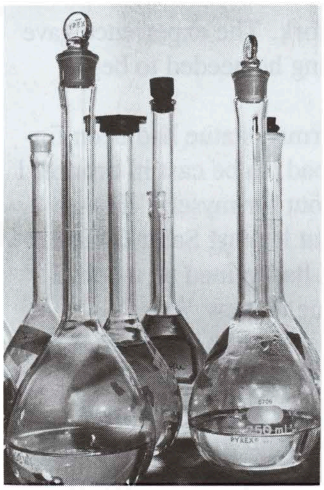


False Idyll

Beyond the tranquillity of an Adirondack snowfall, trouble is lurking. When the snow melts and enters the water system, it will wreak environmental havoc.

NEW KNOWLEDGE

Despite its lofty reputation, faculty research is frequently a down-to-earth process of natural curiosity, refined by education and provided with resources and direction. Its results are often less mysterious—and more interesting—than most of us imagine.
by Dana L. Cooke

One day in March, the sun breaks through the clouds and creates the first spring day in New York's Adirondack Mountains. The snow in the branches grows heavy. It flops off onto the ground, melting and running into the region's streams and lakes. Shortly thereafter, fish begin to die.

The cause is "acid snow." Like acid rain, snow in the northeastern United States contains nitric and sulfuric acids, produced by industries to the west. When the accumulated snow eventually melts, Adirondack streams and lakes are flooded and acid content increases dramatically. Suddenly, living systems that had survived the entire year cannot survive any longer. Some threshold has been crossed.

Charles Driscoll Jr., SU professor of civil engineering, is studying acid precipitation in an effort to locate and identify that threshold—monitoring the month-by-month makeup of the aquatic environment, testing and retesting in search of those conditions that make a crucial difference. He coordinates eight separate environmental data-gathering projects, with sponsored funding that totals $1.2 million.

One of the largest projects, funded by the Environmental Protection Agency (EPA), entails sampling the waters of 17 separate Adirondack lakes. Members of Driscoll's 15-member research team venture into the region monthly (or, in the spring, weekly) for a two-day tour of key locales. At each site, the team fills finger-sized plastic test tubes and, there in the field, conducts chemical tests for particular water properties that change rapidly (aluminum content, for example).

Then, in the civil engineering department's labs in Hinds Hall, a full battery of tests is performed. In the case of the EPA project, there are about a dozen analyses required: specific conductivity, pH, alkalinity, dissolved oxygen, dissolved organic and inorganic carbon, etc. In all, Driscoll produces at least 21 separate composition breakdowns of water samples collected for his various projects. The team also conducts some manipulative studies, experimenting, for example, with the use of lime to counteract acidification.

From this information, Driscoll can begin to draw preliminary conclusions: He has discovered, for example, that increased aluminum concentrations actually contribute to water clarity; however, this clarity raises water temperatures and consequently alters organism distribution in the lakes and streams. The balances are that delicate.

The goal of Driscoll's voluminous data-gathering is a firmer sense of the magnitude of the acid rain problem and its future. "It's fairly easy to quantify the effects," he says, "but how much do we have to reduce loadings to significantly reduce the effects? If the EPA starts to implement some greater control mechanisms, will they have any effect? That's the question they're trying to answer."

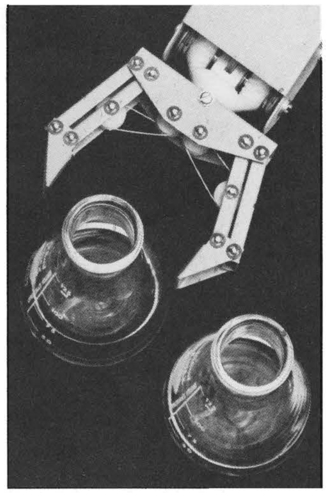
Here's a job for you: You're hired to help an ambitious young biologist in his laboratory work. You are to mix dry compounds with pungent, exotic solvents, creating a volatile and highly toxic solution. Then you must run the resulting samples through a battery of analytical tests and finally store them. Because of interfering reactions to light, you must perform the entire procedure in complete darkness. There are 300 such samples to process before tomorrow morning.

Daniel Macero, SU professor of biology, has found just the man for the job, and he isn't a man at all. He's a robot.

The application of robotics to difficult and boring duties is nothing new, of course. Industry is in the process of automating its most routine manufacturing procedures, and even in labwork the use of robotics has begun. But for the average laboratory (on a college campus, for example) the cost of robotics and required control systems is prohibitive, both in terms of initial acquisition and daily programming. Macero hopes to change all that.

