will include an electronic data base, which a health professional could use to produce a set of illustrated easy-to-read instructions tailored to each patient's needs—medication, diet, exercise and precautions.

45 minutes to Mars

Carnegie Mellon's Robotics Institute has created a prototype of an autonomous robot with a "brain" and motor skills for NASA. Called the "Ambler," the 12-foot-tall aluminum robot has six legs and can slip over crevices and large boulders. The Ambler's legs lift separately, advance and circulate to their original position, much like an egg beater. Researchers are suggesting the self-sufficient, walking Ambler as an alternative to wheeled rovers for explorations on the Moon and Mars. The Ambler can create three-dimensional maps of its surrounding topography and decide what it wants to see and advance accordingly. Its autonomous decision-making is a necessity since transmission time from Earth to Mars, for example, is 45 minutes, one way. Researchers note that the Ambler might also prove useful on Earth in construction, mining, timbering, hazardous waste management and emergency response.

Playing the game

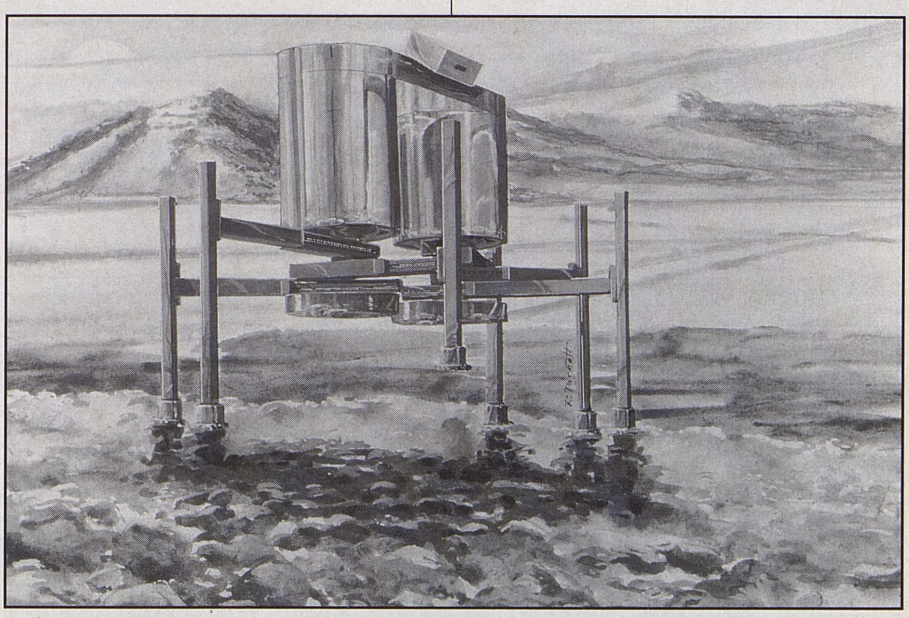
Monopoly is not the big game at Carnegie Mellon's Graduate School of Industrial Administration. The Management Game is. Developed in the '50s, the game simulates a business environment and permits students to learn business by working with professionals in simulated businesses. The game basically introduces the use of scientific and quantitative techniques as management tools. Still in use, The Management Game runs on computers today.

Proof positive

The Introduction to Logic course in Carnegie Mellon's Philosophy Department makes use of a computer program called CMU Proof Tutor, developed by researcher Richard Scheines. The program teaches students formal argument construction by allowing them to construct proofs backwards or forwards and giving them help anywhere along the way. Students may also take a self-paced logic course that uses tutoring programs for introducing concepts of logic and giving practice in proof construction.

No pipe dream

In September Carnegie Mellon will become the first university in the world to offer a major in the bagpipe. The school's Music Department will award bachelor of arts degrees in performance with the bagpipe as principal instrument. James McIntosh, a native of Broughty Ferry, Angus, Scotland, will head the program. He has taught undergraduates bagpiping as an extracurricular activity since 1985. His students, dressed in traditional Scottish garb, regularly lead the commencement procession. McIntosh played the pipes as a boy in Scotland and joined the Queen's Own Cameron Highlanders in 1939. He studied at the Army School of Piping at Edinburgh Castle and learned "piobaireachd"—classical pipe music—with the Queen's Pipers at Balmoral Castle. Also a reedmaker and bagpipe designer, McIntosh won the top piping awards in Scotland and retired from competition after taking the Eagle Pipers' Society gold medal for three consecutive years. When he gave a performance for the Carnegie Mellon Music Department, grown men and women wept.



The Ambler ambling about Mars in a 12-x-15-inch painting by Robert Parrett. The work hangs in the office of William L. Whittaker (E'75), a principal investigator on the robot. Other chief investigators are Takeo Kanade and Thomas Mitchell.

Some stats

• The purchase of computers by primary and secondary schools has increased 300 percent in the last three years.

• One study of home computers found that 67 percent of children over 12 and 88 percent of children under 12 use the computer for entertainment.

• When 42 children aged three to five were asked about who computers are for, girls or boys, the majority thought they were for both although the boys were not as sure of this as were the girls (71 percent of the girls and 57 percent of the boys).

• An examination of video-game packaging showed four women and 28 men in cover illustrations.

• The very first computer programmers were women hired by the Navy during World War II to calculate shell trajectories on mechanical calculators. When ENIAC, the first operational computer was built, these women programmed it and became known as the "ENIAC girls."

• At gambling establishments in Reno, Nev., researchers found that women will play "video poker" rather than "in person" poker.

Source: "Poolhalls, Chips, and War Games: Women in the Culture of Computing" by Sara Kiesler, Lee Sproull and Jacquelynne S. Eccles in Psychology of Women Quarterly

A tidy robot

Intervention Technologies Inc., a commercial arm of Carnegie Mellon's Center for Human Service Robotics, recently demonstrated a robot that will bag silverware for use on air flights and will lift used trays and shake refuse into a trash can. Roger A. Edwards, president of ITC, says it is the first robotic system specifically designed for the in-flight food service industry.

Apples for the teachers

The College of Humanities and Social Sciences gave its faculty personal computers in 1982, the first Carnegie Mellon college to do so. Students in the college use computers for writing papers, analyzing data and performing statistical analysis. In 1988, a grant from Apple brought 60 Mac II workstations to faculty in the college for use in developing educational software.

Video victory

Vince Eirene, perennial protester at the Software Engineering Institute, stars in a video "No Victory Without a Battle: A Video Retrospective of Civil Disobedience at CMU/SEI." The tape records protests at SEI from January 1988 through the Hiroshima Day demonstration last summer. Protesters object to development of software that may be used in weapons system by the Defense Department. The tape mingles protests with images of nuclear destruction.

Andrew at 10

Launched by President Richard M. Cyert in 1980, Andrew is a distributed computing environment in which powerful personal computers or workstations are connected by a high-speed data network to central storage facilities called file servers, which make up a file system. Unlike time-shared or mainframe computers, Andrew doesn't have one large processor. The system, named for university founder Andrew Carnegie and supporter Andrew Mellon, is made up of thousands of personal computers each with its own processor.

More than 5,000 students, faculty and staff use Andrew each month for word processing, computer programming, electronic mail, bulletin boards and computer games. In fact, Andrew contains more than 2,000 bulletin boards and is connected to virtually every computer network in the country.

Over its 10-year lifespan, Andrew's proponents have dreamed of a revolutionary academic environment—one where undergraduates, with the help of their personal, centrally connected computers, would earn bachelor's degrees in three years.

"Andrew clearly has not lived up to those expectations," says John Howard, director of the Information Technology Center, which developed Andrew. "It clearly has not revolutionized education. On the other hand, we have done some very worthwhile and interesting things."

Two of Andrew's more successful components are the data network and the file system.

"The network is the best network at any university in the country," says William Y. Arms, vice president for academic services. "It provides a variety of services, is reliable and has pretty good performance."

"The Andrew file system," says Howard, "is the only distributed file system that can handle thousands of workstations. Period. With it, you have a way for thousands of people to cooperate and share information with each other conveniently."

Both Arms and Howard predict that most of Andrew's components will be improved. For example, the network will be more reliable, faster and bigger; the file



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system will be faster and will support more types of computers; and the electronic mail system will be easier to use.

"My feelings for the various components range from 'we got that right' to 'that'll do for the time being, but we still have work to do,'" says Arms. "The overall assessment, however, is that we've got a super computing environment."

The Moon and the Mac

Students as young as three use Macintosh computers at Carnegie Mellon Children's School. In one project, three to six year olds made a computer graph showing how many of their classmates were wearing long-sleeved or short-sleeved shirts. The exercise is part of the DASH project—Developmental Approaches in Science and Health. Based at the University of Hawaii at Manoa, DASH involves about 30 school districts nationwide, which are developing science, health and technology curriculums for elementary schools. In the computer area, children work with Super Paint, Hypercard and computer learning games. They are taught that the computer is a tool that can save time. "Nothing is magic; it happens because you make it happen," says Judith Hallinen, teacher at the school. In a non-computer DASH project, the children followed moon patterns for a month. When the new moon appeared, the class gave it a birthday party.

On the education front

The Software Engineering Institute has developed a master of software engineering degree, offered through Carnegie Mellon's School of Computer Science. In addition, the institute develops curriculums for use in software engineering courses on the graduate and undergraduate level. Through a video dissemination project, the institute has made videotaped courses, geared to graduate students and continuing education students. Another video thrust concentrates on supplementing traditional teaching materials with advanced learning technologies.

25 years of computer science

The School of Computer Science will celebrate the 25th anniversary of the establishment of the Computer Science Department with a symposium, Sept. 24-26, at Carnegie Music Hall and Foyer in Oakland. The talks are open to the community without charge. A listing of speakers and topics follows.

Monday, Sept. 24

9:30 a.m.	Ivan E. Sutherland, "Technology and Courage"
10 a.m.	Jon L. Bentley, "Tools for Experiments on Algorithms"
11 a.m.	C. Gordon Bell, "Three Decades of Multiprocessors"
11:30 a.m.	Raj Reddy, "Will 3G Supercomputers Also Gather Dust?"
Noon	Richard F. Rashid, "Mach: A Case Study in Technology Transfer"
2 p.m.	J. Doug Tygar, "Strongbox: A System for Self-Securing Programs"
2:30 p.m.	Joseph F. Traub, "What is Knowable?"
3 p.m.	Roger B. Dannenberg (S'82), "Expressing Temporal Behavior Declaratively"
3:30 p.m.	Campus demonstrations, tours

Tuesday, Sept. 25

9 a.m.	Allen Newell (IA'57), "Formulating the Problem Space Computational Model"
9:30 a.m.	Zohar Manna (S'68), "Tools and Rules for the Practicing Verifier"
10 a.m.	John K. Ousterhout (S'80), "The Role of Distributed State"
11 a.m.	A. Nico Habermann, "Generation of Integrated Task-Specific Programming Environments"
11:30 a.m.	Charles E. Leiserson, "VLSI Theory and Parallel Supercomputing"
Noon	H. T. Kung (S'74), "Heterogeneous Multicomputers"
2 p.m.	Marc H. Raibert, "Dynamic Robots That Run"
2:30 p.m.	Douglas W. Clark, "Large-Scale Hardware Simulation: Modeling and Verification Strategies"
3 p.m.	Takeo Kanade, "Computer Vision as a Physical Science"

Wednesday, Sept. 26

9 a.m.	Anita K. Jones, "Scientific Databases: The Next Revolution"
9:30 a.m.	Dana S. Scott, "Teaching Projective Geometry via Computer"
10 a.m.	Hans J. Berliner (S'75), "Producing Behavior in a Searching Program"
11 a.m.	Steven A. Shafer (S'79), "Why Can't We Model the Physical World?"
11:30 a.m.	Samuel H. Fuller, "When Does Technology Transfer Work Well and Why?"
Noon	Herbert A. Simon (S'90), "Problem Representation"

For further information on the symposium and social events connected with it, contact the 25th Anniversary Committee, School of Computer Science, Carnegie Mellon University, Pittsburgh, Pa. 15213; telephone: 412-268-8525; fax: 412-681-5739; CS25@cs.cmu.edu on ARPANET.

Mach talk

Mach, created at Carnegie Mellon by 20 graduate students and faculty, is an operating system kernel that enables the development of other software. Mach has become the system of choice for the Open Software Foundation, a group of companies, including IBM, Hewlett-Packard and Digital Equipment Corp., working to create basic software for computers. OSF will use the six-year-old Mach as a basis for its first product, OSF/1, due for release this fall, according to Richard Rashid, associate professor in the School of Computer Science, who is often identified as the father of Mach.

