A single machine is challenging our concepts of intelligence, emotion, and individuality. It will change the way we work and the way we live. The machine is, of course, the Robot A Special Edition.
Carlo Fiorito, a New York-based photographer, was inspired by Michelangelo's "The Creation of Man" to interpret the re-creation of mecanoids in man's own image. This comment on the emergence of robots in our time was commissioned for World magazine.

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As the era of the robot approaches, Omni is devoting much of its issue to the question of how intelligent machines might change our lives. We're rapidly adjusting to using automation in our science, art, and businesses. But so far machines have helped us mainly with the things we hate to do. What then will happen when we face new options in our work and home, where more intelligent machines can better do the things we like to do? What kinds of minds and personalities should we dispense to them? What kinds of rights and privileges should we withhold from them? Are we ready to face such questions?

Today our robots are like toys. They do only the simple things they're programmed to. But clearly they're about to cross the edgeless line past which they'll do the things we are programmed to. Already there's so much power in those arcade chips that one might think the toys are playing with our kids.

Most robots rolling around these days are mere fakes, remote controlled by people hiding out of view. A few though do some things that real robots ought to do, like sensing the sounds of certain words and acting on those words and phrases. And as they reap the fruits of research, these machines will show more visible signs of having minds.

For years there existed an odd paradox. We learned to make computers expert in many special skills but couldn't endow them with much ordinary common sense. Why not? The reason was so simple it was hard to see. We've all so accustomed to using common sense that we take it for granted, but it is actually the most complicated thing we do! An "expert" can get by with a few kinds of highly specialized information but a sensible person needs a large body of general knowledge. We'll have to wait awhile longer for computer sensibility—a decade or a century perhaps but just a moment in the grand march of history.

So soon enough we'll learn to make computers organize their thoughts. We'll make them learn from us and help teach others, too. We'll give them inhumanly dexterous limbs and uncannily observant senses and show them how to build copies of themselves. This could begin a flood of "autonomous self-replication" machines making more machines at very low cost. Then we'll learn to cope with the resulting exponential growth of wealth and productivity.

What will it take to make machines that really think? That solve new problems? It won't suffice just to feed computers a lot of separate facts. Each must be linked to other things we know. A mind is merely the web formed by such connections its quality depends on how well it correlates the scraps of knowledge in that web and when it decides to use those scraps—and when not to. (Common sense, for example, demands knowing the exceptions to the rule. You can put things in your pocket—but not if they're too big to be belong to someone else or be too hard. And minds must also know about their own intentions, how and when one should persist, submit, or balance among action and reflection.)

How big are these "human webs" of information and belief? I'd guess a billion links would more than match the mind of any sage. A billion seconds stretches 30 years—and no psychologist has ever found a way to make a person learn something new each second for any prolonged period. But a billion bytes of memory may soon be cheap. Today computer memories do single operations at a time; soon they'll do millions simultaneously. But let's face facts. We just don't yet know how to weave our knowledge webs into our new machines.

I see this as the most exciting research problem of our time: how to put enough mechanisms together in harmony to form minds of growing competence and breadth. Most people still think such things must be impossible to understand. I think they're only very complicated.

Eventually the day will arrive when human knowledge becomes the domain of the computer. When everything we want is already done for us by thinking machines. How will we spend our time? Which entertainments will we choose? What custom-programmed stimuli? And why not the meager years our bodies last? Our mortal stay seems fixed by make-shift engineering. Our body cells, "controlled" by programmed suicide and war, degenerate and die as immune systems fail and misinform us to destroy ourselves.

I'm sick of hearing evolution praised as self-respecting programmer would bury software bugs such dreadful ways! I did we'd do at least as well to start afresh (without that billion year accumulated mess) and try to transfer all we really want from those vast symbol-process structure webs we call our selves into more safe and neat immortal codes.

Then finally we'll have to think of how to treat minds made to our design. How right will it be to switch them on and off? How wrong would it be not to make all the minds one can? Our present civilization's code of ethics came to us too easily. It assumes that man has no control over mind. We had to choose only how far our loyalty need reach, past family and friend, to stranger from another land. But when we really start to make ourselves, why then we'll really have to face ourselves.

Marvin Minsky is former president of the American Association for Artificial Intelligence.
Welcome to the Era of Robots, the focus of this issue of Omni. The pages ahead celebrate the arrival of a technology that promises to alter the next 100 years as surely as the steam engine transformed the century before. But our reports of the coming robotic revolution also carry a counterpoint. The growth of these humanlike machines has stirred substantial misgivings and even some primordial fears.

Consider an obvious and immediate problem: the rapid robotization of industry and the displacement of millions of workers. A labor-and-technology analyst at MIT predicts that in the next ten years General Motors alone will purchase 20,000 robots that will disrupt the lives of 40,000 to 50,000 auto workers. But, according to Stanley Polcyn (page 35) unless the United States introduces robots into industry it won't be able to compete with foreign markets, and even more jobs will be lost. Polcyn is president of the Robot Institute of America and senior vice-president of Unimation, Inc., a leader in the construction of industrial robots.

Many other prominent, respected—and sometimes eccentric—authorities have contributed to this issue. John McCarthy, one of the founding fathers of robotics and the man who coined the phrase artificial intelligence (AI), is the subject of this month's interview (see page 100). And in First Word (page 6) Marvin Minsky, another pioneer of superintelligent machines, shares his philosophical musings about the role of mechanics. Co-founder with McCarthy of MIT's AI laboratory, Minsky forecasts a world in which robots will be programmed as we are programmed—that is, their computer brains will be capable of common sense.

At the same time robots stimulate questions about human learning and development: the machines themselves are becoming more like people. On page 26 freelance writer Michael Edelhart describes a fledgling science called robotics psychology that studies this phenomenon. In researching his article Edelhart met Rover—the crude prototype of a "smart" robot—which can respond intelligently to novel situations and can sense and maneuver around obstacles without preprogrammed instructions.

But as robots gain intelligence, they also provoke more controversy. And in fact controversy spread even to the Omni staff specifically over the choice of illustration for the story "Robots at Home" (page 70). Art director Elizabeth Woodson chose a painting of a female humanoid with mechanical arms for its beauty and for its synthesis of woman and machine. But writer Richard Wolkomir points out, "The robots in the article have male names, such as Isaac and Bob. Anyway in my house we divide the so-called woman's work."

Overall editor of our robotics section was senior editor Douglas Colligan.

In addition to celebrating machines of the future, this month we also salute the past and future achievements of the Japanese edition of Omni. The Obunsha Company, publishers of a wide assortment of books, educational reference works, and magazines, launched the Japanese version in May 1982. The edition is our second native-language entry into the international market (the first is the Italian Omni). It draws 50 percent of its material from the concurrent U.S. edition, with the remaining 50 percent derived from past U.S. editions and independent Japanese sources. Our congratulations go to president Yoshio Akao, executive director Takuji Ishikawa, editor in chief Yasushi Okada, and the entire staff on a successful first year.

Staff of Japanese Omni.
Cloned Archaeologist

I have studied archaeoastronomy under Anthony F. Aveni at Colgate University located in Hamilton, New York. Some years ago I heard a rumor that Dr. Aveni was cloned while on a field trip in Mesoamerica. He is now supposed to be able to do twice as much work as he could do before.

To get to the point: in your September 1982 issue Robert Paton's article 'Coparts' mentions an Anthony Aveni. This Aveni is supposed to be an anthropologist at Cornell University. Since Cornell is not very far from Colgate and both these researchers seem to be working on the same project of mapping Nazca lines, could this Aveni be the long-sought after clone of past rumors? I called Cornell University information and they told me that there is no Anthony Aveni teaching or working in the anthropology department. The National Geographic Foundation informed me that there is an Anthony Aveni who is doing a study funded by them. He is an astronomy professor at Colgate University.

This is very confusing; I thought the clone rumor had ended but now I'm not so sure. With all this detective work, I may need my own clone. Will the real Anthony Aveni please stand up?

John Lari
New Haven, CT

We stand corrected. The real Anthony F. Aveni is, in fact, a professor of astronomy at Colgate University—Ed.

Women in Love

The news that women can be sexually aggressive to the point of savagery [ "When Women Rape Men," The Body December 1982] would have come as no surprise to Euripides' author of The Bacchae. As Freud often reminded us, the ancient Greek writers had seen it all.

An attack by a group of women also played an important role in the life of D.H. Lawrence. Employed in a factory where he was one of only a few males, Lawrence was popular with the girls. He was, however, unprepared for the explosive and violent sexuality of the female factory workers. Caught off guard he was emotionally, if not physically, raped. This experience became the subject of his celebrated short story "Tickets Please" and according to a close friend was the direct cause of Lawrence's well-known cynical attitude toward women.

Georgia Whitesel
Jacksonville, AL

Waiting for Asimov

I truly appreciated the October 1982 anniversary issue. The excerpt from Foundation's Edge Isaac Asimov's latest entry in the field of SF was especially welcome. Being but fifteen, I read the Foundation trilogy only three years ago so I cannot imagine the anguish of those who have waited closer to three decades for this new book.