"I envision a time when a laboratory that currently has five chemists doing routine jobs will one day have four robots and one chemist to supervise the progress," he says. "This will free the other four chemists to do more creative and demanding tasks."

Common household microcomputers are the answer to both the equipment-cost and programming barriers. Guided by Macero, chemistry graduate student Brian McGrattan is performing a robot-microcomputer marriage. He has interfaced the electronics of the two devices, and he has codified that process to create a new computer language that is designed to control robot movement. The single command

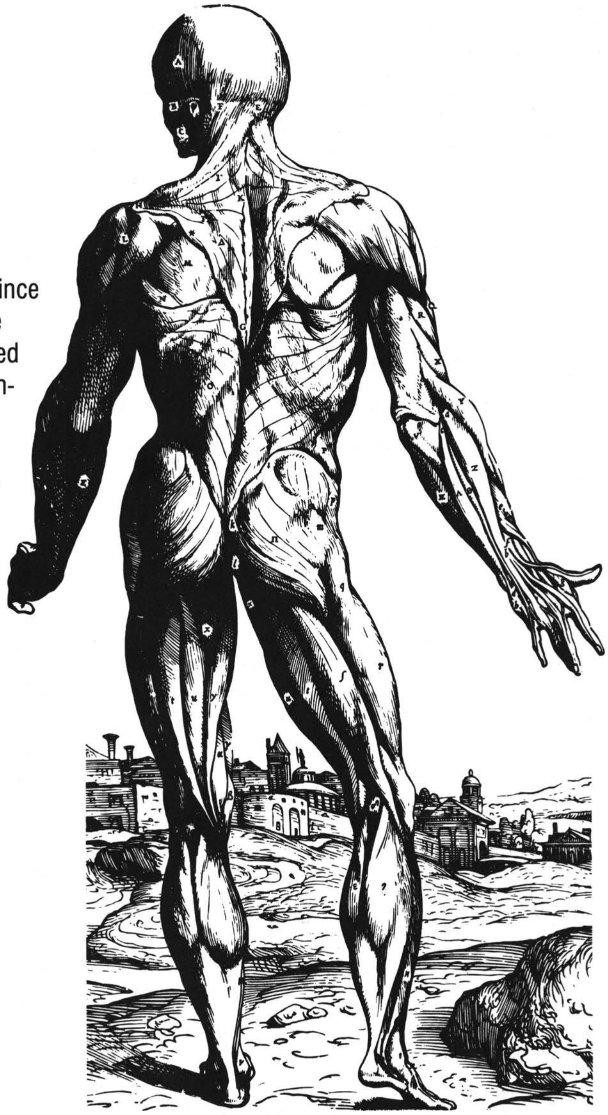


Marriage of Convenience

Robots would be as helpful in small laboratories as they are already in large manufacturing plants *if* they were cheaper and easier to use. The key to that transition may be the common, household microcomputer.

Muscle Growth

It has been five centuries since anatomists first defined the dozens of muscles contained in the human body. Contemporary scientists now hope not only to understand muscle development but to stimulate it as well.



"Move," for example, replaces the sophisticated electronic input that tells the arm where to go and what to do. The program is also capable of storing the locations of obstacles, and thus manages to avoid accidents on its own.

Using the language, McGrattan can program a specific lab function, store it on disk, and recall it any time it is needed—a capability that Macero terms "flexible automation." It takes perhaps an hour to program a five-function routine capable of processing four separate beakers (which includes finding the beakers in separate locations and returning them to separate locations).

Today, the robot is still a fairly slow helper, and not quite graceful enough to take on the more delicate lab duties. When it rotates, gears click and the claws shiver nervously. On the other hand, the claw already incorporates a feedback function that allows it to sense the pressure it is exerting on objects in its grasp, and further revisions will provide other needed capabilities.

It shouldn't be long until the robot is a reliable helper. In McGrattan's lab, there is only one rack of test tubes that have been badly mistreated, their tops broken and jagged, and you can't blame that on the robot. "I dropped those in the sink," Macero admits.

From the day a person is born, the muscles begin to grow. In an adolescent male, the effect is often dramatic, the limbs acquiring weight and strength rapidly. In adulthood, muscle growth slows and stabilizes; the body is capable of replacing muscle cells as they die.

Why then, in old age, do the muscles begin to lose that battle? Why, when muscular dystrophy strikes, is the battle lost almost from the onset?

Scientists may be on the verge of answering such questions. Recently, the hormone somatomedin has been identified as the primary stimulator of muscle growth. There are high hopes that the isolation of somatomedin and its adaptation as a clinically introduced stimulant could both prolong life and defeat MD.