People who develop systems software and applications recognize Mach's advantages. "You see it indirectly through what other people do with it," Rashid explains. Mach is not an application program that comes with the computer system but the gut software that allows other things to be done. It lets the user develop such applications as a database or graphics more easily. And it lets the user move information more rapidly from one program component to another.

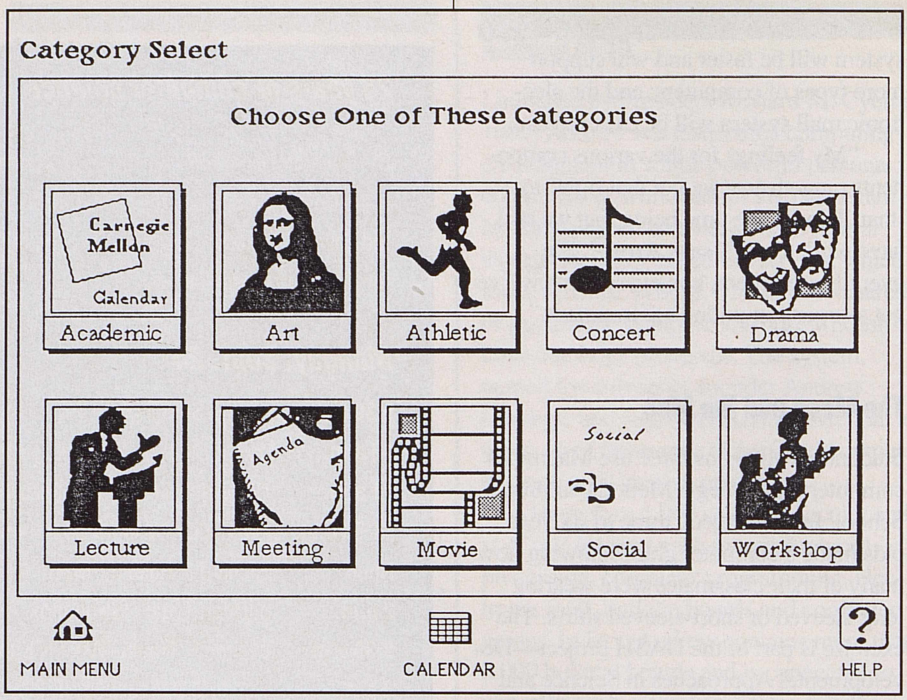
Why did the OSF choose Mach, which rivals UNIX, invented by AT&T? "It's an operating system technology that has proven to be very highly portable," says Rashid. "We have Mach running here at Carnegie Mellon on several dozen different kinds of computers. Nationwide, various companies and organizations have Mach running on just about every major hardware platform."

Mach provides features that aren't available in other commercial systems, such as good support for parallel programming and parallel processing. It provides techniques for managing and manipulating memory and communications. "It really gives application builders, who want to build system software on top of the operating system, more tools and more flexibility," says Rashid.

At Carnegie Mellon, for example, Mach is used in speech recognition programs and on MachMac, which runs Mach on Apple computers. It is part of research projects at the University of Rochester, Massachusetts Institute of Technology and Syracuse University. It is licensed to about 300 companies throughout the world including IBM, Olivetti, Hewlett-Packard and NeXT Inc. "That's what system software does," Rashid says. "It's an enabling technology."

Funded by the Defense Advanced Research Projects Agency, Mach to date has cost $10-15 million. But since other developments in operating systems have cost $100 million, Rashid comments, "We've done our job fairly cheaply. Doing this kind of work in a university environment is more cost effective than in an industrial setting." Younger people work harder, he says.

"In some sense it's surprising to a lot of people in the operating system community and the computer science community that we've been able to build a system that performs very well and more than holds its own with the competitive technology," Rashid adds. "That comes back to the long-standing philosophy at Carnegie Mellon that, in the systems area, we not only come up with good ideas and design and build prototype systems, but we build things that work and that other people can use.... We really do use our own stuff, and we view that as being an important attribute of our work."



Key to the campus are four computerized information centers that lead visitors and others to various events and activities at the university with just the touch of a finger.

In touch with campus

Campus Information Centers, which are basically Macintosh computers housed in gray kiosks, bring electronic information to campus with the touch of a finger. Users touch a box or icon on the screen to read the faculty, staff or student directory or the latest edition of the 8 1/2 x 11 News, a weekly campus update. If they touch an events icon, they learn the time and location of campus events listed by the offices of Housing, Public Relations, Special Events, Student Activities, Student Affairs and The Tartan. Mona Lisa's face designates arts events; a speaker indicates lectures. A map icon reveals an aerial view of campus. Touch a particular building, and the computer will list offices there or show a photo of the building. The computerized information centers are on the first floor of Warner Hall, Skibo, Morewood Gardens and Hunt Library. About 1,000 people use the centers each week. Brian Harrison developed the software. Mark Lubinski (E'90) has maintained the system for the past two years.

Checkmate bait

Hitech, one of Carnegie Mellon's chess-playing computers, competed in the AEGON chess tournament in the Netherlands via trans-Atlantic computer network in May. Hitech defeated International Grandmaster David Bronstein of Russia and came to a draw with Jeroen Piket of Holland, also a grandmaster. Bronstein was the strongest player ever defeated by a computer. Hitech finished the tournament with four wins and two draws. Human participants outscored the computers by 47-37, closer than last year's ratio of 57.5 to 23. Computers are banned from play in all but three or four important U.S. chess tournaments. Hitech in its last tournament scored 5-0 against its human competitors in the 1989 Pennsylvania Chess Championship, its third consecutive win of that tournament. Hans J. Berliner (S'75) is the chief research scientist on the Hitech project.

Looking at L.A. air

Carnegie Mellon researchers, led by Gregory J. McRae, associate professor of chemical engineering and engineering and public policy, are fighting air pollution with supercomputers. McRae has found that "the $30 billion annual price tag for controlling urban air quality can be cut substantially by attacking the problem with supercomputers." The researchers examined Los Angeles' smog on the Pittsburgh Supercomputing Center's Cray Y-MP/832 for 200 hours. McRae's model looks at 50 kinds of chemicals and such factors as temperature, pressure, intensity of sunlight, the meteorology responsible for pollution transport and the topography and traffic patterns of primary pollutants. The supercomputer revealed that not only was it necessary to decrease hydrocarbon emissions, but nitrogen oxide also needed to be reduced in the Los Angeles area. McRae found that converting half the automobiles in the Los Angeles area to methanol, an alternate fuel, would decrease peak ozone and particulate levels in the air. McRae's findings over the past several years have influenced new clean air legislation as well as President Bush's proposed new federal clean air standards.

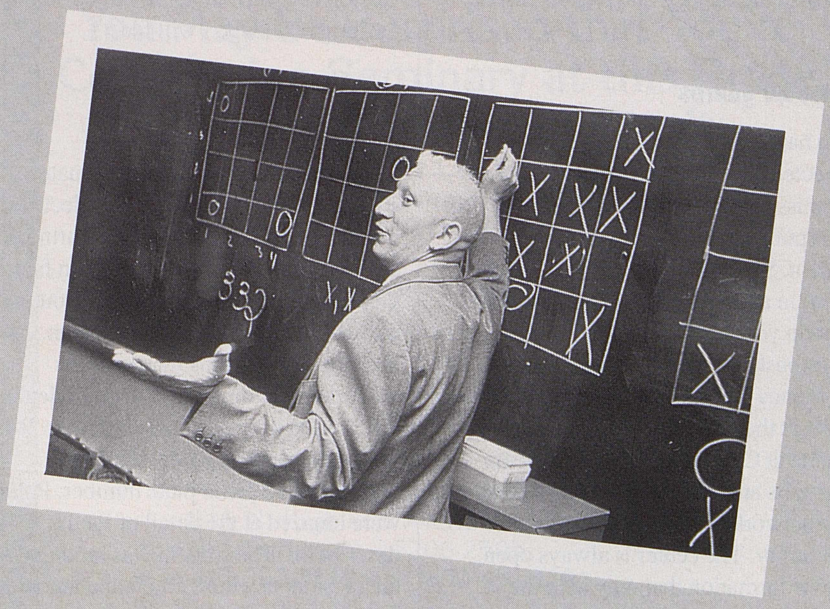
The Perlis part

Alan J. Perlis became the head of Carnegie Institute of Technology's Computer Science Department when it was started in 1965. He had arrived a decade earlier to set up the Computation Center with its IBM-650, a small drum machine, which became the workhorse for university computing around the country. Perlis produced the first algebraic compilers that could be used effectively with such small machines, moving these universities into the world of reasonable programming languages.

According to his associate, computer science Professor Allen Newell, "Computer science was just emerging as an academic discipline during those years, and Alan Perlis became one of its chief spokesman. He was witty and pithy in his pronouncements, which seemed to capture the very essence of the new field—'One man's constant is another man's variable.'" When the Association of Computing Machinery, the field's scientific society, created its major scientific prize, The A. M. Turing Award, Perlis was its first recipient.

"He was sort of an administrative magician," says Newell. "He cared not a whit for administration and formal organization, so he simultaneously become head of the Computation Center, Mathematics Department and Computer Science Department and ran them all with a free and easy hand." Along with Newell and Herbert A. Simon, Perlis set the tone for computer science at Carnegie Mellon. It became, says Newell, "a place that was free-wheeling and iconoclastic, focused on the content of the science rather than its form."

Carnegie Mellon Magazine had planned to feature Perlis along with Newell and Simon in the People section of this computer science issue. However, Perlis died of a heart attack Feb. 7 in New Haven. The magazine carried an obituary in the summer issue.



Alan Perlis at home in the classroom. His associates see the fun and flare of this computer scientist in this early photo.



Trying out the Piano Tutor are its developers, from the left, Roger B. Dannenberg, Annabelle Sachs Joseph and Marta Sanchez, all alumni and faculty.

Non-knuckle-cracker

Piano Tutor, a new high-tech tool, is helping novice piano students learn how to play better, faster. As notes appear on a computer monitor, the beginner practices lessons on a connected piano keyboard/synthesizer. The computer follows the performance, makes on-screen corrections of pitch and rhythm and keeps a record of the student's progress. Developed by research computer scientist Roger B. Dannenberg (S'81) and Music Department professors Marta Sanchez (A'58) and Annabelle Sachs Joseph (A'53), Piano Tutor is designed to substitute for a teacher between lessons. Other researchers on the project are students Peter Capell and Robert Joseph.

Computer guards

It can happen to any computer that is connected to a computing network. You may miss a file or notice changes that you didn't put in. Sometimes this happens by accident. Sometimes someone has clearly broken in and messed with your material. What do you do? Forget "911" or "Ghostbusters." Call the Computer Emergency Response Team Coordination Center at the Software Engineering Institute at Carnegie Mellon. The team focuses its attention on Internet, a computer network that serves the scientific community. The center is always open, stores information that may help the 200,000 computer sites linked to Internet, can provide rapid communications during emergencies and can advise users on security risks and improvements.

Board games

It's not a movie sequel, but watch for Deep Thought II sometime in the next five years. It may be the first chess-playing computer to beat a human world chess champion. The next generation of Deep Thought will use 1,000 processors to attack all chess problems at once and will operate from an IBM workstation. Deep Thought was originally created by Carnegie Mellon computer science doctoral student Feng-hsiung Hsu (CS'90). The next Deep Thought will consider one billion positions per second and will be able to search an additional two moves ahead for each player. World champion Gary Kasparov told The Wall Street Journal that playing the 1,000-chip version of Deep Thought will be "the most exciting challenge I will face."

On computer uses

Chakkalamattam J. Paul, a graduate student in Carnegie Mellon's Electrical and Computer Engineering Department, is a detail man. He notices things. In fact, that quality helped Pittsburgh police round up three suspects in a credit card scam. After noticing a suspicious man near his apartment building, Paul stored a detailed description of him on his computer. When the man turned up again, Paul even obtained his license plate number. Police were amazed at the detail of Paul's description. The student was among 68 area residents whose credit and automated teller cards were stolen and misused by the suspected thieves. Detectives told Paul, "'If you ever get tired of doing engineering work, give us a call. You'd make a pretty good cop.'"

On top in Pennsylvania

Herbert A. Simon (S'90), the Richard King Mellon university professor of computer science and psychology and a member of Carnegie Mellon's Board of Trustees, received the 1990 Governor's Award for Excellence in the Sciences from Gov. Robert P. Casey of Pennsylvania in May. The awards recognize Pennsylvanians for outstanding individual creativity and achievement. Pulitzer Prize-winning playwright August Wilson (HA'87) received an award for excellence in the arts. Artists Ron L. Desmett (A'79) and Kathleen Mulcahy, former Art Department faculty member, created the glass sculpture presented to those honored. The foot-high award resembles a toy top.