Russel Paulsen
Dixon, IL

Space Food

Noel Valtmeyer's picturesque "Seeds of a New Eden" in the December 1982 issue was just great. It's good to know that when NASA is finally ready to build their space station, there will be technology available for food production in space. The Sadyat Island challenge that was accepted by the University of Arizona crew is a giant step in the right direction—feeding the masses.

Keep up the fine reporting. It is great to see that there are some positive outlooks in this world of ours.

John Staff
Caldwell, IN

Sakharov

I thoroughly enjoyed your article "Genius Hunting" [November 1982] especially the part about the Chudnovsky brothers. Omni readers might be interested in knowing that Marcel Dekker has just published the Collected Scientific Works of Andrei D. Sakharov edited by David and Gregory Chudnovsky.

Marlene Goldrich
New York
In which the readers, editors, and correspondents discuss theories and speculation arising out of Omni. Readers are encouraged to debate views and pose questions to Omni, the scientific community, and the science fiction establishment. The opinions published are not necessarily those of the editors.

$65,000 Mother
It always seems to be a man who laments the lower birth rates ['Baby Makers Inc.', Continuum, September 1982], and the solution is to have the government or a corporation use embryo implantation or artificial insemination to make babies in test tubes.

As a woman let me tell you that getting pregnant (though it can be life-endangering) is the least objection I have to making babies. I also do not mind being pregnant. I actually enjoy it and find it to be a very healthy happy time.

My contention is that producing babies is not the issue. There should be no problem finding women who would for a reasonable fee, be happy to spend a year being pregnant. It seems to me that $35,000 would be a reasonable price for this service.

The real problem is finding enough people interested in devoting about 18 years of their time toward socializing, educating, and raising another human being. I haven't seen many men willing to give up nearly two decades of emotional and physical freedom to do that.

If men or their state want more babies, let them do the raising, feeding, nurturing, and training. Or let them begin to pay decent wages for such a job. It seems that $85,000 is an excellent place to start negotiating.

Ruth Austen
Riverside, CA

Equality in Space
It was with great amusement that I read Kathy Keeton's First Word [December 1982] on women in space. In her naive article she states, "Women's superior relaxes and endurance capabilities will give them the edge as the spaceshippers of the future." And they may fare better in space itself." She also reports "the results of a rigorous five-year study by NASA proved women superior to any group of men at adapting to the physical and emotional challenges of space." At twenty-two, I hold a master's in aeronautical engineering, a bachelor's in computer science. I am in superb physical condition and am seriously considering joining NASA to become an astronaut. With all these credentials I know that there is no female who can even come close to me in any physical or mental test. I don't care how many studies NASA conducts.

Men are superior to women and will fare better in space. This statement may label me as the perfect male chauvinist but I look at things realistically.

Let's face it, women just don't measure up to men in conditions that demand strength, ruggedness, endurance, speed, and bravery. History has proven this. I would like to bring Kathy Keeton back to reality and prevent her and other women from being disappointed.

Zenith R. D. Knight
Port Washington, NY

As the medical officer in charge of heat-stress evaluation of the Mercury Astronaut Selection Program at Wright-Patterson Air Force Base during the late 1950s, I had the opportunity to become quite familiar with the physiological reactions to heat of astronaut candidates in top physical condition. During the course of the program some women (nonastronaut candidates and physically untrained) were also tested. Their individual results were far superior to those of the male astronauts as a whole. While the women absorbed heat faster from the environment, their physiological reactions were much milder than the men's, perhaps indicating that Kathy Keeton's argument has some basis. Although one cannot generalize on the basis of several individual tests, it is my recollection that these women who underwent heat tests also excelled in altitude centrifuge and other stress tests.

Joseph Gold, M.D.
Syracuse, NY

No Women Allowed?
It is distressing to read in a purportedly progressive magazine like Omni an article as blatantly sexist as "Tinkering With Utopia," by Michel Salomon [November 1982]. Is it not the central issue of our times that women should enjoy a more important decisive role in society than they have in the past? Why does Mr. Salomon find it unnecessary to include the opinions of some of the eminent women in our scientific community? By excluding women from his article Mr. Salomon has seriously weakened its credibility. He is omitting at least half of the knowledge and opinions available—a serious oversight for a supposedly forward-looking piece of research.

D. G. Anderson
Ottawa, Ont., Canada
When West German authorities began construction of Frankfurt's new airport runway, they expected a battle. They were not disappointed. Protestors bitterly opposed to the destruction of a forest in the runway's path raised flaming roadblocks that tangled airport traffic. Nearby, in the fashionable downtown shopping district, other demonstrators challenged bands of riot police equipped with armored trucks and water cannons. The doomed forest itself, which environmentalists had spent years trying to protect, was the scene of the worst fighting. In one day alone, more than 100 policemen were injured — by angry youths hurling stones and by elderly women throwing acorns and pinecones.

Supertanker crews and shipyard workers watched first in curiosity then in disbelief as a ragtag flotilla of fishing boats lined up to block the mouth of Hamburg harbor. For years fishermen had complained of industrial pollutants poisoning the fish in Hamburg's Elbe River. And now, when the damage seemed irreversible, they ganged the harbor in a last act of defiance. Soon after, the leader of the blockade loaded his family aboard his boat and set sail for Ireland.

In America, the sight of knapsack-carrying youths hitchhiking for hundreds of miles might have signaled a huge pop festival. But this was West Germany, and these were protesters heading for Bonn to greet President Ronald Reagan. The American President had come in hopes of persuading West German leaders to aim Pershing II missiles at East Germany. To the demonstrators, who numbered over 200,000, the problem was one of perception. When Ronald Reagan looked over the wall to the east he clearly saw the enemy. When young West Germans looked in the same direction, they saw a walter of humanity — and the other half of their country.

West German politicians had long believed those protests to be widely disparate events. But to a group meeting in Offenbach's modern City Hall at the end of 1979, the connection between such demonstrations was obvious. Each new protest they declared was one more cry heralding the noisy birth of Germany's new political force: the Green Party, dedicated to nuclear disarmament and a clean, unlopered environment.

The roots of the Green Party can be traced to the years following World War II, when the Germans were struggling to reconstruct their society. Their factories desperately turned out automobiles and refrigerators, machine tools, and cameras until the Sixties Germany became the world's fourth-largest industrial power.

This success, however, also made Germany one of the most polluted nations on earth. Its affluent population soon choked streets and highways with eight times more automobiles per square mile than could be found in the United States. Frenetic manufacturing plants produced some 450 million cubic yards of refuse yearly — enough to form a mound as high as the Zugspitze, the country's tallest peak. And though tons of sulfur dioxide, carbon monoxide, and hydrocarbons spewed daily from a maze of factory smokestacks, the nation's avid industrialism was constantly clearing land to make way for still bigger manufacturing plants.

By the early Seventies, a generation of Germans bred on ecological devastation had come of age. And many of them despised what they saw. As one young woman who took part in the Frankfurt runway protests explained, "In a country like Germany you come to see the futility of your life style. We began to hate industry, consumption, and their poisonous by-products. Our parents' work seemed empty, even destructive. They went about their business without considering the damage they caused. That type of attitude was frightening to us. We had to find another way."

That new way soon became apparent in Ruhr City, a hazly wasteland of belching factories and furnaces, walls were covered with a single bold slogan: "Schade das Beton nicht brennt." Or "Too
Beneath the quiet towns of central France, the Pyrenees and northern Spain, restless ancient dwellers carved a monstrous stone head, half man, half cat.

In over 30 caves in France and Spain, giant bison, reindeer, mammoths, ibex, bears, and other beasts are outlined in red or black, their fur and muscles filled in with carefully placed strokes that use the natural protrusions and fissures of the walls themselves. And where real figures give way to magical ones: headless horses, duckbilled people, wolf-headed bears, disembodied hands, floating arms and legs, snake patterns and dots and dashes are portrayed. Some of these paintings appear in large central areas that could have housed over 100 spectators, or actual participants in ancient ceremonies. Others are carved or painted in such inaccessible caves that professional spelunkers have fainted from claustrophobia trying to gain access to these remote passages, even in the sunless tunnels, and heightened sounds and cool stagnant air, something of significance was going on—or so theorizes anthropologist John Pfeiffer in his new book, The Creative Explosion. As Pfeiffer suggests, religious leaders may have reserved the private sanctuaries for individual ordeals, confrontations, or communications with the spirit world. For larger ceremonies early masters of trickery and illusion may have led their kin through convoluted alleys, playing flutes, drums, xylophones and cisterns while they held lamps beneath the paintings. The flickering torchlight would have caught one image and suddenly another. Then after the tortuous trek, these first priests may have assembled their flocks in the grand rotundas, where disoriented audiences sensed stripped of normal time and place, were held in rapt attention.

But what were the shamans conveying during their cryptic rituals? What did the paintings mean? Why the sudden first flowering of human art and ceremony? Pfeiffer's explanation is bound to ruffle the feathers of both creationists and anthropologists, for within his theory lies the suggestion that religious fervor has a biological component.