James Florini, SU professor of biology, has spent the last 25 years in this effort and is a regular recipient of Muscular Dystrophy Association research funds (money raised during the Jerry Lewis Labor Day telethons). His years of careful, step-by-step labwork are beginning to bear fruit.

Florini's interest in muscle regeneration evolved from circumstance. While a research group leader at Lederle Labs in the early 1960s, Florini was assigned to find a drug to fight post-operative shock and muscle deterioration. He decided that he would first have to study how the body stimulates muscle growth. Eventually, full-time pursuit of somatomedin became his central research focus, and in the late 1970s his team identified the hormone as the primary muscle growth stimulant.

Now the task is to isolate and define the links. If somatomedin is the growth stimulant, then can we assume it is lacking in the aged and MD victims? "There *is* a deficiency of somatomedin in older people, and it is known that muscle growth is slower in the aged," Florini says.

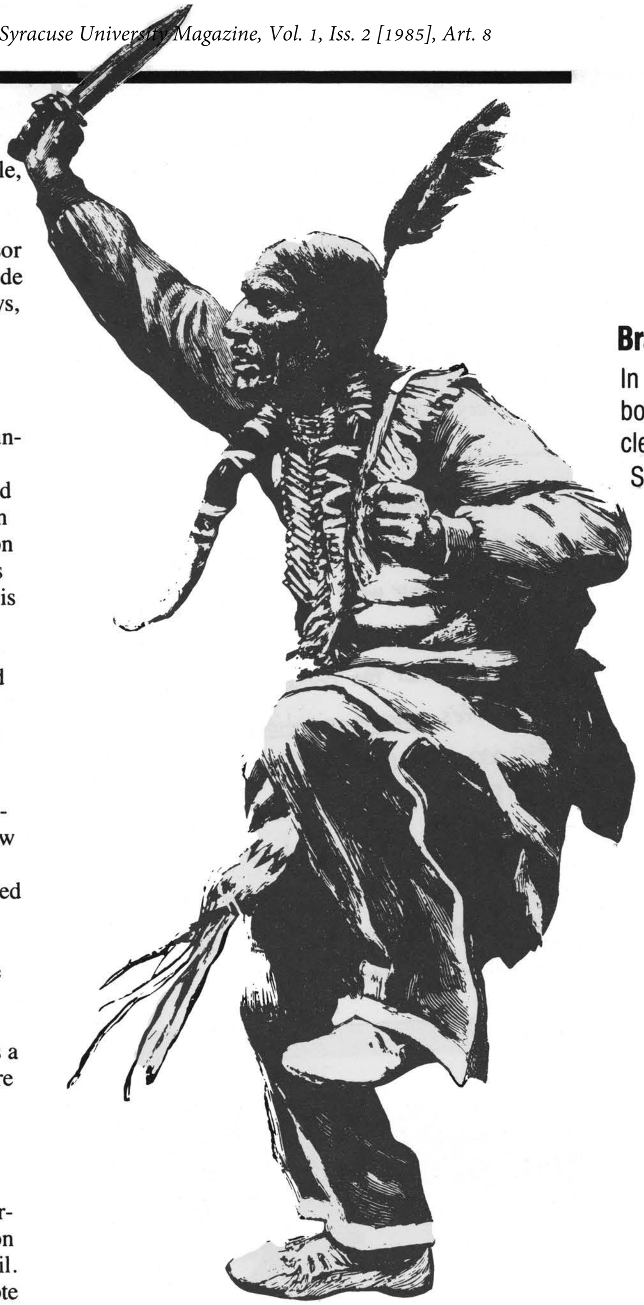
According to Florini, the MD connection is less certain. "Although it is not yet known whether there is a deficiency of somatomedin in those with muscular dystrophy and other types of muscle-wasting disease," he says, "it is possible that this research will help in treating those disorders in the future."

Florini points to other applications; Beef production worldwide would be greatly enhanced by a drug that convinced muscles to grow more swiftly. "The control of meat protein formation is a very important agricultural problem that is being actively pursued by several drug companies," he says.

And, of course, there is the most profound implication. It is imaginable that, in the future, coping with old age may be a routine matter of hormonal fine-tuning.

From the earliest days of western expansion until the early 1970s, American Indians got no respect. Their removal from the land was likened to pest control. Their religions were compared to voodoo. In television and the movies, they were portrayed as clownish, paint-splashed savages. That image was adopted by sports teams nationwide, and the American Indian was reduced to mascot status.

Somehow, in the space of two decades, attitudes toward native Americans have changed profoundly. Indians have become exemplars of American Culture. Their spirituality is the topic of university



Brave New World

In the classic world of Cowboys and Indians, it was always clear who played the villian. Since then, attitudes toward the American Indian have changed dramatically.

religion courses. Their contemporary plight is the stuff of the six o'clock news. Their original lifestyle, respectful of the land on which we live, is a prototype for the ecology movement.