Taking stock

After the "Black Monday" stock market crash of October 1987, two Graduate School of Industrial Administration professors, John O'Brien and Sanjay Srivastava, invented Simulab, a software program, which teaches student stock market traders how to build stock portfolios and accumulate capital. Termed an automated stock market laboratory, Simulab links economic theory to actual stock market trading. The system uses a network of microcomputers tied to a central control. The microcomputers allow the student traders to look quickly at many stock activities and store information in a memory on a system capable of providing color graphics depicting market activity.

A composition of note

Reza Vali, an assistant professor of computer music at Carnegie Mellon, will perform his composition "The Night of Power" at 7:30 p.m., Sept. 24 in Carnegie Music Hall. Commissioned by the School of Computer Science as part of its 25th anniversary symposium, the work was composed for violin, cello, percussion instruments, piano, brass quintet and ViodeoHarp. David Stock (A'62) will direct a combination of musicians from his group, the Pittsburgh New Music Ensemble, and the Carnegie Brass Quintet. Developed by Paul McAvinney, a former research programmer at Carnegie Mellon, the VideoHarp, which is shaped like a small conventional harp, senses hand gestures as they move through light rays and converts them into a code understandable to a music synthesizer. The Sept. 24 concert is open to the public free of charge.

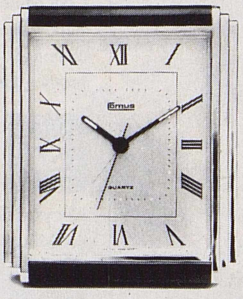
The Supercomputer

Since its opening in 1986, the Pittsburgh Supercomputing Center has attracted some 2,300 researchers from 257 institutions in 47 states. Operated by Carnegie Mellon, the University of Pittsburgh and Westinghouse Electric Corporation, the center contains the first Cray Y-MP installed at a non-governmental site. "Scientists can attack the most difficult questions in their field because they know that the most advanced computing resources will be at hand," says Michael J. Levine, center scientific co-director and a physics professor at Carnegie Mellon. Recent scientific projects examined at the center include: "Modeling Gravitational Radiation from Stellar Core Collapse," aluminum can design, "Testing the Renormalization Group Theory of Turbulence," "Mathematical Modeling of Aquatic Animal Locomotion," the earthquake rupturing process and roll-call voting in the U.S. Congress from 1789 to 1989. Most researchers work on the supercomputer from remote locations via a high-speed network.

First doctor of robots

Caroline Clarke Hayes has become the first person to earn a Ph.D. in robotics from Carnegie Mellon. She received her degree at commencement exercises in May. Her work focused on modeling the process of making manufacturing plans for machined parts. Her computer model, Machinist, can produce manufacturing plans comparable to those made by a human machinist with five years experience. Hayes also earned a bachelor's degree in mathematics and computer science and a master's degree in computer science and mechanical engineering from Carnegie Mellon. Her other interests include photography, drawing, sewing, windsurfing and restoration of houses.

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L Library School
MI Mellon Institute, Honorary Alumnus (a)
MM Margaret Morrison Carnegie College
PE Program for Executives
PM Printing Management
S Mellon College of Science
UP School of Urban and Public Affairs
X Attended

27

Robert L. Lepper (A), Carnegie Mellon professor of design emeritus, was honored with establishment of the Robert L. Lepper Distinguished Lecture Series in Creative Inquiry, set up in the Art Department by his former student **Russell J. Cameron** (A'41). Lepper taught at the university from 1930-75. His students included **Mel Bochner** (A'62), **Philip Pearlstein** (A'49) and **Andy Warhol** (A'49).

28

Katherine M. Bradley Thomas (MM) and her husband, Aaron, spoke on ways to "Pep Up Your Life—Living the Wellness Way in 1990" at Winter Park Hospital in Orlando, Fla., to an audience ranging in age from 55 to 85. The couple, married 61 years, speaks on the problems and glories of aging.

30

Howard M. Wilkoff (E), retired president of the New England Tape Co., has established the Howard M. Wilkoff Chair in Electrical and Computer Engineering at Carnegie Mellon. First recipient is Ronald A. Rohrer, university professor of electrical and computer engineering. Wilkoff lives in Weston, Mass.

34

Burt D. Miskimen (PM), retired president of Domoney Corp., who founded the Central Ohio Fibrosis Assn. in Columbus, Ohio, is chairman of the board of the USA Fibrositis Assn. He and his wife, Betty, live in Worthington, Ohio.

35

John Nagy (S), who consults on mine safety problems in the U.S. and Canada, represented the U.S. at a coal mine safety seminar in Australia. He spoke before the New South Wales Coal Mine Inspectorate in Sydney. Nagy, of Finleyville, Pa., worked in mine safety research and technical support for 43 years before retiring. His brother, **Elmer P. Nagy** (E), lives in Lafayette, Calif.

37

Basia McCoy (A), the former Barbara Kocyan, played Helen in "The Road to Mecca" at the Mountain Theatre in Roanoke, Va.

39

William L. McGaw (E) is a self-employed consulting engineer. He retired as a consultant to the state of Connecticut on energy matters in March 1989. He and his wife, Ruth, live in Glastonbury, Conn.

40

Robert K. Howarth (E) retired as manager of international accounting for U.S. Steel after 35 years. His wife, **Ruth Smith Howarth** (MM'41), was a home economics teacher at Ambridge Junior High School in Ambridge, Pa. They live in Central City, Pa., and Sebastian, Fla., and spend time playing golf and bridge.

41

Russell J. Cameron (A) has established the Robert L. Lepper Distinguished Lecture Series in Creative Inquiry in Carnegie Mellon's Art Department. President of the Ross Operating Valve Co. and a recent graduate of the Cranbrook Academy of Art, Cameron was a student of **Lepper** (A'27).

43

Jean Foster Jenkins (A) is a professor at El Camino College in Torrance, Calif. She has shown her ceramics at Syracuse, Enamel Society International and Canada International. She and her husband, **Jobe Jenkins** (E'41), live in Palo Alto, Calif.

44

Frederick C. Corey (E) is self-employed as vice president of Northrop Corp. in Newbury Park, Calif. He received the AIAA Missile Systems Award in May 1989. He and his wife, **Dorothy Stauff Corey** (MM), live in Montecito, Calif.

46

John W. Michener (S) is a senior scientist at Milliken Research Corp. in Spartanburg, S.C. He was awarded the 1989 Palmetto Award by the governor of South Carolina. He and his wife, Ruth, live in Moore, S.C.

47

Samuel L. Collier (E) of Houston, Texas, is a consultant and expert witness on pumps and percussion drills. He is active in the petroleum division of the American Society of Mechanical Engineers as chairman of the Worthington Medal Committee and serves on the selection committee of the National Inventors Hall of Fame. He was honored as a life member of the Houston Engineering and Scientific Society and wrote an article for the January issue of World Pumps.

48

Philip Chosky (E), who worked backstage on Carnegie Mellon Drama Department productions as a student, has established the first endowed chair in the department. He is founder of Electronics Institutes of Pittsburgh and Harrisburg and Rosedale Technical Institute in Pittsburgh. The first Philip Chosky Professor of Drama is **Yossi Yzraely** (A'71), head of Carnegie Mellon's directing program and himself a director, both in the U.S. and abroad.

Robert Nowack (S), a civil engineering professor at Clemson University in Clemson, S.C., for 41 years, has been named an Alumni Professor. Nowack commented, "I'm 100 percent teaching, no research. I made that decision many years ago.... That in itself has allowed me to be fully available to my students."

51

S. Allen Heininger (S), corporate vice president of resource planning for Monsanto Co. in St. Louis, is president-elect of the American Chemical Society. He has served on the society's Task Force on Non-Academic Sabbaticals, the editorial advisory board for Chemical & Engineering News and the Task Force on Industrial-Academic Cooperation.



Paul V. Offermann (PM'51) is president of Harold Warner Advertising Inc. in Buffalo, N.Y. He joined the firm in 1954.

52

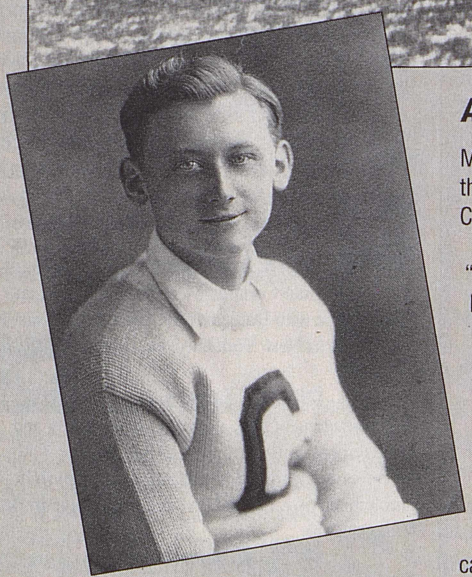
Carl F. Zorowski (E), professor of mechanical engineering and director of the Integrated Manufacturing Systems Engineering Institute at North Carolina State University in Raleigh, N.C., received the R.J. Reynolds Tobacco Co. Award for Excellence in Teaching, Research and Extension. A former faculty member at Carnegie Mellon from 1953-62, he pioneered the use of digital computers and mathematical modeling in metal forming and textile mechanics research; is internationally known for his studies of the mechanical behavior of fibers, yarns and fabrics; and did research in tire mechanics that led to development of the comprehensive computer models describing tire deformation.

53

David A. Kane (E) retired from the International Telecommunication Union and lives in Wayne, Pa.

Charles L. Fuellgraf Jr. (E), a Carnegie Mellon trustee and chief executive officer of the Fuellgraf Electric Co. in Butler, Pa., was re-elected for three-year terms to the boards of the six Nationwide Insurance companies. He was also re-elected board chairman of Nationwide Communications Inc. and Nationwide Development Co. He and his wife, Johanna, live in Butler.





Tartan cheerleader Mark Seibert. Carnegie Tech's defeat of Notre Dame resulted in a Tartan player, Lloyd Yoder (A'27), making the All American Eleven for the first time.

An underrated underdog

Mark Seibert calls it "the most brilliant football game that Pittsburgh has ever seen." Writing in the Sunday News in Lancaster, Pa., Seibert (A'28) recalled that Nov. 27, 1926 game in which Carnegie Tech defeated Knute Rockne's Irish of Notre Dame, 19-0, at Forbes Field in Pittsburgh.

He remembers because he was one of Carnegie Tech's all-male cheerleading team. "As thousands sat through a chilling snowstorm," he writes, "it wasn't long until they forgot the low temperature because there was too much excitement.... Those thousands were happy in the cold as they saw their favorite lads outpass, outrun, outguess, outkick and outplay a superior defensive and offensive game."

Seibert, now retired president of Seibert Unpainted Furniture, notes that Notre Dame had removed Carnegie Tech from its 1927 schedule but put the school back on after the defeat. This time, the game took place at Notre Dame. The Irish had not lost a home game in 23 years. History happened that Nov. 17, 1928. As Seibert recalled, "Carnegie Tech just surprised the living daylights out of the Irish by the fury of its play to the tune of 27-7."

The famous Irish football coach Knute Rockne had lost only 12 games in his coaching career, and two of those were against Carnegie Tech, obviously an underrated underdog.

Two fellow Lancaster men made the win possible: Tackle Newt Cowan (X'29) and Center William Manby (X'28). Both came from Lancaster High and had followed another brilliant Lancaster player, Max Bastian (A'26), to Carnegie Tech.

Cheerleader Seibert, when he isn't writing for the Lancaster paper, makes and exhibits art, hangs around with the Lancaster Rotary Club and continues an interest in Boy Scout work that began in 1919. He and his wife, Ella, have three children and seven grandchildren.



"Serres, Foucault, Beckett (Paris Light)," a pastel by Harvey Breverman (A'56), a professor at the State University of New York at Buffalo. Breverman exhibited recently in the 4th International Print Biennial at the Taipei Fine Arts Museum, the 10th Print Internacional, continuing through September in Barcelona, and at SAGA 90 at the Grand Palais in Paris. Babcock Galleries, New York City, gave him a solo show in May. He will show at Galeria Fort in Cadaques, Spain, in September.

54

Frederick H. Dill (S) of the senior technical staff at IBM Corp. in Hopewell Junction, N.Y., was elected to a two-year term on the board of the Institute of Electrical and Electronics Engineers Inc. Dill, who works on semiconductor manufacturing systems and control, holds over 20 patents and made IBM's first semiconductor lasers. He has taught at the University of California at Berkeley and the Massachusetts Institute of Technology.