His controversial hypothesis is based on events that took place some 40,000 years ago, when irrevocable climatic changes were sweeping Europe and Africa. Glaciers to the north and desert to the south concentrated populations in France and Spain. At this time the Neanderthals, ancient racial variants of modern man, died out—replaced by today's human beings. These new individuals, the Cro-Magnons, began to make new tools out of such experimental materials as ivory, bone, and antler. Whereas the Neanderthals used only large stone implements to tell their prey fan their hides and pound their seeds and berries, these modern people were much more innovative. They invented bracelets, pendants, and beads to adorn their bodies, and needles for sewing man's first tailored clothing. For the hunt they fashioned lightweight harpoons and miniature projectile points, perhaps used in the first bows and arrows.

If so, new hunters could move off the high plateaus to pitch their skin tents at the fords of valley streams and shoot...
Forget science fiction starships.
And forget about the British Interplanetary Society's theoretical papers on interstellar travel that Daedalus starships probably won't fly, and if it did would soon explode according to some advanced computer studies in the United States. The most important starship work in the world takes place at the University of California's Lawrence Livermore Laboratory where the U.S. government has paid people like Rodenick Hyde and Lowell Wood to work on the design of starship engines.

To be fair the Lawrence Livermore ship has a few features in common with the Britishers' Daedalus.

- It is powered by microscopic hydrogen bombs, each less than a millimeter across; each detonating with the modest force of a firecracker.
- These microexplosions will be set off by intense laser beams now being developed at the laboratory for weapons simulation and fusion power research.
- The hot exhaust that drives the rocket will be expelled from a nozzle formed with magnetic fields, not ordinary metal or ceramic. This approach offers performance vastly better than that of any rocket now in existence.

For years, tight security restrictions kept the details of the work by Hyde and Wood and their colleagues largely unknown outside Lawrence Livermore itself. Recently, news of the starship plans has begun to leak.

The story begins in 1972. Rod Hyde was just completing the requirements for his B.S. at MIT after little more than two years. He was interested in astrodynamics and the science of orbits and trajectories followed by spacecraft. He wondered whether some advanced, exotic engine might not indeed turn interplanetary flight paths into straight lines.

At the same time, Lowell Wood was one of Livermore's brash young leaders in the new field of laser fusion. His work, called for preparing micropellets of fusion fuel, then zapping them with powerful laser beams to produce tiny hydrogen-bomb explosions. In addition, he was a recruiter for a fellowship program, this job took him to MIT where he and Hyde talked of future engines.

Both scientists agreed that laser microexplosions might be used to propel a starship. Wood arranged for Hyde to get the fellowship and visit Livermore for the summer. Without a security clearance Hyde couldn't work on the real problems which involved classified questions about the pellets and lasers. But he could study other details, including Wood's notion of using magnetic fields to form a rocket exhaust nozzle. These fields would allow exploding pellets to blow out the craft's back and produce thrust. Such a rocket could achieve performance a thousand times better than anything yet flown.

Hyde's work—most of it packed into four straight days and nights of calculating and writing so that he could finish in time to attend the world chess championship in Iceland—yielded an amazingly detailed approach to the starship design. He presented his report to the world of aerospace engineering at the Propulsion Specialist Conference in New Orleans, late in 1972. Hyde laid it all out—the physics, the design concepts, the calculations, and the performance equations.

Almost no one in the audience had the background to follow him. But soon hundreds of requests for copies of his paper started to pour in. Even the National Security Council, under Henry Kissinger and the office of the President's science adviser at the White House asked for copies. Hyde was nineteen years old.

Back at Livermore security became even tighter. Laser fusion and its applications represented a highly classified area of work and Wood and Hyde were forbidden to publish any more in this area. Hyde wrote a very lengthy report giving many more details. This report, UCRL-16556, has been updated since with new material. Quite likely it is the world's most authoritative reference on starship-engine design. It has never been published, but enough is known to give a fairly clear picture of the current state of the Wood-Hyde starship plans.

The most important part of the secret...
Carefully Rover moves forward. He spots an obstacle in his path and stops to examine it. Friend or foe? Satisfied it holds no danger for him, he continues on his way.

An ordinary occurrence, certainly nothing worth noting, except for the fact that Rover is not a dog, but a robot. An autonomous, moving, environment-evaluating machine created by robot expert Hans Moravec of Carnegie-Mellon University, in Pittsburgh. What makes Rover so special is his ability to judge the state of the world around him and, in a sense, consider his best interests.

As variables in Rover's environment shift, Moravec notes, 'The robot's behavior would change from boldly pursuing its main goal (whatever that may be) to cautiously feeling its way around. We are tempted to give such variables names like 'fear' and 'enthusiasm.'

What Rover presages is the day when a robot will come equipped with its own psychology. Such a machine would adhere to Isaac Asimov's three laws of robotics, which essentially instruct a robot to protect itself but never at the cost of a human life. And while machines like Rover are not all that sophisticated, they have forced scientists to address the question of what to put in the souls of these new machines.

Already robots in industrial settings all over the world are practicing the prime law of never harming humans. Advanced industrial robots powerful enough to crush a man by accident, are now equipped with arrays of sensors backed by computer programs that are designed to recognize human forms and motions. If these patterns appear in the workplace, the robot will stop automatically.

Slightly more complex applications of robo-psychology are being built into experimental mobile robots (see "Robo-Shock," page 44) like Rover. These robots must be able to sense situations and respond appropriately to circumstances that their programmers might never have anticipated. For example, at Tsukuba University in Japan, robot scientist Yutaka Kanayama's mobile robot Yamabico uses some of these skills.

Early models of Yamabico could avoid obstacles and hazards only if the robot had been specifically programmed to respond to them beforehand. It could not apply its programming to unforeseen situations. If placed on a table, for example, it would simply roll off the edge if not instructed to do otherwise.

The new Yamabico will have more complex software that allows the machine to react to obstacles as it meets them. Special balance sensors and a vision system enable it to look ahead, see an obstacle, and sense an impending edge so that it can react in time. In other words, the robot has an innate sense of self-preservation. The next step, says Kanayama, is to teach Yamabico to recognize common everyday objects and have an understanding of their uses.

"Once we give him the ability to sense his universe and then to function in it independently, the scientist says of his machine, we can start to teach him ways of responding to it."

At the Tokyo Institute of Engineering, Professor Shigei Hirose has already crafted a robot with responsive abilities. His creation is a four-legged spiderlike machine (see "Robots: Fantasy Versus Reality," page 60) that can climb stairs of any size without special instructions. A human says "go" and the robot manages the rest itself.

The machine begins its climb down by feeling along the stair's edge using its tactile sensors in its paws the way a blind man uses his cane. These guide the legs down the back side of the stair while balance sensors in the squat robot body keep it level horizontally. When a stair is too deep for a leg to touch bottom, the robot lowers its body to give the leg more reach. If the leg still can't reach the next step, the robot stops. It won't allow itself to tip over. It protects itself by responding in a flexible fashion to its environment—psychology at work.

Professor Hirose points out that this is not a state of mind within the machine so much as a way of acting that we...
By Phoebe Hoban

By this time next year, your personal computer may be able to store roughly five times more data—even if you own last year's model. The key to squeezing so much extra mileage out of today's machines is a new generation of "virtually recorded" disks.

In laboratories from Tokyo to San Jose to Minneapolis, computer engineers are racing to perfect a promising offspring of conventional "horizontal" recording technology that could multiply the storage capacity of software by a factor of ten. This technology could give home computer users the storage capacity of an IBM mainframe at a cost per bit cheaper than today's software, claims Jack Tananto, president of Applied Information Memories, in Milpitas, California, which has developed a prototype system.

As even children seem to know in these dazzling days of computer literacy, it is the software that tells a computer how to function and serves as an electronic filing system—automatically storing and retrieving information. The software consists of complex computer instructions (or programs) and the characters of stored data in the form of "bits," the binary one/zero digital code that is the basis of all computer language.

With the exception of those personal computers small enough to fit in a briefcase, most home machines use programs recorded on 5.25-inch floppy disks—thin Mylar platters a little smaller than 45 rpm records. With today's technology, a disk holds a maximum of roughly 860 kilobytes (850,000 characters) of information and sells for about $4. It is read by a disk drive—the computer equivalent of a tape deck.

Like ordinary audio tapes, computer disks are coated with a film of magnetic material—typically iron oxide. Information is recorded and read on the disk by using an electromagnetic head to magnetize the particles so that different regions have different polarities—each acting like a miniature permanent magnet that represents either a one or a zero in the binary code.

In today's horizontal (or longitudinal) recording technique, these microscopic magnets are lined up and end like a long row of straight pins. The trick to increasing data storage, however, is to pack the digital bits as closely as possible.

The horizontal format inherently limits the bit density because when the north and the south poles of a magnet are located too close together, they tend to neutralize, causing the material storing the data to demagnetize.