Five years ago, Amanda Porterfield, SU professor of religion, asked herself how this change of attitude had come about. What she has discovered, she says, amounts to "the construction of a new American religion."

All religions, Porterfield explains, are based on idealized views of reality, or *myths*. Porterfield is now attempting to track the evolution of a new foundation myth: America prior to 1492 was an Eden, the story goes, and that ideal would have continued forever in perfect balance were it not for European intruders. This story of the New World's perfection and subsequent defilement, like other myths, does not necessarily adhere to real life. So, Porterfield is asking, where did it come from?

She has poured through mountains of literature pertaining to Indians—more than she ever realized existed. Hers is not an archaeological pursuit; the book will not contain a single bit of hard data that hasn't already been published elsewhere. Instead, her contribution will be a reflective one, offering new ways of examining not only Native Americanism, but also the American Protestantism that grew up alongside it.

Porterfield is finding that neither religion escaped influence from the other. She expects her comparative study to provide, in fact, new ways for Americans to think about their own religion. "We lose sight of the most important aspects of our religion and culture because it's the water we live in," Porterfield says. "American Indian religion is a place to get out of the water and look at our culture anew."

At 10 o'clock one morning, in a small city somewhere, a little girl disappears from the school playground. There is no word until an hour-and-a-half later, when a neatly handwritten note on watermarked stationery arrives in the parents' mail. Sent before the crime was even committed, the note states the reason for the kidnapping and sets the ransom, to be paid in a particular city park by sunset. "The girl will be killed," the note reads. It is signed, "The Guardian."

Within minutes, the FBI has called Murray Miron, SU professor of criminal psychology and the country's most respected criminal psycholinguist. A copy of the ransom note is telecopied to Syracuse and within two hours Miron sends back a surprisingly detailed, three-part report. The first section provides standard, demographic information—the perpetrator's gender, age, level of education, etc. The second section is a broad personality profile, in which Miron identifies the psychological quirks with which the perpetrator is battling. And in part three, Miron draws some conclusions about the perpetrator's willingness and ability to carry out the threat. He may report, for example, that "the subject does not display the resolve nor the determination to commit a lethal attack." All this he derives from the kidnapper's single note.

The key to Miron's astounding capabilities is his realization that most of what constitutes a personality is reflected in words. "Language is the sum total of what we do, where we've been, and what we intend," he says.

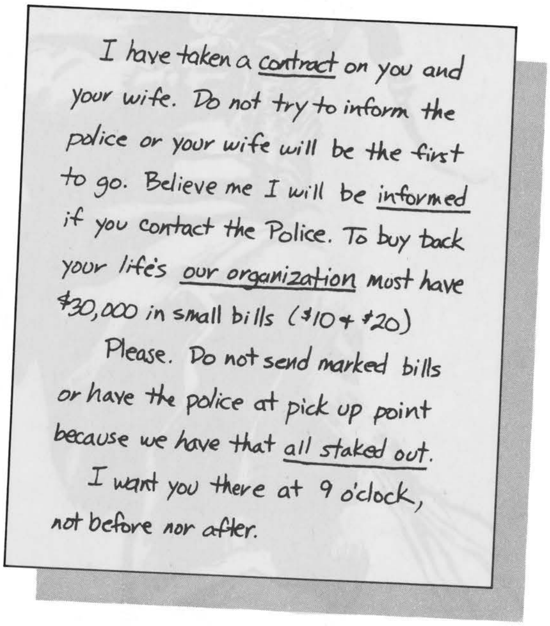
Miron has assembled a vast database of extraordinary, often threatening, verbal communications. He searches for correlations between linguistic traits and personality traits, creating a "threat-analysis dictionary" that contains approximately 250 specific linguistic traits that point to modes of behavior. For example, a person's use of imaginary technical terms—a demand that the government cease production of its "mirrowave stamatic refermirators"—is a likely indication of schizophrenia.

Miron is called about 150 times a year to file his three-part reports. Cases include bomb threats, extortion, kidnappings, hostage negotiations, and multiple murders. Although most of his "cases" are little known, a few are front-page stories in newspapers nationwide. He has analyzed the intentions of Patty Hearst; provided a psychological profile of the Son of Sam killer, David Berkowitz; and assisted the search for the Los Angeles "Hillside Strangler" and the Atlanta child murderer. He analyzed porn publisher Larry Flynt's audio tape allegedly proving that John DeLorean had been threatened by FBI narcotics agents; it was a fraud, he believes. He has also studied linguistic evidence remaining from the Lindbergh baby kidnapping in 1936, at the request of convicted kidnapper Bruno Hauptmann's widow.