55

Dominick M. Schrello (E) is chairman of Schrello Direct Marketing Inc. His most recent books include "The Consultant's Marketing Handbook," "Product Evaluation and Planning" and "Strategic Planning." He and his wife, Georgia, live in Long Beach, Calif.

56

Joseph LaMarca (E), president of LaMarca Inc. restaurant in New York City, is president of the Third Avenue Merchants Assn., director of Cabrini Hospital advisory board and director of New York Greenmarkets.

Milan Spanovich (E), senior principal engineer and president of Engineering Mechanics Inc., a consulting geotechnical firm, accepted a Professional Development Award on behalf of the company from the Pennsylvania Society of Professional Engineers.

Hans H. Buchwald (A) of Stuttgart, West Germany, owns Consulting-Design-Engineering, which specializes in U.S. and European projects.

Werner P. Kalinowski (IA) retired as a client service director from J. Walter Thompson advertising agency after 34 years. He is an independent advertising consultant for the Outboard Marine Co. in Frankfurt, Germany.

Arthur I. Rosenblatt (A) is vice president for capital projects of the Grand Central Partnership in New York City. He is the former vice president of architecture and planning at the Metropolitan Museum of Art.

Joan M. Veleff Sheffler (A), who spent nine months in Bulgaria on a Fulbright scholarship, studied and filmed mask rituals, related to fertility and good health. The rituals involve costumes, bells, swords and dances. Sheffler received a master's degree from Duquesne University in 1984 and wrote her thesis on mask rituals. She has visited Bulgaria yearly since.

Edward A. Feigenbaum (E) is a professor of computer science in the Knowledge Systems Laboratory at Stanford University.

57

Allen Newell (IA), U.A. and Helen Whitaker professor of computer science at Carnegie Mellon, received the Piore Award from the Institute for Electronic and Electrical Engineers for his "seminal contributions to artificial intelligence." See p. 8.

Ferd J. Sauereisen (IM), president and CEO of Sauereisen Cements in Pittsburgh, was appointed by the U.S. Secretary of Commerce to a two-year term on the Western Pennsylvania District Export Council.

58

Shiao-Hung Chiang (S), Ernest E. Roth professor of chemical and petroleum engineering at the University of Pittsburgh, is a fellow of the American Institute of Chemical Engineers and holds an honorary professorship at the Nanjing Institute of Chemical Technology in China. He is president of the Pittsburgh/Ohio Valley Chapter, American Filtration Society.

Marilyn Little Klein (MM) teaches business education at the Sheridan Vocational Technical Center for Broward County in Hollywood, Fla. She belongs to Delta Kappa Gamma, an honorary society for women educators. She and her husband, Richard, live in Hollywood, Fla.

Denise Huot du Maurier (A) performed in "Beggar's Opera" and "A Chorus of Disapproval" in Chicago.

Charlie Caine (A) supervised costumes for "La Gioconda" at The Metropolitan Opera in New York.

59

Warren G. Doty (A), architect, has formed a new firm, Tighe, Doty, Carrino, P.A., in Secaucus, N.J. The firm offers services in architecture, engineering, planning and interior design. Doty lives in Hillsborough, N.J.

Regina Dancull Gouger (A), a signature member of the Pennsylvania Watercolor Society, is owner and designer of Ginger & Spice Needlework Designs in Reading, Pa. She was named Woman of the Year in 1983 by the American Association of University Women.

Alan E. Howard (PM), president of Sundance Press printing company, received the Lyle Isbell Award as Tucson Lithographer of the Year. He founded the company in 1982.

Julian Feldman (IA) is a professor in the Information and Computer Sciences Department at the University of California, Irvine.

60

Allan R. Baumgartner (E) is president of the International Computer Contracting Corp., an IBM analyst with Dataquest Inc., and a columnist for MIS Week in New York City. He lives in San Jose, Calif.

Clifford E. Rowden (E) is president of Q/P Management Inc., a quality, productivity and management consulting firm in Bay Village, Ohio. He holds a patent in steel making and a copyright in problem solving. He and his wife, Mary, live in Bay Village, Ohio.

Charles W. Schmidt (A) received the first Arts Award of the Greater Willow Grove Chamber of Commerce. The Pennsylvania town gives the award to a regional artist who achieves national or international fame. Schmidt, a professor at Tyler School at Temple University, began his career as White House social calligrapher during the Kennedy administration. He has painted numerous works in connection with the space program and is represented in the collections of the National Art Gallery and the San Francisco Museum of Art.

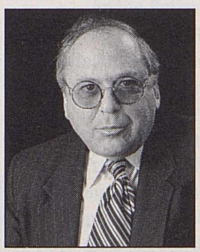
61

Glenn G. Jones (IA) created the Management Consulting Department of KPMG Peat Marwick in Madrid, Spain, in 1977. He would welcome a visit from old friends. He lives at La Maso, 18 - 1A1, Madrid, Spain.

Edward A. Onders (E), a law graduate of Fordham University, is general counsel for Hazeltime Corp. in Greenlawn, N.Y. He and his wife, Lydia, live in Northport, N.Y.

Judith Binstock (S) received a Fellows Prize for Outstanding Research in Science from Los Alamos National Laboratory in Los Alamos, N.M. The prize recognizes those whose research has made a significant impact on a discipline or program in the past 10 years. She and her colleagues also received a Department of Energy Weapons Recognition Award for development and demonstration of an enhanced predictive capability for nuclear weapons hydrodynamics.

George W. Ernst (E) is an associate professor in the Computer Engineering and Science Department at Case Western Reserve University in Cleveland, Ohio.



Gerald Gurland (A'61), director of museum development and coordinator of construction for the Holocaust Museum in Washington, D.C., was invested in the American Institute of Architects College of Fellows at its convention in Houston in May. A Fulbright scholar, Gurland was associated for many years with I.M. Pei & Partners and Richard Meier & Associates. His architectural work has included design of FAA air traffic control towers in 21 U.S. airports, the High Museum of Art in Atlanta, the Des Moines Art Center addition, the U.S. Embassy Chancery in Santiago, Chile, and the Barnum Museum in Bridgeport, Conn. Gurland, a member of the Carnegie Mellon Admissions Council for 26 years, lives in New Jersey and Washington, D.C.

62

Susan Gordon Weinberger (MM), who earned a Ph.D. in education management from the University of Bridgeport in 1987, is a public affairs officer for the public schools in Norwalk, Conn. She is also president of the Association of School/Business Partnership Directors. She and her husband, Norman, and their two children live in Norwalk.

Robert J. Mattauch (E), chairman of the Electrical Engineering Department at the University of Virginia, was named BP America professor of science and technology in electrical engineering.

63

Richard M. Goldman (E) is a patent attorney in the Intellectual Property Law Department of IBM in Endicott, N.Y.

William A. Harrison (E) received a master of business administration degree from Georgia State University in 1989. He is assistant general manager of Granite Panelwall Co. in Elberton, Ga. He and his wife, Dawn, live in Marietta, Ga.

Yuji Ijiri (IA), Robert M. Trueblood university professor of accounting and economics at Carnegie Mellon, received an honorary doctor of laws degree from DePaul University in June.

Kathleen Nord DePuy (MM), a teacher at South Park High School, was elected to the borough council in Whitehall, Pa., where she lives with her husband, Meade, and daughter.

Paul C. Rizzo (E) heads Rizzo Associates in Pittsburgh. The firm, which has opened offices in Wilmington, Del., and Columbus, Ohio, was responsible for engineering, design and project management for the Yough Hydro Plant, constructed below the Youghiogheny River Dam near Confluence, Pa.



William Kerr (A'63) has joined the architectural firm of Damianos Brown Andrews Inc. in Pittsburgh as a principal. Kerr has worked on such projects as the Pittsburgh Center for he Arts, Shuman Center and the Mine Safety Appliance Building in O'Hara Township. The firm is located in The Pennsylvanian.

64

Marilyn Taft Thomas (A), head of the Music Department at Carnegie Mellon, was one of three Pennsylvania composers featured at the First Festival of Women Composers in March at Indiana University of Pennsylvania.

Stephen J. Bucchieri (A) won a 1989 Design Award from the Cleveland chapter, American Institute of Architects, for his design of a three-story home in Hunting Valley, Ohio.

Jerome A. Feldman (S) is director of the International Computer Science Institute in Berkeley, Calif.

John A. Darringer (E) is director of Electronic Design Automation for IBM Corp. in Somers, N.Y.

Robert F. Caviness (S) is a professor of computer and information sciences and mathematical sciences in the Computer and Information Sciences Department at the University of Delaware in Newark.

Robert M. Balzer (E) is director of the Software Sciences Division of the Information Sciences Institute at the University of Southern California at Marina del Rey.

65

Roman L. Weil (IA), a professor of accounting at the University of Chicago Graduate School of Business, has been appointed to the Financial Accounting Standards Advisory Council.

Gary A. Page (E), director of loss prevention and audits for American Cyanamid in Wayne, N.J., received the National Safety Council's Distinguished Service to Safety Award. He oversees safety, industrial hygiene, loss prevention and environmental health programs at all Cyanamid locations.

John Grason (E) is a member of the technical staff at AT&T Bell Laboratories in Holmdel, N.J.

L. Stephen Coles (S) is senior technical manager in the Jet Propulsion Laboratory at the California Institute of Technology.

Gary E. Lindstrom (S) is a professor in the Computer Science Department at the University of Utah in Salt Lake City.

66

Paul A. Allaire (IA), president of Xerox Corp., will also serve as chief executive officer. A Carnegie Mellon trustee and member of the business school's advisory council, he is on the board of Xerox, Rank Xerox Ltd., Fuji Xerox Co. Ltd., Xerox Financial Service Inc., Crum and Forster Inc., Sara Lee Corp. and Catalyst. He and his wife, Kathleen, have two children.

Benoit M.P.D. de Chassey (IA), mayor of Neyron, France, managed information systems for the organization committee of the 16th Winter Olympic Games in Albertville, France. He runs his own software and computer services business in Neyron.

Georges G. Aigret (E), an engineer with Solar Turbines Inc. in San Diego, returned to Belgium after 22 years. He does consulting work and represents U.S. firms in Europe. He lives in Chimay, Hainaut.

Frederick C. Stone (E) is associate scientist in the Engineering Laboratory of the Dow Chemical Co.'s Central Research. Stone is credited with leading Dow into using modern chemical reactor technology, developing kinetic models that describe reactions used to produce styrene and ethylene dichloride and contributing to processes for manufacturing monomers and polymers.

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Bernard J. Dobroski (A'68), dean of the School of Music at Northwestern University, heads a faculty of 53 and a department with 550 students. Also a graduate of Catholic University and Northwestern, he is a contributing editor to The Instrumentalist, a tubist and keyboard performer and president of the Oregon Music Administrators Assn. He formerly performed with the U.S. Navy Band, Concert Band, Ceremonial Band and Brass Quintet.

Jay Avner (IA) is vice president of marketing with CKT Leasing Services Inc. in Cincinnati, Ohio.

Randy Purcell (A) conducted 60 musicians from Carnegie Mellon's Music Department at a Jazz Band concert at Carnegie Music Hall in April. The group performed Purcell's "Keepin' It Together," among others.

Daniel L. Gulling (IA) is executive vice president and chief operating officer of Cruisers Inc. in Oconto, Wis. He is responsible for manufacturing, engineering, materials and customer service.

James F. Plappert (E) is owner/manager of Sales Consultants of Newtown in Langhorne, Pa. He specializes in recruitment of personnel for the environmental industry as well as sales people for business equipment, graphic arts/advertising, medical/pharmaceutical, industrial sales and scientific equipment.

Jerome F. Tatar (S), president/general manager of the Fine Paper Division of the Mead Corp., is a director of the First National Bank of Dayton, Ohio. He and his wife, Lorelei, live in Ketering, Ohio.

69

Richard A. Long (E) is chief engineer of the gas turbine business unit of Fluor Daniel Corp. in Irvine, Calif. He and his wife, Linda, live in Orange, Calif.

Richard J. Waldinger (S), regarded as an originator of, and the world's leading authority on, a methodology for deriving computer programs to meet given specifications by using mathematical deduction, was named a fellow of SRI for 1989. He is principal scientist in the Artificial Intelligence Center at SRI International, a consulting professor of computer science at Stanford University and an editorial board member for the Journal of Automated Reasoning and Logic and Computation. He is co-author of "The Logical Basis for Computer Programming." Volume two on the subject is due out this year.