But imagine if you turned these straight pins on end, perpendicular rather than flat in relation to the surface of the disk. Many more pins could be packed much closer together, while the magnetic poles located on either end of the magnet's length would remain the same distance apart. No matter how tightly the magnets are squeezed side by side, it sounds like an obvious solution to a geometric puzzle. And, in fact IBM first started investigating the possibility of vertical recording as early as the 1950s.

"Vertical recording is almost as old as recording itself," says Chris Baprek, manager of IBM's Storage Systems and Technology Research Division in San Jose, which is working on vertical technology. "The problem was finding the optimal medium."

The breakthrough came in the mid-1970s when Shunichi Iwaski, of Japan's Tohoku University, found that a chromium/cobalt mixture provided the perfect columnar structure for vertical recording. It has a lovely crystal—each one is like a dozen little pencils," says Clark Johnson, president of Vertimag Systems Corporation, in Minneapolis. Johnson's company has developed a working prototype of a 5.26-inch floppy disk that holds 5 megabytes. The company's pilot plant will begin producing the chromium/cobalt vertical disks, drives, and recording heads early next year.

Other companies have taken slightly different approaches, using the same recording principle. Toshiba Corporation of Tokyo, for instance, has demonstrated the prototype of a 3.5-inch floppy disk and drive system that holds 3 megabytes. And at least a dozen more computer manufacturers, including giants like Sperry Univac, Burroughs, Honeywell, Packard, Control Data, Nippon Telegraph and Telephone, Olivetti, and Apple, are also working on vertically recorded disks. Products are expected to reach the market within the next 12 to 24 months.

Exactly what does all this technical jargon mean to the consumer? Experts say that a vertically recorded disk could eventually contain 10 to 40 times as much information as today's disks hold. While the vertical disks are expected to sell for $15 to $25, the actual cost per bit will be dramatically cheaper, so the consumer will get much more storage for his money.

Vertimag's Johnson foresees recording mailing lists, encyclopedias, even entire libraries on single disks. And the smaller 3.5-inch disks would be a handy way to upgrade today's briefcase computers. Vertical recording could also have a significant impact on digital audio and...
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Robots and Our Jobs

For the knee-jerk technophobes among us, robots must seem an easy target. Each robot on an assembly line replaces, on average, two people leaving a single human overseer for every four or five machines. Although the need for productivity improvements in manufacturing is generally accepted, many members of the press, academia, labor groups, and corporate management itself link productivity gains—particularly those attributed to robots—with declining employment levels.

Yet when we look at the real causes of unemployment in America, it becomes clear that in the long run, robots will create jobs, not destroy them. Consider a few facts:

• The steel and auto industries have already lost hundreds of thousands of jobs—far more than the current level of automation can account for.

• Even the highest estimates agree that annual robot sales will reach only $2 billion in the early 1990s, or 40,000 machines per year—and that is still ten years away. This is certainly a modestly slow rate by most measurements.

• Every new advanced technology developed has created employment. Witness the computer and semiconductor industries that were nonexistent not long ago.

• While unemployment spread here Japan's 1982 trade surplus with the United States totaled some $12 billion, equivalent to 460,000 jobs lost by the Americans to the Japanese.

Japan, a world leader in robot use, could achieve that surplus because its goods—particularly in the auto and electronics industries—are sold cheaper and are perceived by many to be better than ours. Unless we can change this, further loss of jobs is inevitable. But if we regain our reputation for quality goods at low prices, an expanding job market is just as sure.

Automation can help in this effort, but not single purpose machines that churn out identical products in enormous volume. A recent Pentagon study found that the vast majority of items purchased, even by the military, are made in lots of fewer than 100. What we need are machines that can turn out a few specialized items, then be reprogrammed cheaply and accurately to make a slightly different model or another product altogether. We need robots to revitalize our markets and create new jobs.

Robots have long had the brawn for machine loading, spot welding, spray painting, die casting, materials handling, and other brute force tasks. As technology improves, robots will acquire control and senses to match. These developments will be fueled by our need for greater efficiency to save lagging industries that robots have not yet entered.

Robot vision is already well on its way. Soon robots will be used to grade the quality of bacon by comparing the amount of dark meat and white fat. Laser 3-D vision will let robots recognize one part lying on others in a bin of many components. They will learn to assemble intricate machinery without having to be presented parts with special care. Already they can assemble a few small electrical relays accurately and fast.

The sense of touch will be cheaper and perhaps more useful. It will enable robots to check the parts they handle, making sure that each is free of defects. Auto-engine valves will no longer be about the right size; they will be exact. Quality will rise as a result. Tomorrow's robots will also be able to handle items too delicate for today's models. A decade from now they may shear sheep, pick fruit and package easily bruised foods.

Where most robots use grippers designed for a single job, soon they will carry the most versatile holding device of all—a hand. Making it standard equipment will cut the cost of robots so that small businesses will be able to automate their production lines and compete with large manufacturers.

The result will be high-quality products and new demand for American goods and services. And as our industries recover, job opportunities will reappear. These new jobs may not be the same ones we have today. Assembly line jobs will be replaced by positions in quality control, robot repair, programming, and service industries yet to be invented. This is no hardship; it is a rare factory worker who really enjoys tightening the same bolt in the same car door for years on end.

The issue is not whether robots and other technologies should take over American industry. It is how to encourage the new businesses they bring and how to train those with obsolete trades to find roles in growth fields desperate for skilled workers.

—STANLEY POLCYN

Stanley Polcyn is senior vice president of Unimation, Inc. and president of the Robot Institute of America, an association of robot manufacturers.
GENDER TRANSPLANT

Tiny pieces of living brain were recently transplanted from newborn male rats into newborn females. The result: The females grew up believing themselves to be males, despite their anatomy.

The object of the study, according to neuroscientists Gary Arendash and Roger Gorski of the University of California at Los Angeles, was to determine whether part of the brain could survive and function when transferred from one animal to another.

The dramatic behavioral change in the female rats (which now pursue other females in a frenzy) has convinced Arendash and Gorski that brain tissue can indeed survive such transfer. This conclusion is bolstered, they add, by autopsies showing that nerve cells from the transplanted tissue had hooked up to the host brain.

Other researchers have shown that transplanted brain tissue would connect with blood vessels and remain alive, but Arendash says he and Gorski are among the first to show that the neurons themselves would interconnect and the transplanted brain part would function.

The research holds out the promise of a cure for a variety of debilitating human diseases, including Parkinson's disease, multiple sclerosis, Alzheimer's disease, and others, all of which are caused by the loss of neurons in the brain.

If partial brain transplants can be made to work in humans, it should be possible to replace the lost neurons and thus eliminate the disease — Paul Raeburn

"You cannot hold a man down without staying down with him."
— Booker T. Washington

NOT TONIGHT, TEDDY

If you want your newborn to reach his or her full potential, put away that teddy bear, paint the nursery black and white and talk baby talk. That, at least, is the advice of Susan Ludington, director of the Infant Stimulation Education Association.

Ludington and other members of the Los Angeles-based organization have spent the past ten years observing infants in hospitals and labs across the country. Now, after synthesizing much of the research, Ludington has come up with a few unusual guidelines.

Although that pink pastel nursery filled with flowers and fluffy stuffed animals may please the parents, she says a newborn is completely indifferent to such surroundings. During the first six months of life, babies actually prefer sharp, high contrast color combinations, especially black and white.

They stare with great concentration at moving dots, stripes and bold geometric patterns. And says Ludington, "above all, babies love eyes."

Moreover, she notes, the traditional teddy bear can overwhelm a newborn, who would rather play with a mobile composed of three-dimensional geometric shapes. Kicking and reaching for the mobile greatly improve a baby's motor skills. The teddy should come months later, to help foster emotional attachments.

To stimulate the right and left hemispheres of the brain, Ludington and her colleagues suggest three Bach, Brahms and baby talk. Infants are captivated by the high pitch and regular beat found in all three.

In fact, auditory stimulation can start even in the womb. At the UCLA School of Nursing, where Ludington conducts her research, expectant mothers place earphones against their abdomens and play tapes of "Mommy and Daddy talking." Babies stimulated this way prenatally have eagerly turned their heads in the direction of their parents' voices right after birth.

As for music during pregnancy, Ludington recommends Vivaldi's baroque masterpiece, The Four Seasons.

"I am only a public entertainer who has understood his time."
— Pablo Picasso

Gorski's rats. After the females received transplanted male brain tissue, they began to exhibit male sexual behavior.
HEART-ATTACK JOBS

Do you work in a highly structured, fast-paced environment? Do you lack the opportunity to make independent on-the-job decisions? If so, you are a likely candidate for cardiovascular disease and heart attack, according to research conducted at Columbia University, New York City.

To reach these conclusions, sociologist Robert Karasek examined health and occupational records of men in the United States and Sweden. His finding: Occupation can be as significant a factor in provoking cardiovascular disease as smoking or blood cholesterol buildup.