The linguistic samples Miron collects in the process are invaluable, he says. Working with the FBI is, in fact, his field research. He doesn't deny that it's also very exciting.

In a Word

To the psychologist, words sometimes speak louder than action, revealing an individual's roots and personality. In criminal situations, this type of insight becomes vital.



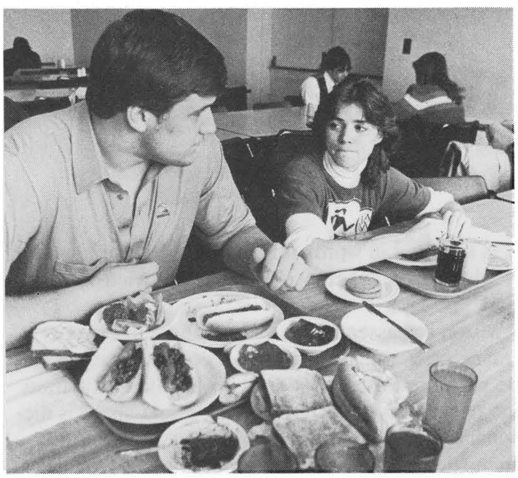
I have taken a contract on you and your wife. Do not try to inform the police or your wife will be the first to go. Believe me I will be informed if you contact the Police. To buy back your life's our organization must have $30,000 in small bills ($10 + $20)

Please. Do not send marked bills or have the police at pick up point because we have that all staked out.

I want you there at 9 o'clock, not before nor after.

Food Factory

Some athletes consume five times as much food as the average person. Whether such an extreme appetite is appropriate is a very complicated question.



The human body is a staggeringly complex factory, devoted to a deceptively simple process: burning food to produce energy. Anyone hoping to control or manipulate this process must first recognize its delicacy and sophistication. Ultimately, proper nutrition depends on counting every calorie consumed (and vitamin and mineral) and every calorie spent.

Unfortunately, considering the variety of foods we eat and the chemical complexity of each, such comprehensive calorie counting is all but impossible.

Sarah Short, SU professor of nutrition, has spent a decade addressing that barrier. She has already computerized intake and activity calculations, and now hopes to create a program that would go a step further, analyzing those calculations to produce specific recommendations about foods to eat and foods to avoid.

The program would be based on two others already developed by Short. In the early 1970s, she and her son, Dr. William R. Short, created an extensive food database, including both domestic foods and a long list of commercial foods—everything from an Arby's roast beef sandwich to a Kit Kat bar. There are now 5,000-plus food items in the database, each with 17 nutrient breakdowns. Anyone who is capable of providing the computer with a reasonably detailed list of foods eaten in one day receives in response some 35 subtotals of food consumption: calories, protein, fats, carbohydrates, fiber, fatty acids (saturated and nonsaturated), cholesterol, 10 vitamins, eight minerals, and related ratios.

The Shorts have also developed "activity software," capable of analyzing a regular day's activities (240 different types) and calculating the amount of calories expended. It is the combination of these two preliminary packages that will result in the kind of ultimate diet-analysis system Short envisions. "Ultimately we'd like to provide a personalized diet for each person," she says.

Already the first program, the diet analyst, is being put to good use. Hospitals and individual dieticians nationwide use Short's program today as a basis for nutritional counseling. "They want hard facts on which to base their decisions," she says.

Athletes, who also have special dietary needs, have benefited from the software. Since 1978, Short has monitored the eating habits of 16 SU athletic teams. She discovered some extreme examples of unusual nutritional demands. One football lineman that Short encountered a few years ago was consuming more than 14,000 calories each day without gaining a single pound. (The typical "reference man" consumes approximately 2,700.)

Beyond the bizarre statistics, Short's work has also yielded some extremely pertinent conclusions about various athletic diets. Football players, for example, consume one-half of their diet in the form of fat, far exceeding the 35 percent figure recommended by medical authorities. Also, "most of the athletes I've analyzed have three to five times as much protein as they need," Short says.

Although the average person does not need such detailed analysis, special populations (such as athletes) do. Short's hope is that, aided by a computer, prescriptive nutrition will meet those needs.