Richard E. Fikes (S) is senior manager of AI research at Price Waterhouse Technology Center in Menlo Park, Calif.

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Steven R. Friedman (E) has joined Friedman, Eisenstein, Raemer and Schwartz in Chicago to establish its Business Valuation Department. He was a senior manager of business valuation for Arthur Andersen & Co. and has served as an officer for three years in a local chapter of the American Society of Appraisers. He lives with his wife, Judi, and two daughters in Evanston, Ill.

Hilary Kurzweil Taub (MM) is office manager for Prestige Real Estate. She is author of a book of poetry and short stories, "Monday Mornings," published in 1989. She and her husband, **Steven I. Taub** (E'71), live in Narberth, Pa.

Peter A. Freeman (S) is a distinguished visiting professor of information sciences and systems engineering at George Mason University in Fairfax, Va.



Carole J. Banks Robbins (HS'70) is project manager of consumer research in the Marketing Services Department of The J. M. Smucker Co. in Berea, Ohio. She and her husband, Michael, and their two children live in Orrville, Ohio.

James R. Selevan (E) completed his second trans-Pacific crossing from Los Angeles to Honolulu, serving as celestial navigator and medic in a two-man race. He practices internal medicine in South Laguna, Calif., and is founder and editor of The Formulary, a monthly journal providing drug information to hospitals.

Michael Jonathan Howard (PE) lives in Chelmsford, Essex, England, and is an associate of Premier House.

Stuart K. Card (IA) is area manager and research fellow for Xerox Corp. in Palo Alto, Calif.

Louise L. Levy (HS) of West Hartford, Conn., is working on a master of science degree in teaching with a concentration in environmental administration at Antioch New England Graduate School in Keene, N.H. She is a partner in Levy and Atkins Inc., co-chair of Our Town, Our Planet, a member of the Steering Committee Recycling Task Force, a writer of planetarium shows and a member of Dance New England.

James Figura (IM) is vice president, consumer research and insights, for Colgate-Palmolive Co. He will direct the company's market research in the U.S. and internationally. He lives in North Salem, N.Y., with his wife, Eleanor, and two sons.

James C. King (S) is manager of advanced technology with Adobe Systems Inc. in Mountain View, Calif.

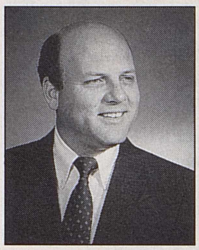
71

Gerald W. Mangold (E) is manager of the process validation/scale-up section in the Biopharmaceutics Department of A. H. Robin's research and development division in Richmond, Va.

Bernard N. Meisner (S) is chairman of Meteorology Department of the University of St. Thomas in Houston, Texas. Certified as a consulting meteorologist by the American Meteorological Society, he has appeared as a weather expert in the Houston media.

Donald E. Heller (S) is a senior research computer scientist with Shell Development Co. in Houston, Texas.

Douglas L. Steidl (A) is a principal with Braun & Steidl Architects Inc. in Akron, Ohio, and president of Barder Development Inc. He is a member of the Carnegie Mellon Architecture Department's Alumni Outreach and past president of the Akron/Canton chapter, American Institute of Architects. He and his wife, Susan, live in Stow, Ohio.



Karl V. Pfirrmann (E'71) is assistant director of transmission planning for Allegheny Power Service Corp., an affiliate of West Penn Power Co. in Greensburg, Pa. He is active in the Edison Electric Institute and the West Point Little League.

Patrick J. Georges (E) is technical director at ARM Conseil in Puteaux, France. His wife, **Mari Klein Georges** (S), is technical manager at CAP SESA Innovation in Paris. They live in Asnieres, France.

Anil Bhalla (IA) is on a three-year assignment in Tokyo, Japan, with Manufacturers Hanover Securities Co.

Pierre M. Chechan (IA) of Paris, France, is director of international development and vice president of sales in the space and industry branch of MS2i, a subsidiary of the French Matra and SEP. The new company specializes in earth observation systems by satellite.

Dileep P. Bhandarkar (E) is the technical director of RISC Systems at Digital Equipment Corp. in Maynard, Mass.



John Foote (E'71), director of systems engineering for BellSouth Communication Systems, was named to the BellSouth Enterprises President's Council. The council honors top sales and service personnel. Foote of Roanoke, Va., is a board member of the Cave Spring United Methodist Church; a member of the Roanoke Chapter, National Railway Historical Society; and chairman, Eagle Board of Review Committee, Blue Ridge Mountains Council, Boy Scouts of America.

Hans Van Gelder (IA) lives in Heilao, the Netherlands, where he started his own quality control consulting firm, Van Gelder Management Services.

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Margaret I. Johnston (S) of Silver Spring, Md., is chief of the Developmental Therapeutics Branch, National Institutes of Health, in Bethesda, Md. A Ph.D. graduate of Tufts University, Johnston manages programs geared to allergies and infectious diseases, including programs on the discovery and development of new therapies for treating AIDS.

Mary M. Shaw (S), professor of computer science at Carnegie Mellon, was named a Fellow of the Institute of Electrical and Electronic Engineers.

Penny Larrick Howard (A) is art editor for the book "ABCs of the Human Mind," published by Reader's Digest in March. She and her husband, Robert, and daughter live in Chapel Hill, N.C.

Edoardo Berera (E) is a telecommunications consultant for Digital Equipment at the European Technical Center in the Sophia-Antipolis International Scientific and Industrial Park in Valbonne, France. He lives in Vallauris, France.

Yves C. Bienvenu (E) of Evry, France, is research head and teacher at Ecole des Mines de Paris, Centre des Materiaux. He and his wife, Francoise, have two children.

Haskell Small (A), pianist and chamber musician, performed along with others, including Sidney Harth, Carnegie Mellon director of orchestral Hall in New York in March. On the faculty of the Washington Conservatory, Small recently took part in the PBS "A Celebration of the Piano," taped at Wolf Trap Farm Park for the Performing Arts in Vienna, Va. His awards include top prize in the Johann Sebastian Bach International Competition and a solo recitalist's grant from the National Endowment for the Arts. He is planning a tour of South America.

Adelle Potter Pollock (HS) of Jacksonville, Fla., received the first master's degree in fiction creative writing from the University of North Florida. She plans to work on a doctorate in American literature and semantic linguistics at the University of Florida in Gainesville.

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Robert J. Smith (S) is a development associate with Dow Chemical in Southfield, Mich. He and his wife, **Terry Lynn Siemon Smith** (A'74), live in Brighton, Mich.

Bruce W. Irwin (S) works at the University of Hildesheim in Hildesheim, West Germany. He and his wife, Anne Linnes, and son live in Hildesheim.

Thomas E. Buzas (HS) is an associate professor of marketing at Eastern Michigan University. He earned additional degrees at Gannon University and the University of Michigan.

Donald N. Cohen (S) is a computer scientist at the Information Sciences Institute at the University of Southern California at Marina Del Rey.

Andrew R. Wolk (A), screenwriter and director, visited Pittsburgh last spring to direct an HBO film, "Criminal Justice," which he also wrote. He spoke to drama students, recalling his first directing experience. "Someone came to me with a play.... They said, 'Do you want to direct this play?' I was so excited that I went home, called him up and said yes. I didn't even read the play. I would have directed the telephone book."

Michael J. Knudsen (S) is a member of the technical staff with AT&T Bell Laboratories in Napierville, Ill.

Charles M. Geschke (S) is president and chief executive officer of Adobe Systems Inc. in Mountain View, Calif.

Gregory D. Gibbons (S) is manager of the AI Department of Systems Control Technology Inc. in Palo Alto, Calif.

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Ralph W. Yearick (HS) is vice president, public relations, for George Hill Co., a marketing communications firm in Pittsburgh.

Louis J. Anschuetz (HS) is an associate director of the Computer Center at Youngstown State University in Youngstown, Ohio. He was named in Who's Who in the Midwest and Who's Who in Computing in 1989 and is an associate member of Sigma Xi. He and his wife, Linda, a certified public accountant, live in Canfield, Ohio.

Steve D. Rubinstein (IM) is senior vice president and manager of planning for First City Bancorporation in Houston, Texas.

Martin S. Kanovsky (S), a cardiologist with the Washington Clinic in Washington, D.C., is also chief of cardiology and associate director of the cardiac catheterization laboratory at Sibley Memorial Hospital. He and his wife, Ellen S. Teller, an attorney, live in Potomac, Md.

Edward J. Karkalik (E) is manager of technical development for BP Oil International in London, England. He and his wife, Joyce, and daughter live in Hinchley Wood, Surrey.

Pamela Dalley Eager (S) is a market development specialist at BASF Corp. Her husband, Randall, is an applications specialist. They live in Livonia, Mich.

Robert Scott (A) showed his sculpture and other art at Cabrini College in Radnor, Pa., in "A Celebration of Black Artists." He won an award in the Greater Harrisburg Arts Festival and took part in the Second World Black and African Festival of Art and Culture Inc.

Robert C. Chen (S) is a hardware engineering consultant with Digital Equipment Corp. in Boxboro, Mass.

Mario R. Barbacci (S) is a senior member of the technical staff of the Software Engineering Institute at Carnegie Mellon.

William C. Mann (S) works with the Summer Institute of Linguistics in Nairobi, Kenya, and the University of Southern California at Marina del Rey.

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Marc Onetto (IA) is vice president of service and systems for General Electric-CGR in Issy Les Moulineaux, France. He lives in Villepreux, France.

Karl A. Herman (A) of Montclair, N.J., is principal clarinetist with the New Jersey Symphony Orchestra. He is in residence during July with the Adare Festival in County Limerick, Ireland.

Elizabeth A. Bansavage (A) of New York City made her Broadway debut in Larry Gulbart's political satire "Mastergate." She also played in "The Majestic Kid" and "Vampire Lesbians of Sodom" off-Broadway.

Barbara R. Freeman (HS), a corporate film director in Chicago, was named an Outstanding Young Working Woman for 1990 in the March issue of Glamour magazine.

Stanley J. Goldman (E) of Dallas, Texas, is an engineering specialist with E-Systems, Garland division. John Wiley & Sons Inc. published his book "Phase Noise Analysis in Radar Systems Using Personal Computers." He is a senior member of the Institute of Electronic and Electrical Engineers.

Hein V. Graafhuis (IA) founded the firm In-Ex-Sys AG in Zurich, Switzerland. It specializes in information and expert systems for the banking and finance industry. He plans a second company offering scientific software solutions for industry.

Gabriel Urwitz (IA) is president of the GOTA Group in Stockholm. It is the fourth largest bankholding group of Sweden.

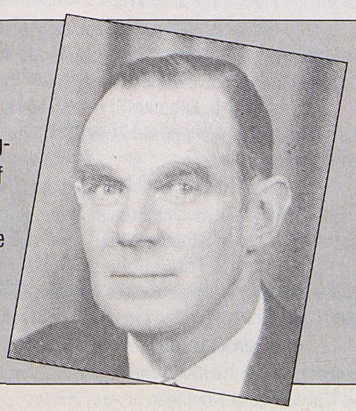
Arnold J. Karr (HS), a free-lance writer and communications consultant, does public relations, publicity and promotional writing for Bugle Boy Industries, J.C. Penney, GQ, Esquire and the Men's Apparel Guild in California, among others. He is a contributing editor for Sportswear International and a Menswear Retailers of America newsletter. He, his wife, Rhea, and son live in Merrick, N.Y.

Amunde Lunde (S) is a senior consultant with SYSDECO A/S in Oslo, Norway.

Ashok D. Ingle (E) is a member of the technical staff at AT&T Bell Laboratories in Piscataway, N.J.

Good knight, Sir Antony

In what was perhaps a Carnegie Mellon first, Antony Driver (PE'71) was knighted by Queen Elizabeth II of England for his six and a half years of service as chairman of the South West Thames Regional Health Authority. The authority, with a budget of £800 million, was responsible for health care for three million people. Now retired and living in Surrey, Sir Antony is former director of BP Oil Ltd. and chairman of Hoogovens (UK) Ltd.



Richard D. Fennell (S) is director of the innovation and systems development division at the Federal Judicial Center in Washington, D.C.

James K. Baker (S) is chief executive officer of Dragon Systems in Newton, Mass.

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Charles R. Connell III (PE) is chief academic officer for Troy State University's European region with campuses in eight countries. He is based in Wiesbaden and lives in Eltville, West Germany.

Christopher Michael Glover (PE) is with Sherwood Public Services Ltd. in Gloucestershire, England.