Among those at highest risk, Karasek contends, are assembly-line workers and phone-company customer-service representatives. People in such occupations experience harmful psychological strain, he notes, because they don't have the freedom to ease tension by establishing their own work pace or job technique. The service representative, for instance, is the target of nerve-racking abuse from complaining customers, continuous psychological pressure upsets the worker's hormonal balance, which may eventually trigger a heart attack.

"The myth is that managers run the highest risk of heart disease but they really don't," Karasek says. "That is because managers have optimal control over their jobs."

Karasek recommends that management solicit worker suggestions on how to reduce on-the-job psychological strain. He also believes that a worker's schedule should be coordinated with his biorhythm chart — Eric Mishara

"We expect rough treatment from our colleagues whenever we produce something shoddy. The essential factor which keeps the scientific enterprise healthy is a shared respect for quality."

— Freeman Dyson

MOONSHINE GASOLINE

Don't throw out grandad's old copper still. Chemists at Purdue's Laboratory of Renewable Resources Engineering say you might soon be able to use it to homebrew gasoline from grain alcohol.

Ethanol, or grain alcohol — the kicker of moonshine whiskey — is not a good fuel. Chemically speaking, burning a fuel adds oxygen to it, it's that process that releases energy. But ethanol already contains oxygen in effect, it has already been partially burned.

Removing the oxygen from alcohol is a process Mobil Oil investigated several years ago. Chemists there used a synthetic mineral called zeolite to remove the oxygen from methanol — wood alcohol. But when the researchers tried the same process with ethanol, the reaction emitted so much heat that it destroyed the zeolite.

Now Purdue's Martin Chang, Allen Anderson and George Tsao have found a way to slow the process to safe speeds — by adding water. By distilling fermented corn or other grains, they can produce the right mixture of water and ethanol. Just pass the hot vapor from the still into a zeolite-filled chamber at about 400° C, and gasoline comes out the other end. Ethanol is still too expensive to compete with petroleum-based gasoline. Chang notes: But dozens of scientists are working to reduce the cost — Robert L. Forward.
A SUICIDE OF QUALITY

A desire to go out with a sense of grace may be one reason many suicides choose to leap off the Golden Gate Bridge instead of the nearby San Francisco-Oakland Bay Bridge. That's the conclusion of University of California at Berkeley suicide specialist Richard Seiden, who has found that five times as many people jump from the famed Golden Gate.

The Golden Gate Bridge joins San Francisco and the counties of northern California and the Bay Bridge connects San Francisco with the cities of the East Bay. Yet according to Seiden the romanticized appeal of the Golden Gate Bridge is so strong that half the suicides from the East Bay actually cross the Bay Bridge to reach the more famous landmark. In contrast, not a single person from north of the city has jumped from the Bay Bridge in almost 50 years.

A big part of the problem is accessibility. Seiden says, "The Golden Gate Bridge is open to pedestrian traffic. The Bay Bridge isn't. Yet when the pedestrian traffic is eliminated from the analysis, the Golden Gate still has three times as many suicides.

The "power of suggestion" Seiden contends is in large part responsible for the Golden Gate's allure - tourist agencies for instance are constantly glorifying the suicide statistics of the bridge, turning it into a kind of suicide shrine - a place where people can end their lives with a sense of beauty.

"Suicide from the Golden Gate has become romanticized as aesthetically pleasing," Seiden concludes, "while jumping from the Bay Bridge is considered ' tacky' and de-classé."

-Marc McCutcheon

Truth comes out of error more readily than out of confusion.
-Francis Bacon

GIT ALONG, LIL WATER BUFFALO

Imported with great difficulty from Trinidad and Guyan by an American rancher with big ideas, some 150 water buffalo are now thriving on land in Louisiana, Florida, Texas, and Missouri. These magnificent beasts, as one researcher describes them, can work like horses, yield good red meat to rival the Angus and Hereford in taste, and produce milk with more butterfat and nonfat solids than cow's milk.

The first thing most Americans think of when they hear water buffalo is a mean, vicious creature running and roaring through Africa. Notes Tony Leonards, of Lake Charles, Louisiana, who is the only commercial breeder of water buffalo in the United States. No one thinks about a beautiful animal with a show ribbon on him. Leonards is working to make that vision a reality.

Leonards became a water buffalo enthusiast after a United Nations report documented how well the animals fare under adverse conditions in hot climates providing meat, milk and work in exchange for forage too poor and scarce to support cattle. To take advantage of this endurance, he imported some water buffalo for development and selective breeding hoping to create "outstanding animals" for herds in the United States and throughout the world.

Water buffalo are not going to replace cattle in the United States, concedes Wyland Cripe of the College of Veterinary Medicine at the University of Florida who is performing basic research in hematology, nutrition and reproduction on Leonards's herd. "But they can supplement cattle particularly on marginal, swampy land.

Cripe is trying to transfer embryos among water buffalo and between water buffalo and cattle. If the experiments are successful embryos from either animal might one day be exported.
to undergo birth in another country. Since embryos do not normally carry hoof-and-mouth disease, their use would eliminate the hassle of quarantine now complicating the importation procedure.—Dava Sobel

"The reasonable man adapts himself to the world; the unreasonable one persists in trying to adapt the world to himself. Therefore, all progress depends on the unreasonable man." —George Bernard Shaw

POOR MAN’S COKE

Synthetically manufactured anesthetics with names like Fentycaine and Florida Snow packaged so they seem almost indistinguishable from cocaine, are being sold openly in head shops across the country. To kids, these products are low-cost substitutes for real coke. Unfortunately they can be fatal.

To date, the Food and Drug Administration has investigated five deaths; six suspects are linked to the use of these commercially available drugs. All the victims succumbed to cardiorespiratory arrest after exposure to a combination of three local anesthetics—lidocaine, procaine and tetracaine.

Pharmacologist Manan W. Fischman, who has been comparing the effects of cocaine and anesthetics on human subjects at the University of Chicago, notes that, although the products aren’t stimulants, they do “cause the person to feel high or mildly euphoric.” Since the anesthetics are often used to activate nerves that stimulate the heart, Fischman adds, “anyone using these products runs the risk of bringing about undetected changes.

According to experts, head-shop coke is, understandably, far less expensive than the real thing. While pure cocaine might sell for $2,000 an ounce, an ounce of material laced with lidocaine or procaine sells for as little as $140.

—Pablo Fanves

"If Jesus Christ were to come today, people would not even crucify him. They would ask him to dinner and hear what he had to say, and make fun of him." —Thomas Carlyle

PRODIGY BURNOUT

He was a young violinist on his way to a brilliant career. Then one day he quit—put down his violin and never picked it up again. He’s a high achiever in medical school now but he nurses a sense of failure that may haunt him for life.

What stopped him from becoming a Perlman or Pagannini? A midlife crisis at age fifteen something that can affect prodigies in music science or the arts says Massachusetts Institute of Technology researcher Jeanna Bamberger.

Bamberger, a pianist herself, says gifted children uniformly seem to go through a period in their teens when the music that once came so naturally no longer seems to flow. The problem occurs because the way children learn is different from the way adults do. Like children with less developed talents, the child prodigy learns much of his music intuitively. But as he enters adulthood he must relearn his skills. Fitting them into the more struc-
POLYESTER DIET

The shortcomings of a diet become apparent at breakfast when the morning allotment of dry unbuttered toast is served. As the day painfully progresses, visions of frosted milk shakes and scrumptious cookies sap willpower. By midnight, the craven dieter surrenders to temptation and dashes for the kitchen.

Wouldn't it be terrific if someone discovered a way to take the calories out of fattening foods? Now an indigestible substitute for culinary fat and oil called sucrose polyester just about does this. "If you allow you to ingest what seems to be a conventional high-fat, high-cholesterol American diet," says University of Cincinnati internist Charles Glueck, "but it lacks most of the calories because the body's digestive enzymes just can't break it down."

More than 400 of Glueck's patients have already dated on foods made with sucrose polyester, a synthetic compound composed of sucrose and eight fatty acids. In one recent trial ten obese volunteers lost an average of eight pounds in 20 days.

The calorie-free food substitute blends into a tasty 155-calorie shake with ice milk (270 calories less than the real thing), says Glueck and can be baked in cookies that have 30 calories less than normal. Although it lowers vitamin A and E levels in the body, that deficiency can be compensated for with vitamin supplements. The compound is currently undergoing Food and Drug Administration review, and Glueck suggests it may eventually be sold as a prescription product in the form of a food dressing or spread.

"The brute curiosity of an angel's stare! Turns you like them to stone."

—Allen Tate

"There is precious little in civilization to appeal to a yet!"

—Sir Edmund Hillary

Better-fed children were more expressive, less anxious, more readily involved in group activities, and more open to new situations.

UNDERNOURISHED EMOTIONS

Emotional health may depend upon how well an individual eats during the first years of life, according to psychologist David Barrett of the Children's Hospital Medical Center in Boston.

Barrett reached this conclusion after studying 138 Guatemalan youngsters. Some of the children had received a high-calorie protein and carbohydrate nutritional supplement from birth while others just received a low-calorie supplement without the protein. To see how nutrition affected development, Barrett tested both groups at age six and found behavioral differences between them.