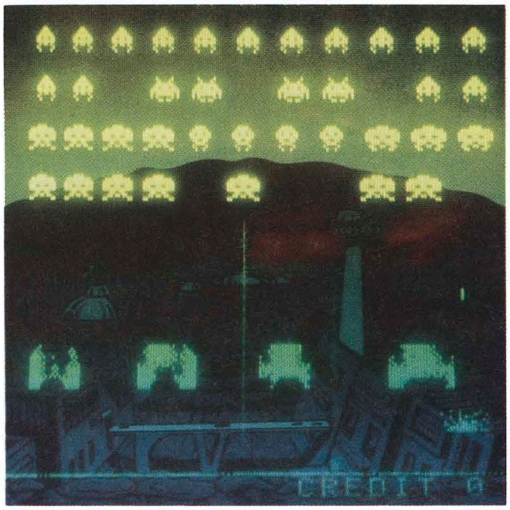
There are two kinds of exertion—physical and psychological. They are different in a crucial way: Physical stress strengthens the cardiovascular system, but psychological stress seems to do the opposite. For whatever reason, someone prone to frequent psychological stress (the "Type A" personality) is more likely to develop heart disease. Scientists do not understand that link, but its existence is rarely disputed.

Alan Langer, SU assistant professor of psychology, wants to define the link—not only to understand it but eventually to reverse it as well. He has been studying stress since he was a graduate student at the University of North Carolina at Chapel Hill in the late 1970s. Langer has already found that biofeedback can indeed help "Type A" individuals control their reaction to stress. But is that helping them ward off cardiac arrest?

In his laboratory, Langer monitors the physiology of test subjects engaging in both forms of exertion. Test subjects sit in a padded recliner playing, of all things, the video game Space Invaders; he considers the frustrations of the game representative of psychological stress. A nearby computer monitors the cardiovascular and pulmonary responses of healthy, young adults as they blast away rows of invading space warriors.

Then, while still attached to the monitoring equipment, subjects pedal an exercycle mounted near the foot of the recliner—a common form of physical stress. By comparing heart rate, blood pressure, and oxygen consumption during the two activities, Langer can draw parallels and distinctions.

When he is done, Langer hopes to explain why psychological stress kills, and whether there might be something we can do about it.



Stress Test

When a game of Space Invaders is lost, psychological stress may set in. For some people, the stress could, in turn, produce a susceptibility to heart disease.

Human vision—how we see and comprehend the world around us—remains one of the most intriguing and baffling physical abilities studied by scientists. The work of the eye itself is relatively simple, but what happens to its harvest once it reaches the brain remains almost a complete mystery.

In their efforts to unravel that mystery, researchers have identified the components of vision. They speak of contrast sensitivity, acuity, field of vision, stereoscopy, etc., all adding up to an ability to perceive and interpret visual data. Researchers hope to build a model of vision, made up of particular portions of each component. To do so, they study each component separately, examining the simplest of visual tasks.

Denis Pelli, associate professor of neuroscience at SU's Institute for Sensory Research, has a different idea. Pelli has elected, instead, to study a *complete* visual function and to determine which visual abilities it requires. The function Pelli has chosen is mobility: how vision allows us to move through our living room without falling over the coffee table. Mobility is an ideal candidate for vision research. "The problem of guiding one's body through an environment is common to all visual systems," he says.

Pelli's approach results in some of the most unusual-looking research being conducted at SU. At the sensory research center at Skytop, Pelli and his assistants have constructed a short circular walkway interrupted by seven-foot-high orange pillars, carved from foam rubber. Test subjects don optical equipment that simulates, in variable degrees, three forms of visual impairment. They venture off to complete the maze while Pelli or a lab attendant records the subjects' speed and collisions. By repeating and repeating this type of test, altering the degree of impairment and changing the maze layout, Pelli is building conclusions about just how much acuity, contrast sensitivity, and field of vision we need to get around.

One thing he has found is that mobility requires less vision than scientists have assumed. When Pelli presented his findings at a scholarly conference last fall, colleagues were skeptical. The thresholds were too low, they said, and they blamed the controlled conditions of the laboratory maze. So, during the 1984 Christmas shopping season, Pelli took his subjects and optical gear to a suburban shopping mall and turned them loose in the crowd. "They performed better there than in the lab," Pelli says.

The next stage in Pelli's work is to make a predictive reevaluation of his data. He will bring subjects with actual impairments into his lab; measure their acuity, field of vision, and contrasensitivity; and then attempt to predict their performance in the maze. If he is successful, he is well on his way to a completed model of human vision.

Vision Quest

Even with their vision temporarily impaired, most people move about more easily than one would expect. Understanding that ability is a challenging task.

Rough Rider

Grizzly has *always* been successful as a mechanical concept. As originally designed, though, the all-terrain vehicle was expensive to build and extremely unkind to its human occupants.

In 1978, Canadian inventor and entrepreneur Ernie Weaver invented a new kind of all-terrain vehicle, which he called Grizzly. It definitely was not your average bear.