Rudy A. Fabian (E), a 1989 law graduate of Duquesne University, has joined the Pittsburgh office of Reed Smith Shaw & McClay.

David M. Pahnos (HS), president of the board of the Bloomfield/Garfield Corp., accepted an Award of Merit from the Pittsburgh History & Landmarks Foundation for the corporation's contributions to the preservation of historic architecture and neighborhoods.

Gideon Ariely (S) is head of the Computer Science Division of the Ministry of Science & Technology in Jerusalem, Israel.

Sten F. Andler (S) is a research staff member with IBM Almaden Research Center in San Jose, Calif.

Roderic G. Cattell (S) is a distinguished engineer with Sun Microsystems Inc. in Mountain View, Calif.

Douglas W. Clark (S) is senior consulting engineer with Digital Equipment Corp. in Littleton, Mass.

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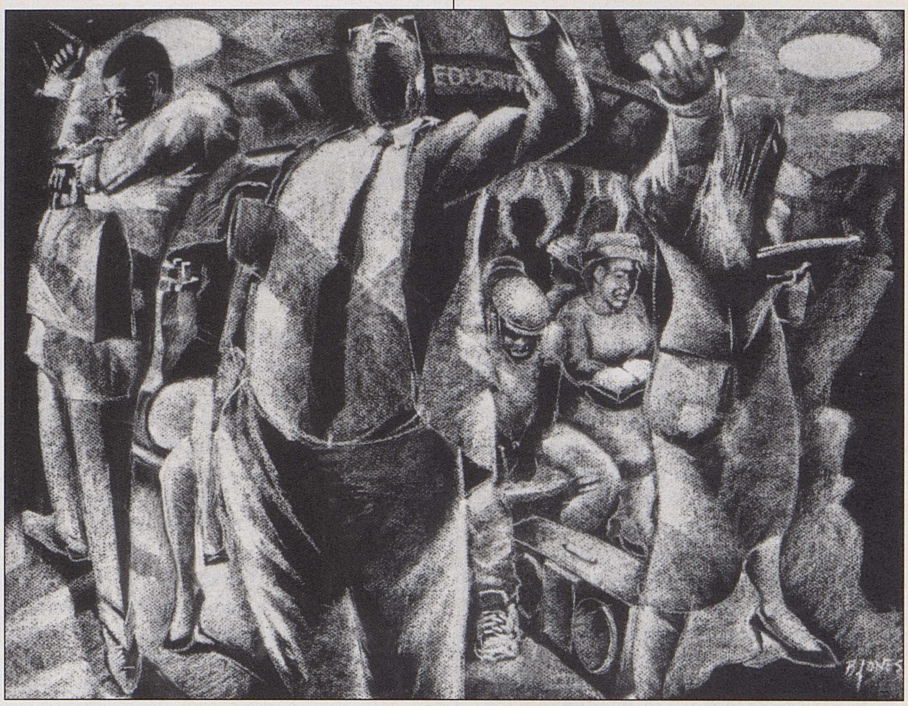
Kenneth C. Kettering (S), an attorney with Reed Smith Shaw & McClay, was elected a partner. A graduate of Harvard Law School, he works with the firm's Corporation, Banking and Real Estate Group. He and his wife, Joan, and son live in Pittsburgh.

Charles P. Yeager (HS) is publications manager with Unisys in Roseville, Minn. He and his wife, **Linda Nanko Yeager** (S'78), and two children live in Wyoming, Minn.



Cheryl R. McAbee (E'77) has joined the law department of Equitable Resources Inc. in Pittsburgh. She earned a law degree from Duquesne University.

Lynn Devaul Constan (E) is planning coordinator for the New Orleans Aviation Board, the government agency that owns and operates New Orleans International Airport. She and her husband, Nicholas, live in New Orleans.



"Public Space, Sacred Place," a blue pastel on a black background, was the title piece in a one-man exhibition of works by Brian Jones (A'79) of Corning, N.Y., at the 171 Cedar Arts Center in Corning. A senior communications designer at Corning Inc., Jones has won awards for printmaking, poster design and illustration from the Rochester Society of Communication Arts and the American Institute of Graphic Arts. He worked previously at the Smithsonian Institution and the Bairstow Gallery House in Washington, D.C.

Roy Levin (S) is a senior consulting engineer at the Systems Research Center with Digital Equipment Corp. in Palo Alto, Calif.

Ellis S. Cohen (S) is a principal technical consultant with the Open Software Foundation in Cambridge, Mass.

Lawrence E. Flon (S) is president of Quality Software Products Inc. in Culver City, Calif.

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John G. Stephens III (A) is manager of technical service for Equimeter Inc. in Pittsburgh. He lives in New Kensington, Pa.

Leslie Stonehouse (A) would like to contact other alumni in France. She lives at 50 Rue Pergolese, Paris, France 75116.

Deborah Campbell (A) is an associate in the New York City firm of Pei Cobb Freed & Partners, Architects and Planners.

Philip L. Lehman (S) is director of marketing of file systems for Transarc Corp. in Pittsburgh.

Gerard M. Baudet (S) is in the Computer Science and Statistics Department at the University of Rhode Island in Kingston, R.I.

Larry K. Lai (S) is vice president of product development for Objectivity Inc. in Menlo Park, Calif.

John E. Laird (S) is an assistant professor in the Artificial Intelligence Laboratory at the University of Michigan at Ann Arbor.



John J. Golec (E'78) is manager of loss control for Consolidated Natural Gas Co. in Pittsburgh.

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Lee W. Cooprider (S) is vice president of software engineering at Stardent Computer in Newton, Mass.

Ronald J. Mosso (E) is a manufacturing manager for Raychem Corp. in Menlo Park, Calif. His wife, **Sarah Nettleton Mosso** (E), is an environmental engineer at Seagate Magnetics in Fremont, Calif.

Melanie Kneip Davison (E) is a product engineer in Graphic Films with Eastman Kodak Co. in Rochester, N.Y. She and her husband, Peter, live in Pittsford, N.Y.

William C. Brantley Jr. (E) is a research staff member at the IBM T.J. Watson Research Center in Yorktown Heights, N.Y.

Herbert W. Martin (HS), poet-in-residence and English professor at the University of Dayton, is a 1990-91 Fulbright scholar. He will travel to Hungary for 10 months to teach American literature at Jonaus Pannoujus, the University of Pecs. He is working on publishing a book of poems about people with AIDS.

Charles L. Forgy (S) is president of Production Systems Technologies Inc. in Pittsburgh.



Joseph W. Plonski (E'79) is director of graphics marketing for Symbolics Inc. in Los Angeles. Located at the Burlington, Mass., headquarters, he is responsible for marketing of graphics products.

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Beverly F. Rubanoff Moses (S) is a risk analyst at Keystone Environmental Resources in Monroeville, Pa. She earned a master's degree in hygiene and chemical hazard assessment from the University of Pittsburgh. She and her husband, Lee, live in Pittsburgh.

Jean Pellegrini Pasternak (S) is vice president in charge of marketing for J.P. Morgan's Global Custody Services to Institutional Investors in Great Britain. She and her husband, Michael, live in Richmond, Surrey, England.

William P. Parrish (A), who received an artist diploma from the University of Cincinnati College Conservatory of Music, is an adjunct assistant professor of music at the University of Missouri-Kansas City. He also plays oboe with the Kansas City Wind Quintet.

David M. Moret (E) is a manager at Pepsico in White Plains, N.Y. His wife, **Christina Magyar Moret** (HS'83), is a free-lance technical writer. They live in Mohopac, N.Y.

Richard E. Korf (S) is an associate professor in the Computer Science Department at the University of California at Los Angeles.

Robert W. Hon (S) is with Apple Computer Inc. in Cupertino, Calif.

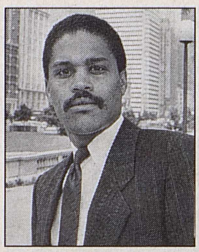
Guy T. Almes (S) is an assistant professor of computer science in the Computer Science Department at Rice University.

David Jefferson (S) is an assistant professor in the Computer Science Department at the University of California at Los Angeles.

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Roger B. Dannenberg (S), researcher in the School of Computer Science at Carnegie Mellon, co-developed Piano Tutor, a teaching aid for piano students. He plays the trumpet in Carnegie Mellon's Jazz Band, which performed his "Elephant Hippopotamus Sine Theta" at a recent concert at Carnegie Music Hall in Pittsburgh.

Tony Hernandez (UP) was named "Legislator of the Year" by the Economic Developers Council of Colorado.



Kurt R. Cherry (UP'81), vice president of the First National Bank of Chicago, received the President's Voluntary Action Award from George Bush in ceremonies at the White House, April 27. Cherry is a long-time volunteer at Jobs for Youth. He teaches a job training class and serves on the board.

Robert P. Merges (HS) earned law degrees at Yale and Columbia universities and is a professor in the School of Law, Boston University. He recently married Josephine Tye Andrews, a Ph.D. candidate at Harvard.

Gail E. Kaiser (S) is associate professor in the Computer Science Department at Columbia University.

John R. Kender (S) is in the Computer Science Department at Columbia University.

Paul N. Hilfinger (S) is an associate professor in the Computer Science Division at the University of California, Berkeley.

Allan L. Fisher (S) is an assistant professor and associate dean in Carnegie Mellon's School of Computer Science.

Nathaniel S. Borenstein (S) is a member of the technical staff with Bell Communications Research in Morristown, N.J.

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Anoop Gupta (S) is an assistant professor at the Computer Systems Laboratory at Stanford University.

George T. Gray III (E) received a Distinguished Performance Award from Los Alamos National Laboratory in Los Alamos, N.M. A staff scientist at the laboratory, he has led a rejuvenation of the materials shock behavior program at Los Alamos. He lives in Los Alamos with his wife, **Altana Bullard Gray** (IM'79), and their two children.

Peter H. Feiler (S) is a senior research scientist with the Software Engineering Institute at Carnegie Mellon.

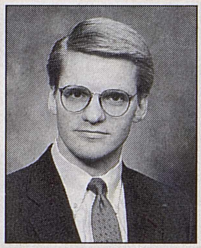
Bruce Dempsey (A) of Pittsburgh exhibited his artwork at Gallery G Inc. in March.

Russell T. Smith (E) and his wife, **Susan A. Miller Smith** (E'83), are lead engineers with the Harris Corp. in Palm Bay, Fla. They previously worked at McDonnell Douglas in St. Louis and received master's degrees from Washington University.

Jeffrey L. Eppinger (S) is a manager of Transaction Processing Development with Transarc Corp. in Pittsburgh.

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Timothy M. Slevin (IA) is assistant vice president in investment banking with Parker/Hunter in Pittsburgh.



James M. Gresh (E'82) is manager of steel making at The Timken Co.'s Faircrest steel plant in Canton, Ohio. He received a master's degree from Harvard's business school in 1988.

Richard A. Sandbothe (IA) is an assistant professor in the School of Management at the State University of New York at Binghamton. He and his wife, Carla, live in Binghamton.

James R. Fisher (E) started the firm, Fisher Engineering, specializing in professional engineering and sewage enforcement services to public and private sectors. He and his wife, Lori, live in Reading, Pa.

Jeanine M. Hoey (E) works for the Structural Design Section, U.S. Army Corps of Engineers in Pittsburgh.

Monica S. Lam (S) is an assistant professor in the Computer Science Department at Stanford University.

Michael L. Mauldin (S) is a research associate with the Center for Machine Translation at Carnegie Mellon.

David L. Dill (S) is an assistant professor in the Computer Science Department at Stanford University.

Mark S. Fox (S) is an associate professor of computer science and robotics in Carnegie Mellon's School of Computer Science.

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George F. Calvi (UP) is village manager for the Village of Ardsley, New York.

Robert A. Rice (E) is a research assistant in the Ph.D. program in solid state and optoelectronic materials and devices in the Electrical and Computer Engineering Department at the University of Colorado in Boulder. He and his wife, Mary, live in Boulder.