The better supplemented children were more expressive. Barrett said they were less anxious, more readily involved in group activities, and more willing to pursue a frustrating task or explore a new situation such as playing with strange toys.

Other researchers have assessed the home situation of each child, the size and condition of the house, and the availability of warm clothing and the amount of teaching provided by the mother. These elements turned out to be reliable predictors of intelligence-test performance, Barrett said, but generally did not influence social and emotional behavior. The findings suggest that intellectual and emotional development may be affected by different physiological and environmental influences.

Conversations in the study were Marian Ranke Yarrow of the National Institute of Mental Health, and Robert E. Klein, of the Institute of Nutrition of Central America and Panama—Dava Sobel
RICH NEUROTICS

Neurotics may have the inside track on making money after all. Men with neurotic symptoms ranging from anxiety and mild depression to occasional fits of panic earn more than men diagnosed as mentally fit, according to a new study linking psychiatric condition to earning capacity.

The study also found that neurotics were generally higher in native intelligence, better educated, and more likely to be employed full time than men untouched by neurosis.

To conduct the study, economist Lee Benham and mathematician Alexandra Benham, both from Washington University in St. Louis, traced the psychological and financial profiles of 434 elementary-school children diagnosed at mental clinics in the late 1920s right through to adulthood some 30 years later. Of the 434 white males reviewed, 25 percent were regarded as mentally healthy, 56 percent as neurotic, 19 percent as sociopathic, and 10 percent as psychotic. The neurotics, researchers learned, earned 23 percent more than those considered totally healthy.

If neurotics really do earn more does neurosis cause the higher income or vice versa? Lee Benham theorizes that compulsive behaviors such as extreme attention to detail often develop into successful business skills. "My best guess," he notes, "is that the disorder causes the income differential.

He adds however, "We're not recommending that people go nuts to get rich."—Robert Brody

"The civilization of one epoch becomes the manure of the next."—Cyril Connolly

FOAM HOME

A new kind of house, made of the same material as disposable coffee cups, could provide a strong energy-efficient shelter from the cold, even for residents of the northern United States. In fact, one such house has proved far more energy-efficient than conventionally built homes, and just as fire-resistant and strong.

Designed by Wisconsin entrepreneur Don Peterson the house resembles a standard adobe home but consists of foot-thick blocks of expanded polystyrene, also used to make Styrofoam. The walls are coated with an acrylic fire-resistant cement, then anchored to the foundation with reinforcing iron bars.

All this makes the structure so energy-tight that, theoretically, it could be warmed with human body heat, says Peterson. One house near Madison, where temperatures routinely drop below 0°F in the winter is expected to have a heating bill of $100, versus the nearly $800 that the owners of a comparably sized conventional dwelling would pay. Peterson tested the strength of another foam home he built by hoisting a Mack truck onto the roof, later he ignited all the furniture inside. Firemen who entered the structure after the blaze detected neither structural damage nor toxic fumes emanating from the walls.

The home comes in nearly two dozen models, ranging from cottage-sized to a roomy, four-bedroom split-level. The cost: about the same as a comparable brick or wood home. Provisionally approved in Wisconsin the design is awaiting federal building-code approval, which may come this spring. After that, says Peterson, you'll be able to buy kits with all the foam blocks you need, color and number-coded for assembly—Douglas Starr

"The moon is the mother of pathos and pity."—Wallace Stevens

Polystyrene house. Fire-resistant, strong enough to hold a Mack truck and so energy-tight it could be warmed by body heat.
CONTINUUM

A psychologist has discovered that children of schizophrenics display a weak brain-wave pulse in response to changes in pitch.

PREDDICTING SCHIZOPHRENIA

The child of a schizophrenic has a good chance of becoming schizophrenic too. If psychologists could just identify the most vulnerable offspring, they might be able to treat them early and head off the disorder.

Now researchers may be on the verge of doing just that, according to psychologist David Friedman of the New York State Psychiatric Institute.

To see whether he could weed out potential schizophrenics, Friedman played a steady series of tones for normal children and the children of schizophrenic parents. Occasionally he'd interrupt the tone or alter its pitch. The children were asked to signal every time they detected a change.

Friedman and his colleagues L. Erlenmeyer-Kimling and Barbara Cornblatt measured a surge of brain-wave activity whenever the children heard a change in the tones. But the brain wave pulse was much weaker in the children of schizophrenics than in the normal children. The researchers also found weakened brain-wave responses in adult schizophrenics.

The findings are puzzling, but Friedman thinks they might reflect the inability of schizophrenics—and potential schizophrenics—to respond properly to changes in their social and physical environment.

Friedman would like to refine his tests to the point where he can predict with certainty which children will become schizophrenic without treatment. He suspects that it might be impossible to do this by studying brain waves alone, though because schizophrenia is such a complex malady. And even if he does learn to predict schizophrenia, he will still face an even more vexing problem: what to do to prevent it.

—Paul Raeburn

"Universities are of course hostile to geniuses."
—Ralph Waldo Emerson

ELECTROCUTED CELLS

When living cells are electrocuted, they spin burst, stick together, or open and close according to the frequency of the current passed through them. West German scientists led by Ulrich Zimmerman, at the Institute for Chemistry in Jülich, just west of Cologne, have perfected electrocution techniques so exquisite that they can choreograph plant or animal cells into a balletic dance.

At one frequency, for example, the cells line up between the electrodes like a pearl necklace. At another frequency, the necklace of cells merges thereby forming a grotesque "supercell" hybrid.

According to Zimmerman, the ability to fuse different kinds of cells with electricity may be crucial to genetic engineers who want to create hybrid organisms containing the characteristics of several species.

Electricity may also be used to split red blood cells for a second just long enough for drugs to be popped inside without letting the contents of the cell spew out. When the researchers used this method to inject drugs into mice, they found that the drug-laden blood cells traveled through the bloodstream normally. When the abnormal cells reached the liver or spleen, they were attacked, as expected, and the drugs poured out.

And the possibilities do not end there. If electrocuted cells are kept alive longer, enzymes or hormones could be wrapped up and released into the body bit by bit over several weeks or months. Such a technique might help scientists obliterate the ravages of diabetes or hemophilia caused by the absence of necessary enzymes.

—Paul Simons

Electrocuted cells line up like a pearl necklace.
ROBO-SHOCK!

BY KATHLEEN STEIN

Fledgling machines trigger old fears

PAINTING BY FRANCISCO MELO
Molinda and Kirk and Mike and Mark are making a robot. They call it R202, the name of the building they work in at a company called TRW. R202's purpose in life will be to move around the office and look at things, says Michael Jamgochian, one of its four systems-engineer creators, "to explore...to go from Mark Thompson's desk to Molinda Sherbring's desk when we tell it to and to avoid obstacles and people. Eventually it will enter deliver one-liners, and leave 'advice Kirk Moody."

Although the TRW group is trying to keep the design simple and modular, building an adaptive autonomous robot is an ambitious program—perhaps never really done before—framed with major problems on every level. The biggest hurdle facing the TRW team, however, is not technological. It's financial. Employed by TRW one of the biggest high-tech companies in the United States, the robot's makers aren't getting a nickel from the firm for research and development. R202's gestation and birth must take place after the working day Molinda Kirk, Mike and Mark have a bright idea, and they have to moonlight it.

In a sense, robots can be seen as a symbol of American technology today, a bellwether indicating the direction of industry: employment, electronic intelligence, and the human use of human beings. And in a sense the boxlike, rolling R202 is a symbol of robotics: its creators, like hopeful parents, want it to win friends, move freely in high circles, and learn steadily. But R202 faces growing pains. Although TRW is supplying some hardware, R202 hasn't yet been given the downpour of corporate support it needs to enter the American workforce. People in fact are blatantly terrified of such machines.

Robots make news. The silly slave cures in the movies generate a huge new toy industry, while the giant praying mantis-type assembly-line robot steadily displaces blue-collar workers in the midlands. When Isaac Asimov recently quipped: "Robots don't kill people; robots kill jobs," he was only half right. In 1982 the Japanese disclosed information they'd been hiding. A robot hadfatally crushed a worker who had strayed into its personal zone. The Japanese supposedly welcome each new robot with a Shinto ceremony when it is installed. Yet behind the scenes Japanese labor unions are beginning to express deep concern about the security of their rank and file.

Four million Americans out of a job by 1990," blares one forecast. And according to Harley Shaiken labor and technology analyst at the Massachusetts Institute of Technology, in the next ten years General Motors alone will purchase 20,000 robots. These machines could displace another 200,000 auto workers besides the thousands already laid off directly and indirectly by automation.

"The argument is often raised," Shaiken says, "that unless we introduce robots, industries in the United States will not be able to compete and even more jobs will be lost. But that's half an argument. It doesn't tell us who will lose their jobs. For workers, robots or foreign competition is merely a choice between hanging and the electric chair. And that's the bind we, as a society, have to break out of."