Measured in terms of raw mechanical performance, Grizzly was at the head of its class: more powerful, mobile, and versatile than most; able to carry 1,000-pound loads over and through obstacles, into remote, environmentally sensitive areas with minimum terrain damage. Grizzly even floated.

Grizzly was, though, a rather unruly bear, complex to assemble, costly to produce, and uncomfortable to operate. "Grizzly was successful in its idea," says Lawrence Feer, SU professor of industrial design, "but it wasn't successful in its design." Feer was called in to help redesign Grizzly, retaining its remarkable mechanical credentials while meeting production and aesthetic requirements more fully.

In this case, the first stage of research was remarkably straightforward. Feer and associates climbed into Grizzly, turned the key, and went. "We drove it through the woods, over rock walls, through ditches filled with water, down highway shoulders, and we drove it into a lake," Feer recalls. In this way, Grizzly's unkindnesses became first-hand knowledge. For example, Feer learned through painful experience that engine-compartment heat was finding its way directly to the passenger's shins.

Design research in its purest form followed, as Feer and the manufacturer's engineers began sweating out the details. Both in the conference room and at the drawing board, they searched for new casting shapes, materials applications, and function requirements that together would address both passenger comfort and production concerns. "The designer has to have some understanding of engineering," Feer says, "and the engineer some knowledge of the human factor."

When they were done, Feer and his associates had made numerous changes to the bear. They extended the engine compartment bulkhead to the floor and added venting louvers, thus addressing the hot-shin problem. They enclosed Grizzly's cockpit-style steering and speed control (the mechanical linkage was previously exposed) and reshaped the wheel itself to avoid contact with the operator's belly. They made fundamental changes to the front, side, and rear bumper castings, to which tailgates, handrails, compartment enclosures, and even the main floor are attached. In addition, they made some purely aesthetic revisions, aimed at creating a product image that meets the expectations of likely buyers. "If it's too sweet-looking," Feer says, "it won't look like the kind of thing meant to be pushing through the wilderness."

For Feer, the opportunity to work on Grizzly was an important type of field work. Each time he takes part in a design challenge such as Grizzly, Feer says, he learns something new about production techniques, marketing strategies, and modern tastes.

Among its holdings, the Norton Simon Collection contains more than 2,000 letters exchanged between art agent Emmy Galka Scheyer and the artists she represented, Munich-based abstractionists Lyonel Feininger, Alexei Jawlensky, Wassily Kandinsky, and Paul Klee. Known collectively as the "Blue Four," those painters represented all that was daring and intellectual about abstract art in the early 20th century. The letters they exchanged with Scheyer, as she toured the United States between 1924 and 1945 promoting their work, are unusually rich from almost any perspective.

Ironically, the letters' richness has also been a hindrance to art historians; collecting and annotating them could take a lifetime. Four years ago, the University of California Press asked Kandinsky scholar Peg Weiss, research associate professor at SU, to delve into the Simon Collection with the intention of publishing the most significant of the Blue Four/ Galka Scheyer letters. It was an assignment that she *had* to accept, though she too understood the magnitude of the task before her.

"I very soon came to the conclusion that I would need to computerize the task; otherwise, it could easily become a life's occupation," Weiss says. Working with Ernest Sibert, professor of computer science, and Anne Shelly, senior research associate at SU's computer technology center, Weiss is now on the verge of completing a computer-aided research methodology that is miles beyond conventional word processing and applicable to all types of manuscript-related research.

Having first used an optical character reader to enter the Blue Four correspondence into the computer system, Weiss is now revising existing translations, using two computer screens simultaneously, one English and one German. At the same time, she is placing within the texts various types of notes, annotating the authors' general and familiar references.

Those notes become extremely important in the step that follows, the system's pioneering triumph.