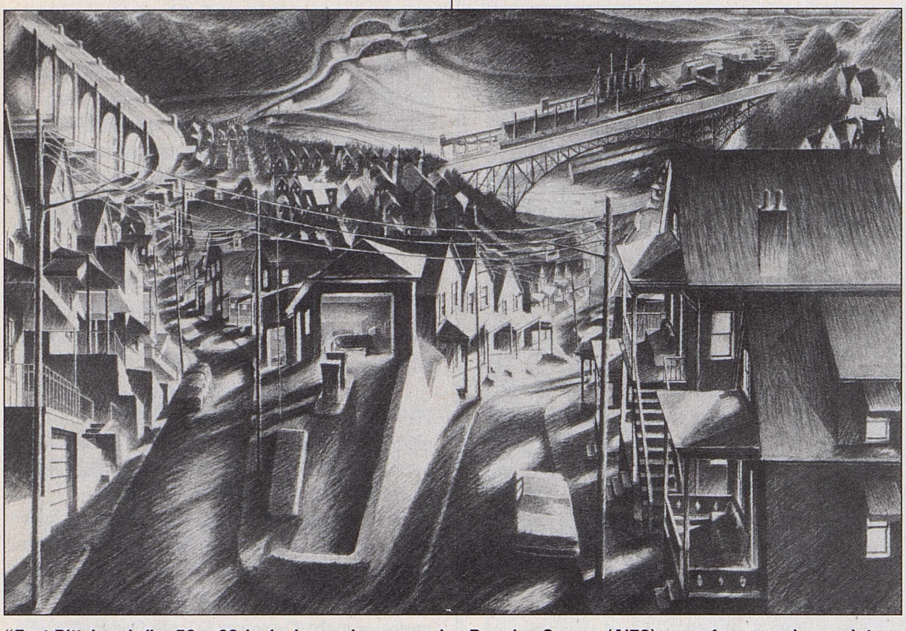
Lisa Feigen Dugal (HS) is a management consultant in manufacturing with Coopers, Lybrand, Deloitte in Cambridge, England. She lives in Huntingdon, Cambs, England.

Russell T. Laufer (A), who is associated with Williams Trebilcock Whitehead, architects, planners and interior designers in Pittsburgh, is working on the renovation of the Nittany Lion Inn for Pennsylvania State University in State College, Pa. He lives in Crafton, Pa.

Deanna J. McCusker (A) is manager of corporate user interface for computer-aided design with Valid Logic Systems Inc. in San Jose, Calif. She participated in the 1989 California state and national championship for sports acrobatics, a new Olympic sport.

David A. Hornig (S) is a principal engineer with the Carnegie Group Inc. in Pittsburgh.

Marc D. Donner (S) is manager of system structures at the IBM T.J. Watson Research Center in Yorktown Heights, N.Y.



"East Pittsburgh," a 56-x-80-inch charcoal on paper by Douglas Cooper (A'70), a professor and associate head of the Architecture Department at Carnegie Mellon. An art critic in Cologne, Germany, reviewing Cooper's recent show there at the Gallerie Der Spiegel, called his work "a roller coaster ride for the eyes." Cooper also showed his work at the American Institute of Architects in Washington, D.C.

Andrew W. Appel (S) is an assistant professor in the Computer Science Department at Princeton University.

Ruth Oroshnik (A), a composer and teacher, will participate in the American Society of Composers, Authors and Publishers' Film Scoring Workshop in Hollywood. She would like to hear from Carnegie Mellon friends. She lives at 930 N. Martel Ave. #308, Los Angeles, Calif. 90046.

85

Joseph A. Doyle (E) is a project engineer with Westinghouse Electric in Pittsburgh, where he and his wife, Mary, live.

Catherine S. Lowney (IA) works for Groupe Bull MTS in Massy Cedex, France. She lives in Paris.

David Greene (S) is an actuarial assistant for defined benefit plans with Herget/C&B Consulting Group. The office serves as East Coast regional center for the C&B Consulting Group, a division of Corroon & Black Corp.

Jamie Gruzska (A) is a printmaking graduate teaching assistant at the State University of New York at Buffalo.

86

Michael C. Murphy (UP) is dean of student affairs at Carnegie Mellon.

Harald Berger (S) is a researcher at FESTO KG in Esslingen, West Germany. She received a Ph.D. in mathematics from the University of Stuttgart in June 1989.

Robert J. Steinmetz (IA) is an evaluator and controller for Dow Corning's European elastomers business in Belgium.

Bernd O. Bruegge (S) is a systems scientist at Carnegie Mellon's School of Computer Science.

Remn-Min Guo (E), a senior staff engineer in Armco Research, received an Armco Research and Technology Technical Achievement Award for 1989. He developed and implemented computer models of rolling mill practices.

C. Douglass Locke (S) is a senior technical staff member with IBM Corp. in Bethesda, Md.

James. R. Driscoll (S) is a professor of mathematics and computer science at Dartmouth University.

Thomas S. Anantharaman (S) is on the technical staff at the IBM T.J. Watson Research Center in Yorktown Heights, N.Y.

87

Maria L. Rehnstrom Pealstrom (A) sang in the Pittsburgh Opera's production of "Mefistofele" last season. She and her husband, Keith, and their daughter live in Westmoreland City, Pa.

Larry Matthies (S) is with the Jet Propulsion Laboratory at the California Institute of Technology in Pasadena.

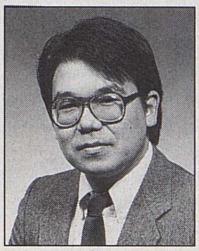
William A. Bir (E) is studying marketing at the University of California at Berkeley. He also works part time for Kleinfelder Assoc., a Bay Area environmental consulting firm.

David J. Fonzi (E) is an engineer in the Product Development Group with Modicon Inc. in North Andover, Mass. He is working on a master's degree in chemical engineering at the University of Lowell and lives in East Boston.

Robert E. Frederking (S) is a project scientist at the Robotics Institute in Carnegie Mellon's School of Computer Science.

Daniel F. Ritz (HS) is an estimator with NILO Construction in New York City. He completed a year-and-a-half management trainee program. He lives in Syosset, N.Y.

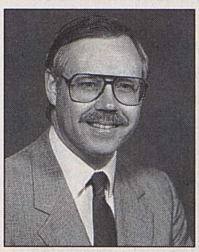
S. Julia Collins (A) of Brooklyn, N.Y., completed a four-month U.S. tour of the musical "The Secret Garden," produced by Theatreworks, U.S.A. She also taught acting workshops for children in Wyoming and Colorado.



Michael Larsen (E'87) is a metallurgist with the GE Research and Development Center in Schenectady, N.Y. He is a member of the Electron Microscopy Society of America and the Materials Research Society.

Melissa J. Kopko (S) received master's degrees in business administration and management of information systems from the Joseph M. Katz Graduate School of Business at the University of Pittsburgh in April 1989. She is a business computing center analyst in the information, logistics and marketing division of Mobay Corp. in Pittsburgh.

Luis Bobillo (IA) returned to Madrid, Spain, after 15 months in the McKinsey & Co. Eurocenter Office in Brussels.



Clayton L. Snyder (PE'87) is group information manager for the Technical Staffs Group of General Motors and head of the Computing Systems Department of General Motors Research Laboratories.

88

Marianne C. Smith (IM) and **Brett D. Brewer** (E) of Phoenix, Ariz., were married in California. Attendants included **Karin G. McCandless** (IM) and **Paul Graves** (E).

Melanie Valencia Kelly (A) is sales coordinator for Yvon Mau Wines Inc. and is a member of Musicians under New York. She and her husband, Fred, live in Woodside, N.Y.

J. Grant Albrecht (A) performed in a Hartford Stage Production of "The Illusion."

Rex A. Dwyer (S) is an assistant professor in the Computer Science Department at North Carolina State University in Raleigh.

Deepak S. Kulkarni (S) is with the Information and Computer Science Department at the University of California at Irvine.

Yumi Iwasaki (S) is a research scientist at the Knowledge Systems Laboratory at Stanford University.

Michael L. Horowitz (S) is a systems designer with the Information Technology Center at Carnegie Mellon.

89

Todd T. Bross (A) is working toward a master of fine arts in drawing at the School of Art at Bowling Green State University. He received a full scholarship and graduate teaching assistantship. He and his wife, Maria, live in Bowling Green, Ohio.

Ari L. Sklar (A) is an architectural designer with CUHZA Architects in Princeton, N.J. His photograph of a school in Miami Beach was selected for the 1991 American Institute of Architects calendar.

Benjamin K. Barrett (S), a U.S. Navy ensign, has completed a Naval Intelligence Officer Course at Virginia Beach, Va.

Mark Derthick (S) is on the technical staff of MCC Corp. in Austin, Texas.

Marianne Hogg (UP) is director of the Medical Social Work Department at Magee-Womens Hospital in Pittsburgh.

Barbara J. Staudt Lerner (S) is a research associate in Carnegie Mellon's School of Computer Science.

William P. Holt Jr. (A) of New York City is assistant to the general manager of Alan Wasser Assoc. He is working on "Gypsy," "Phantom of the Opera," "Les Miserables" and "Miss Saigon."

Jessica K. Hodgins (S) is a postdoctoral associate in the AI Laboratory at Massachusetts Institute of Technology.

Dean S. Daniels (S) is a research staff member at the IBM Almaden Research Center in San Jose, Calif.

Daniel Duchamp (S) is an assistant professor in the Computer Science Department at Columbia University.



Dennis R. Kaiser (PE'89) is assistant director of auditing in the finance and law center of The Timken Co. in Canton, Ohio. He joined the company in 1958.

90

Glenn Paris (A) is the first recipient of a directing fellowship in a program at the Los Angeles Theatre Center, where he will work with directors and playwrights.

Births

Maggie, born to **Penny Larrick Howard** (A'72) and Robert E. Howard

Carrie Elisabeth, born to **Barbara Watts-Robinson** (A'73) and Bill Robinson

Gerrit William, born to Anne Linnes and **Bruce W. Irwin** (S'73)

Kevin Matthew, born to **Terry Lynn Siemon Smith** (A'74) and **Robert J. Smith** (S'73)

Abigail Anne, born to Rebecca J. Owen and **Stuart E. Wilms** (E'74)

Michelle Susan, born to **Karla Salvi Wolniak** (S'74) and Kevin J. Wolniak

Daniel Brett, born to Rhea Karr and **Arnold J. Karr** (HS'75)

Ian Robert, born to **Shelley Rink** (A'78) and Rhoads Rothrock

Jessica Sarah, born to **Susan Olshansky Singer** (HS'76) and **Gary I. Singer** (HS'76)

Victoria Roxanne, born to **Linda Nanko Yeager** (S'78) and **Charles P. Yeager** (HS'77)

Daniel, born to **Sarah Nettleton Mosso** (E'79) and **Ronald J. Mosso** (E'79)

Miranda K., born to Rita Soler Ossolinski and **Matthew Ossolinski** (A'80)

Hannah Elizabeth, born to Karen Chacko and **Rajah Y. Chacko** (S'80)

Sharon Rose, born to **Mary Ann Lawton Pike** (E'80) and **Tod G. Pike** (S'80)

Natacha Nella Stolz, born to **Barbara Bittle Stolz** (AM'80) and Pascal Stolz

Matthew Ross, born to **Elizabeth Meyers Diton** (AM'81) and **Jeffrey E. Diton** (S'81)

Michael Frazier, born to Carla F. Sandbothe and **Richard A. Sandbothe** (IA'83)

Peter Arthur, born to **Christina Magyar Moret** (HS'83) and **David M. Moret** (E'80)

Max Rodwan, born to **Clea Rodwan Angell** (HS'85) and **Thomas Angell** (S'84)

Michael Stanley, born to **Lynn Jackson Kljucaric** (A'85) and **Nicholas J. Kljucaric** (E'84)

Andrew Michael, born to **Lisa Marie Gamez Kafer** (UP'85) and Paul Kafer

Mariel Elisa, born to **Mary M. Wuillond-Aguas** (IA'88) and **Thierry Wuillond-Aguas** (IA'87)

Marriages

Elizabeth Stuart Atwell (MM'36) and **Arthur Smith Armour** (A'31), 427 E. Washington Blvd., Grove City, Pa. 16127

Beverly F. Rubanoff (S'80) and Lee David Moses, 2324 Pittock St., Pittsburgh, Pa. 15217

Jean M. Pellegrini (S'80) and Michael Louis Pasternak, 13 Marlborough Rd., Flat 6, Richmond, Surrey, England TW10 6JT

Pamela Dalley Eager (E'87) and Randall Eager, 1439 Berkshire Rd., Stow, Ohio 44224

Melanie Valencia (A'88) and Fred Kelly, Woodside, N.Y.