Others argue that the loss of jobs is not the most difficult economic challenge posed by robots. "Retraining is the major social problem created by rapid robotization," says industrial-robot expert Eli Lustgarten of Peine Webster Mitchell-Hutchins Inc., not unemployment. Massive retraining programs will be needed to prevent the creation of an oversupply of workers whose skills have become obsolete. And at the moment little is being done to create retraining programs. Much less to draw up strategies such as shorter work hours or longer range plans for the robotized economy as a whole.

"Robots have an extraordinary potential to be beneficial," Shaiken continues. "Robots or foreign competition is merely a choice between hanging and the electric chair. And we, as a society, will have to break out of that bind."
in Yorktown Heights, New York. "When you're in the area of speculative mobile robots—androids—you have left the field of what might be wrong and have entered areas where nothing has gone right yet. Indeed, AI and robotics types don't have the fact that most robots vision is dim. They can hardly hear and barely use a natural language. They don't have the dexterity of a six-month-old baby."

It is much easier to get a so-called expert system computer to play the psychiatrist or diagnose a physical ailment than it is to get a robot to solve the most trivial problem—one that a dog might find simple. Like severely retarded children who require continuous attention from their parents, today's most advanced robots are doted on second to second by their creators. "In a robot, the interaction with the real world is very difficult," says Michael Brady, senior research scientist at MIT's Robotics Laboratory. "You can form artificial models of the real world with all its wants, wrinkles and bumps. Still that's what we're trying to do," he says, laughing.

Thomsen of TRW talks about realism backlash. "First everyone had the SF idea that a robot could do anything. Then the industrial automation people came out saying that is a pipe dream and began cutting back expectations. Right now we're swimming against that. We are at the stage where we can start working on a couple of those pipe dreams."

Marvin Minsky of MIT's AI lab has said that robot makers should be designing the timeliest of automaton-robots that shake rattles, shudder experience gear backlash and droop. And then he says we should create sophisticated software to compensate for all the mechanical faults.

The TRW quartet is doing something like that. They will be able—through high-level software and fairly simple hardware—to demonstrate exactly what can be done with the remote sensing rover today. They are in the vanguard. But where is that?

For one thing, even at the forefront of robot research most machines don't walk. Plans for R202 call for it to roll through an office on three sets of wheels, navigaing on its own, past clutter and moving people at record-breaking speeds of up to one foot per second.

This activity simple enough for the office goer—or even a compsec—presents the challenge of a dragon hunt for a robot. The most complex problem facing the creators of R202 is designing a program that will continuously update the information the robot receives on its daily rounds and make predictions based on that constant flow of sensory data. The program will give the machine, among other things, an internal representation of the robot's immediate environment. Without this "internal world" in its memory the machine couldn't move an inch. It has to be adaptable. "Up to now humans would make decisions about where the machine would go. We're trying to put ourselves in the robot's shoes," Moody adds.

Right now the TRW group is integrating the software and hardware and encountering many additional subtle and complex problems. If the wheels spin on an uneven surface like a carpet or the joints between rooms, and the program tells the robot to navigate a straight line, it has a problem," Thomsen says. "What the robot thinks is a straight line might be something else. The robot will have to correct for that first by measuring with its sensors the distance from walls. Then it will have to keep track of how far it has deviated from its intended path. You have to be certain everything within the robot's internal program fabrication and programming is precise because there will be plenty of external deviations and quirks."

Here's another problem for you. "Moody adds. Say the robot is to move down the hallway in a straight line but its orientation is off by half a degree. That doesn't sound like much does it? But move one hundred feet and see how much half a degree causes your robot to deviate."

R202 will be equipped with three types of sensors: the long distance one being a set of Polaroid sonic range finders, similar to the ones on the camera. Mounted on the robot, the sensors bounce sound off things to determine their distance from the rover. A major problem in this area is that flat surfaces produce noochets and confusing signals which sometimes don't indicate a true distance to the robot. Also says Sheraring, "If you expect to perceive a wall you feel away and the sensors suddenly tell you there's a nothing in front or you feel what. does the robot do? Do you believe your internal world or your sensors?"

The other two sensors are "curb testers," which order the robot to stop immediately if it touches anything and "encoders" on the wheels which measure the angular distance traveled by the wheels. The figure can be translated into distance moved in a direction. That's how R202 can figure out how far it's gone. Thomsen says. "It double checks against what it is in internal maps."

While the TRW group struggles with these problems of mobile robots, researchers at the MIT Robotics Laboratory are confronting the more daunting problems of disembodied robotic arms towards legs and eyes. Scientists at the lab contend with the more complex problems of robot development—accuracy, speed and gripping tactilely. Among others, Michael Brady who claims this is the biggest robotic research enclave in the United States with about 30 researchers, told us about the current limits of mechanical limbs.

The standard industrial robot arm moves about one meter a second. He says, which is only about the speed of an average person walking from the stove to the refrigerator while cooking dinner at a leisurely pace. The MIT group is working hard to break this speed limit.

When I say fast "Brady says about MIT's arm. "I mean on the order of five meters a second"—faster than a short order cook. A one percent increase in speed also accelerates and decelerates with great bursts of speed. That's where all the arm's effort is expended," he explains. "We're developing an arm with about three g acceleration—an arm that can deliver something on the order of fifty pounds at these speeds and torques."

It wouldn't be a good idea to put your head in the way of this robot.

Velocity alone isn't enough. "You don't just want the arm to move at a high speed," Brady continues. "I mean if you're reaching like crazy to pluck a glass of wine from a tray before someone else snatches it. You want to make sure you don't make contact with all the other glasses off the tray while you're at it."

An even greater challenge is mimicking the vast range of motions that is child's
play for human hands. The human hand has not one, but twenty two degrees of motion. Brady says. "It's not powered by one motor, but by forty-eight. Can we build a machine that has such dexterity?"

You've only got to look at the structure of the hand tendon to realize how remarkably complex it is," he continues.

"Suppose you construct a multitudes robotic hand. You've got to control the individual tendons, a bunch of tendons acting together to control a single finger, and a bunch of fingers working together to control an entire hand." What kind of program would you need to have a robot play something simple like "Chopsticks"? "I wouldn't say as simple as "Chopsticks," he responds. "I'd be quite happy if we could get a hand to twirl a baton, or roll a ball around in its fingers or be able to figure out how to pick up a Coke can as opposed to a tennis ball. That's the level we're hoping to achieve in the next couple of years.

Most contemporary robots are numb. They grope for parts and if they don't grasp them they happily flap their grippers around in the air anyway. As Brady says, there's no point in having a hand if you don't put tactile sensors on it.

"There is little experience in building good tactile sensing materials," he says. "The technology is primitive and the information it yields is fairly coarse—garbage. Current tactile sensors give you only a limited number of points per square centimeter. Or if they give you lots of points you can't distinguish the characteristics of one material being sensed from another."

"Machine vision is Brady's specialty and it's an area that has seen some of the most intensive research in the course of a decade. Still there have been no solid results. Right now industrial-robot optics are so primitive a machine couldn't tell whether a humble kitchen fork was lying propped on the table or dull. And that's a simple problem. The key to making robots move flexibly is to provide them with some understanding of say, where to put down the coffee cup."

Brady continues. "Not on the edge of the table. Not in the soup. We don't want to have to say every time "Move the jar to position X equals twenty-seven Y equals thirty-two. Z equals something else. We want the robot to know teapots have spouts and cups have handles."

Removing the scales from a robot's eyes requires extraordinary vision from its creators, if the programmer makes a mistake and the robot's model for "wrenches" isn't complete enough it will vew bad wrenches as good and discard the good one. If you don't present it with enough information, Brady explains, it won't understand the concept of wrench.

"Paradoxically designers must store data about simplicity as well as the hard surfaces of things. For a robot to manipulate a teapot through space and not whack either the wine decanter or your mother-in-law it has to come fortified with extraordinary amounts of data on the space occupied by that particular teapot and on the swept volume as the robot moves through space.

To build such a comprehensive data bank the robot designer must analyze reality on its most primitive geometric level."

"How do I represent free space?" Brady asks. "The space not occupied by things—this particular object that is not an object at all, but is actually full of air? I have to represent that free space and also represent the movement of that much more rarefied object—namely the robot—through it. Ultimately the designer has to consider every contingency one could encounter anywhere anytime in the given space and then integrate the reasoning of the vision and the movements into one machine. There is a model for such a device. "It's called a human being," Brady says glibly.

"From Frankenstein to The Stepford Wives people seem to want to create artificial versions of themselves—to play God. But today complex android mechanical creatures exist only in books and movies, where they tend to exhibit the random forms of egoism and idiocynance. It is as if the mechanical men concept gives a novelist carte blanche to twist human traits to new and bizarre configurations. The crab-shaped robot in Gravity's Rainbow makes only a cameo appearance. But in that time the booms machine continuously smacks gum made of a malleable variation on polyvinyl chloride that sends out detachable molecules transmitting a damn fair imitation of Bemans's licorice flavor, to the robot's crab brain," writes Thomas Pynchon. In the automomies of Philip K. Dick's Game Players of Titan homeostatic maintenance, vehicles collect trash and check lawn growth. Twenty-legged mechanical repair vehicles propel themselves through the streets "hot on the scent of decay."