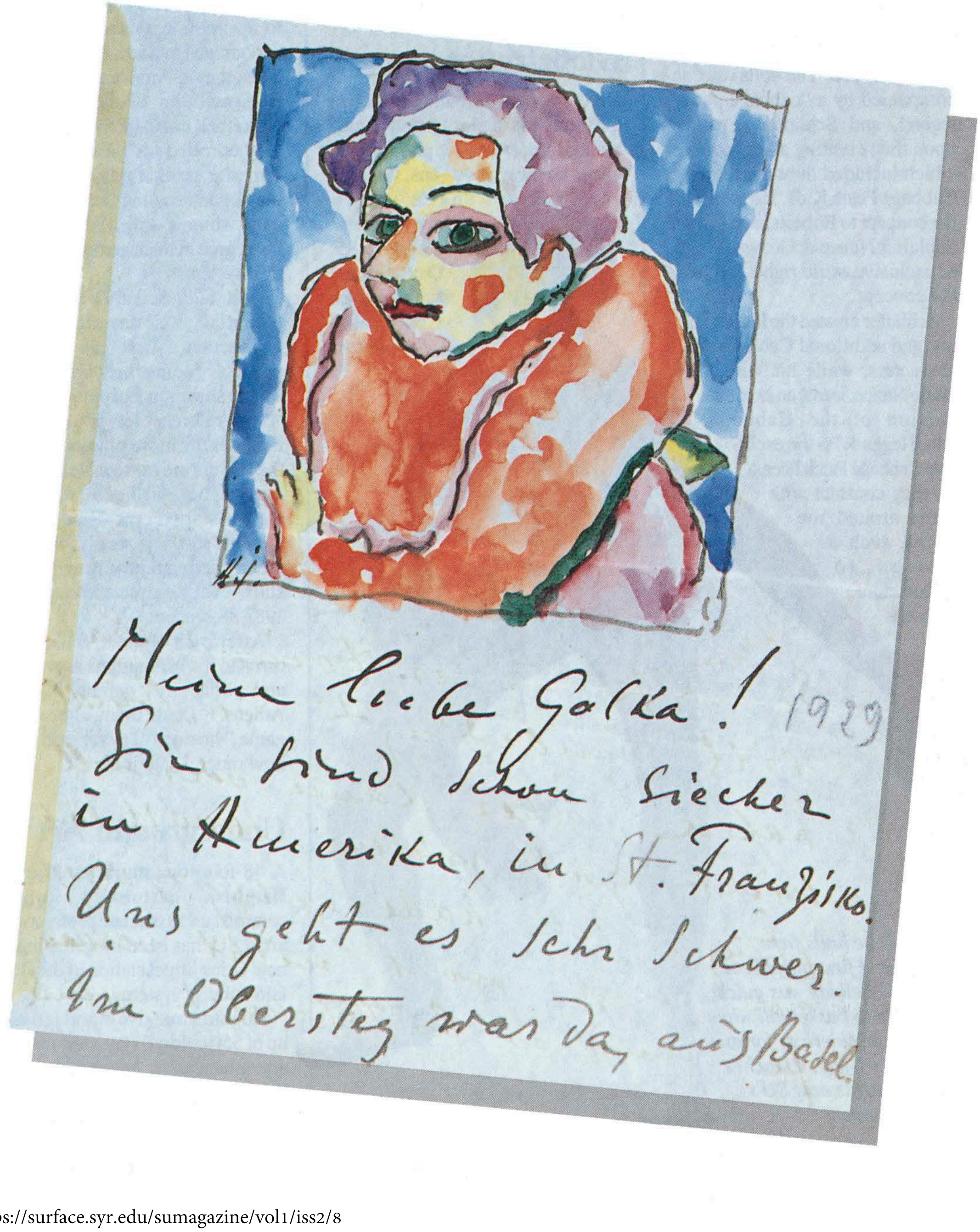
A cluster of LOGLISP-based programs has been created to make the computer a companion in the mental, deductive processes central to Weiss' research. An extremely advanced search function, utilizing logic programming, allows her to enter into the computer (in a form close to natural English) any hypothesis about the topic; in response, the computer locates all materials that it decides may be relevant to the hypothesis.

For example, Weiss can propose that a particular Kandinsky painting, known by one name in California, was actually the same painting that popped up in New York years later under a different title. The computer goes to work. It cross-references all mentions of both painting names, learning in the process all the various names or numbers by which the painting may have been known. It also notes that, in many of the letters, one of those names often appears near the phrase "New York" or near the name of a particular dealer; these passages, it concludes, are probably relevant to Weiss' hypothesis.

Based on this search-and-association, the computer calls forth all passages in the correspondence that seem to help substantiate or repudiate the hypothesis. Weiss looks them over and decides whether the hypothesis has been disproved. Then she types in another.

"The possibilities are staggering," she says. "This kind of thought process happens in research anyway, just going through the files at the library. But you can do it so quickly with this computer program."

Within a few years, Weiss' book, containing about half of the letters, will appear. "The result will be a volume that is *thoroughly* annotated, one in which information is condensed into the best possible footnotes," she says. In the accompanying essay about the Blue Four and Scheyer, Weiss will be able to tell a story never before told, based on the hundreds of fresh associations that the computer helps her find.


Meine liebe Galka! 1929
Sie sind schon sicher
in Amerika, in St. Franzisko.
Uns geht es sehr schwer.
Im Oberstez was da, aus Basel.

Letter Perfect

Letters exchanged between the "Blue Four" and art agent Galka Scheyer are so voluminous and detailed that they have defied comprehensive analysis. It will take a computer, educated in the ways of humanistic research, to do the job.