Katrin A. Wesner (HS'88) and **Donald Gamble** (S'87), 2431 22nd St. #5, Troy, N.Y. 12180

Maria Cosenza and **Todd T. Bross** (A'89), 421 W. Wooster #2, Bowling Green, Ohio 43402

Deaths

MM'12	Elizabeth Lawrie
A'13	J. Vernon Wilson
E'15	Arthur D. Moore
E'23	Melville R. Baum
A'23	Frederick E. Haller
E'23	William E. Lucas
A'24	Armando F. Venditti
A'26	William E. Reed
A'27	Agnes Bittaker Everett
E'27	George E. Vogt
E'28	John M. Byrns
A'28	Grace Oesterling Mills
A'30	Ralph C. Hitchcock
I'30	John K. Kerr
E'30	Joseph W. Ross
MM'30	Ruth Kulamer Swetnam
I'31	John H. Messmore
I'31	William H. Scotti
A'32	Melvin Morris
MM'32	Frances Graham Ray
MM'33	Lois J. Jacobs
E'33	Edward L. Robinson
L'34	Reba Sines Allen
I'34	Sidney M. Feldman
I'34	Carl W. Wirshing
E'35	Henry W. Stein
MM'35	Emma Howard Pyle
E'36	Charles A. Billante
E'36	Walter J. Huemrich
PM'36	Eugene J. Seiberlich
MM'39	Margaret S. Stroud
E'42	Henry U. Fritz
PM'42	Frank W. Lepage
E'43	Robert D. Fitzgerald
A'43	Walter Tischuk
E'44	Richard T. Castner
A'44	Adelyne Roth Levine
L'47	Rita L. Metz
MM'49	Rosalind N. Levy
PM'50	William M. Goodson Jr.
A'50	Clinton A. Roberts Jr.
MM'52	Nancy Ramey Kloap
E'53	Gerald L. Goldman
MM'57	Rita Marasovich Smith
E'62	Jai Pearce
IA'65	Joseph T. Tobin
A'68	Dennis F. McIntyre
E'77	Gregory M. Andreko
UP'85	Thomas J. Gorman

Faculty/Other Deaths

Margaret Carnegie Miller, 93, daughter of Andrew and Louise Whitfield Carnegie, April 11, in Fairfield, Conn.

David Moskovitz, 87, professor of mathematics from 1928-71, June 22, in N. Miami Beach, Fla.

Computer science comes of age

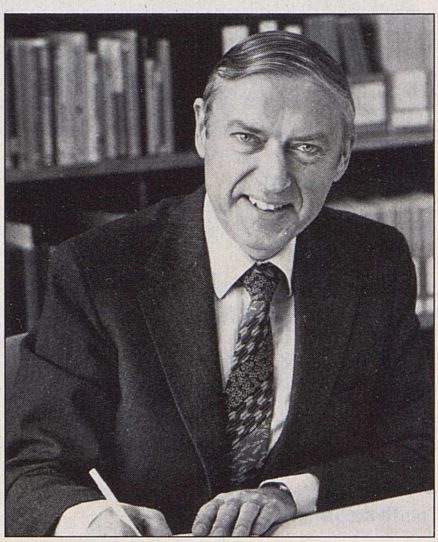
For the last 20 years, computer science has developed its own ideas, foundations and concepts, both in a theoretical sense and also in experimental directions. Many of those ideas are at a stage where you can now talk about a well understood body of knowledge that one can teach and that computer scientists are supposed to know by the time they graduate.

Computer science is now reaching out to other disciplines. You see this in engineering, biology, chemistry, physics, mathematics, business, psychology and philosophy. The symbolic processing of information is something that has interest in itself, but it affects other disciplines in a similar way that mathematics affects physics and engineering. In a sense it is broader because information processing is not restricted to just physics and engineering. It applies to everything.

Computer science shouldn't be buried in an engineering school, for example, because it is not just engineering, mathematics, data processing or artificial intelligence. Computer science really has something to say about the way that information is processed in all disciplines.

The School of Computer Science is building connections among disciplines. Several programs have been put in place and others will follow. We have a master's program in software engineering with the Software Engineering Institute; and programs with Statistics, the business school, Mathematics, Philosophy, Civil Engineering and Mechanical Engineering. We are thinking about a program in scientific computing with Physics and Chemical Engineering.

Over the years, there have been some very important developments in computer science at Carnegie Mellon that have had an impact on the field. In the middle '60s, one of the most important contributions was the idea that computations are symbolic manipulations and are not necessarily numeric in nature. People then thought of computers in terms of computations and calculations. They add or subtract or multiply. But people like Allen Newell (IA'57), Herb Simon (S'90) and Alan Perlis (S'43) showed the world that the computer is able to manipulate symbols and that these symbols may be interpreted for all kinds of purposes and not necessarily numbers.



A. Nico Habermann

In the early '70s, we developed multiprocessor computers, which are now more or less standard. Our contribution to programming languages is significant.

Another example of Carnegie Mellon's contributions to computer science is the Mach system, which is very successful and useful in the design of architectures and the development of large programming systems. It has been accepted by various industries and been taken as the standard by the Open Software Foundation. It's going to be the kernel of many parallel architectures and standards of architectures. That is indeed a success story.

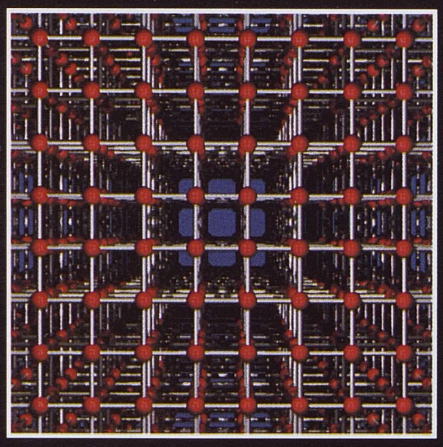
You might say a similar thing is true of iWarp and the Nectar project. Computer scientists look at those as landmarks in the way that the field is pushed. The latest in networking, the Nectar project, involves gigabytes networking (billions of bits per second). Networks now typically have something like three thousand bits per second. We talk about megabytes, which is a million. Nectar's capability is three factors higher than that. One can do that in a room right now, but not over long distances. We have one that goes to Westinghouse, about 30 miles away. We see it as the next step in technology.

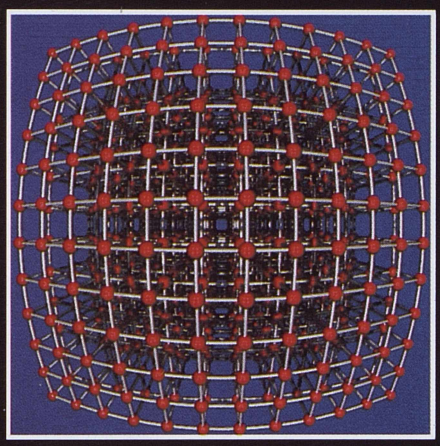
The Machine Translation Center is another success story. There's a lot of engineering work going on there that gradually starts to pay off in realistic translations for manuals. The quality of those translations is really quite good. They want to apply this to phone communication. You talk to someone in Japan. You speak in English, and it will come out in Japanese at the other end. This is not for general speech. It is for limited domains. They can't talk about their technical project at the same time as they also tell you about their family. That won't mix.

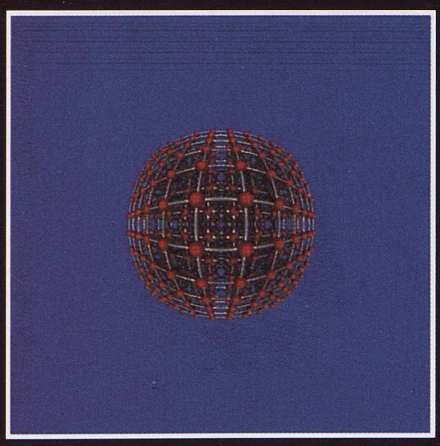
In the technological sense, the whole development here of how one builds those systems, the parallel approach to that, is of great importance to insiders in the field. They see how much more one can accomplish, how one should maintain and develop these systems in certain ways and how one can be organized. Outsiders don't see that or appreciate how important it is.

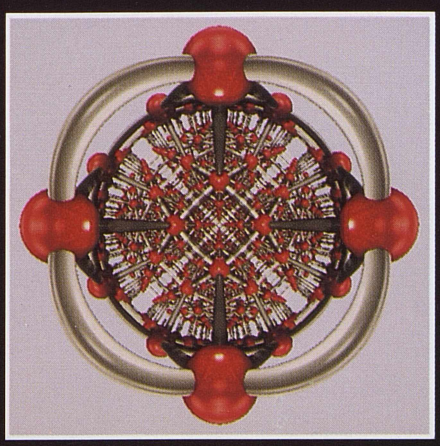
Carnegie Mellon has much to be proud of in its contributions to the field of computer science. To underscore its achievements and mark the 25th anniversary of the establishment of the Computer Science Department, the School of Computer Science will sponsor a symposium, Sept. 23-26 [See schedule on p. 41.], which will bring together many of the world's leaders in this very young and very important science.

A. Nico Habermann is dean of the new School of Computer Science at Carnegie Mellon.









LIGHT

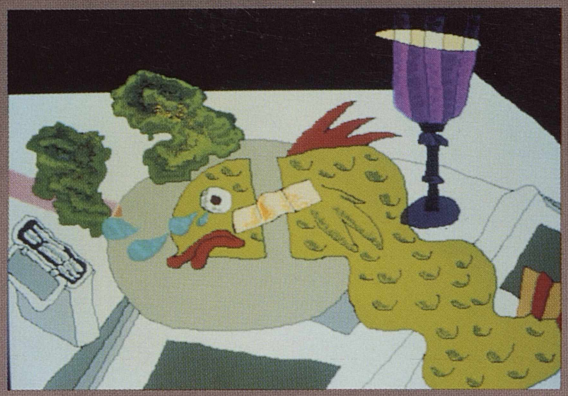
READING

Carnegie Mellon researchers Ping-Kang Hsiung, Robert H. Thibadeau and Robert H. P. Dunn set out to simulate on a computer what objects would look like viewed at close to the speed of light: 186,000 miles-per-second. They used an established method—ray tracing—for creating computer graphics. Their images, from top to bottom, show a structure of straight rods and balls at rest; moving at 95 percent of the speed of light; 99 percent of the speed of light; and a close-up of the structure moving at near the speed of light with the camera rotated 45 degrees. At such speeds, objects farther away from the viewer seem to bend backwards, creating a tight ball. The images in motion blend old and new light moving toward the viewer at various times and distances. The team believes it has produced the first three-dimensional simulations of objects as they appear at near light speed. Hsiung envisions use of the technique in education, industry and entertainment.

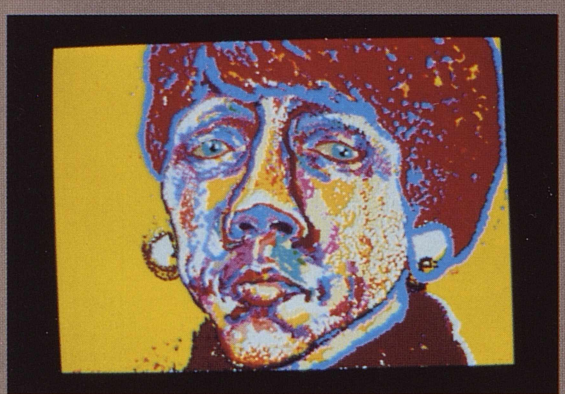
P.K. Hsiung and Robert H. P. Dunn

PANDA PRODUCTS

Carnegie Mellon

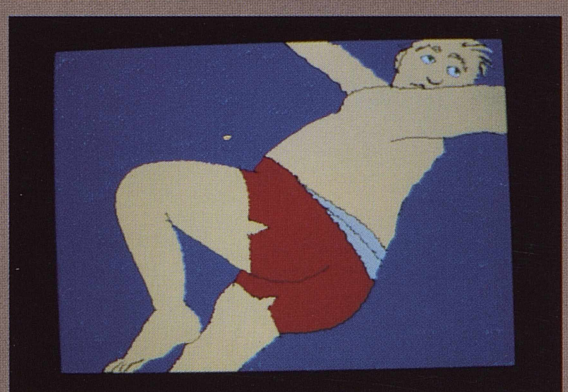








Patricia G. Perrone (A'70) came back to school to earn an M.F.A. in electronic media this year. Perrone's images, all computer-generated, were created using Panda Drawing and Panda Painting systems, developed by Art Department Professor Harry C. Holland (A'63). The paintings are, top to bottom, above, "Case of the Bas" and "Advent," a self-portrait; and, top to bottom, right, "Cana, Inc."; "Pet City, U.S.A."; "Fat Men-in-Space Series: Buffalo"; and "Review," depicting Perrone's teachers Herbert T. Olds (A'60), Holland and Walter Groer. Perrone is teaching computer graphics in the Carnegie Mellon Pre-college Art Program.





Patricia G. Perrone