"Today only in our fantasies do we play out robot soap operas in which the entire household is held hostage when the android maid and the Naugahyde butler mutiny and decide to run the house their way. How can we have a mechanical Upstairs/Downstairs when there is a robot able to negotiate a single step?"

"A robot that does all the work in the house is at least twenty years off," according to Kevin Dowling, a researcher at Carnegie Mellon University in Pittsburgh. The home robot is figutratively speaking is a very dirty environment. Objects are complexly arranged and constantly being changed. But an even bigger problem Dowling says, will be to find enough work to keep the home robot busy. "Since a domestic robot will be expensive having it lying around idle would not be cost-effective. You'd probably give it every conceivable task, but if you were given the whole day the machine would finish in about two hours. And of course there are some complicated legal implications. What if the robot baby-sitter throws the baby out the window?" (For a contrasting view
There's an alternative to having a housecleaning machine—offered by IBM's David Grossman. It's called "design for automation." Instead of having a robot smart enough to run around vacuuming up your wallet with the dust and throwing the baby out with the garbage, build your house so that it looks like McDonald's, where all the tables are attached to the wall and have only one leg, and the chairs are attached to the table. Then it's easy to mop. Maybe you'd have high-pressure hoses along one side of the wall. Everybody out of the room, turn on the hoses, and all the dirt is sprayed automatically to the other side where it collects and runs off.

The mention of McDonald's reminds Grossman of an incident related to him by a former robotics colleague. A conglomerate we'll call Ramjac Inc. was considering a completely robotized version of a fast-food restaurant. Customers could order burgers, shakes, fries, fried shrimp and so on by pushing a set of buttons. With each order received, refrigirator doors would swing open deep in the bowels of the earth, and robot arms would grab hamburgers, throw them onto skillets and grab and move milk shakes. Ramjac built a prototype of this culinary wizardry on Long Island, and Grossman's colleague paid a visit to watch it work.

Everything was indeed robotized except for the final step—putting the food in the bags. That was—and still is—beyond the capability of robots. So at the end of the process stood a human being—with food chutes aimed at him from all directions and a giant display board that told him what combinations to put in each bag. Everything went well for a couple of minutes. Then he dropped a chocolate shake. He still needed that chocolate but the next three milk shakes in the shake line were vanilla. He reached around them to get at a chocolate and in doing so knocked some french fries on the floor.

"Within an hour," concluded Grossman, "he was knee-deep in garbage."

The robot-human connection also went awry at a major New York bank. In learning to love their robo-mailcarts employees at Citicorp in New York City, were forced to make major psychological adjustments. Previously human mailpeople had made one and a half-hour pickup circuits. The robo-carts made the round trip in ten minutes. According to computer expert Randolph Long, a former Citicorp employee the carts conditioned the people to set up "internal clocks" in their minds. After about nine and a half minutes, he remembers, "you began to steel yourself for it—the incessant warning beeps and the heavy rattling. The human carriers were a great source of interoffice news and gossip, too and were sorely missed for that reason. The robo-carts followed tracks sprayed on the carpet and Long remembers he firely considered getting a can of the

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A man could lose his heart in Paris if he can't play the game

BLIND SHEMMY

BY JACK DANN

After covering the burning and sacking of the Via Roma in Naples, Carl Pfeiffer, a famous newsfax reporter, could not resist his compulsion to gamble. He telephoned Joan Otur, one of his few friends, and explained that she accompany him to Paris. Organ-gambling was legal in France. They dropped from the sky in a transparent plasticine egg, and Paris opened up below them. Paris and the glittering chip of diamond that was the Casino Baccarat. Except for the dymaxion dome of the Right Bank, Joan would not have been able to distinguish Paris from the suburbs beyond. A city had grown over the city. The grid of the ever-expanding slum city had its own constellations of light and dark, Haussmann's ruler-straight boulevards, the ancient architectural wonders; even the black, sour-stenched Seine, which was an hourglass curve dividing the old city. Their transport settled to the ground like a dirty snowflake and split silently open, letting in the chilly night air with its acrid smells of mudflats and cinders and clogged drains. Joan and Pfeiffer hurried across the temple toward the high security doors of the casino. All around them stretched the black...
brick-and-concrete wastelands of the city's ruined districts, the feind warrons on the dome's periphery which were inhabited by skinheads and Screamer who existed outside the tightly controlled structure of Uptown Life. Now, as Pfeiffer touched his hand to a palm plate sensor the door opened and admitted them into the casino itself. The precarious outside world was closed out and left behind.

A young man, who reminded Joan of an upright (if possible) Bedlington terrier led them through the courtyard. He spoke with a clipped English accent and had tufts of woolly bluish-white hair implanted all over his head, face and body. Only his hands and genitals were hairless.

"He has to be working off an indenture" Pfeiffer said sharply as he repressed a sexual urge.

"Shush," Joan said, as the boy gave Pfeiffer a brief contemptuous look—in Parisian culture you were paying only for the service—not for the smile.

They were led into a simple, but formal entry lounge which was crowded but not uncomfortable. The floor was marbled, a few pornographic icons were discreetly situated around the carefully laid-out comfort niches. The room reminded Joan of a chapel with arcades figures and stone courts. Above was a dome from which radiated a reddish, suffusing light, lending the room an expansiveness of height rather than breadth.

But it was mostly holographic illusion. They were directed to wait a moment and then presented to the purser an over weight, balding man who sat behind a small desk. He was dressed in a blue camel's hair suit and matching caftan which was buttoned across his wide chest and closed with a red scarf. He was obviously and uncomfortably dressed in the colors of the establishment.

And good evening, Monsieur Pfeiffer and Mademoiselle Otta. We are honored to have such an important guest, or guests, I should say." The purser slipped two cards into a small console. "Your identification cards will be returned to you when you leave. After a pause, he asked, "Ah, does Monsieur Pfeiffer wish the lady to be credited on his card?" Pfeiffer lowered his eyes indicating embarrassment. Quite simply, Joan did not have enough credit to be received into the more sophisticated games.

"Yes, of course" Pfeiffer said absently. He felt guilty and anxious about feeling a thrill of desire for that grotesque boy.

Well then said the purser, folding his hands on the desk, "we are at your disposal for as long as you wish to stay with us. He gestured toward the bar and said, "Johnny will give you the tour," but Pfeiffer pointedly declined. Johnny ushered them into a central room, which was anything but quiet, and—after a wink at Pfeiffer—distractively disappeared.

The room was as crowded as the city ways. It was filled with what looked to be the ragtag, the bums and the street people the captains of the ways. Here was a perfect replica of a street casino, but perfectly safe. This was a street casino, at least to Pfeiffer who was swept up in the noisy and bustling as he whistled his account for the dangerous pleasures of the top level.

Ancient iron bandits whispered 'chink, chink,' and rolled their picture-frame eyes in promise of a jackpot, which was immediately transferred to the purser's account by magnetic sleight of hand. The amplified, high-pitched voices of pinball computers on the walls called out winning hands of poker and blackjack. A simulated stabbing drew nothing more than a few glances. Tomstone booths were filled with figures working through their own Stations of the Cross. Hooked-in winners were rewarded with bursts of electronically induced ecstasy. Losers winched in pain and suffered through the brain-crushing aftershock of weak long migraines.

And of course battered robots clattered around with the traditional completion of drugs, drink and food. The only incongruity was a perfectly dressed geisha who quickly disappeared into one of the rear doors on the far wall.

"Do you want to play the one-armed bandits? Joan asked, knowing his growing claustrophobia, wishing only to escape into quiet. But she was determined to try to keep Pfeiffer from going upstairs. Yetironically—all her emotions seemed to be simultaneously yin and yang—she also wanted him to gamble away his organs. She knew that she would feel a guilty thrill if he lost his heart. Then she pulled down the lever of the one-armed bandit and it read her finger and odor prints and trans fer the proper amount to or from Pfeiffer's account. The eyes rolled and clicked and one hundred international credit dollars was lost. "Easy come, easy go! At least this is a safe way to go! But you didn't come here to be safe right?" Joan asked knowingly.

"You can remain down here if you like" Pfeiffer said, looking about the room for an exit, noticing that his doors were spaced every few meters on the nearest wall to his left. "The casino must take up the whole bloody block, he thought, "how the hell do I get out of here?"

Before Joan could respond, Johnny appeared, as if out of nowhere, and said. "Monsieur Pfeiffer may take any one of the arrangements or if he would care for the view of our palace he could take the staircase to heaven." He smiled, baring even teeth and curtsied in Pfeiffer who was blushing. The boy certainly knew his man, Joan thought sourly.

"Am I jealous?" she asked herself. She cared for Pfeiffer, but didn't love him—at least she didn't think she did.

"Shall I attend you?" Johnny asked Pfeiffer, ignoring Joan.

"No," said Pfeiffer. "Now please leave us alone."

Well, which is it?" asked Joan. "The elevator would be quickest, zoom you right to the organ room."

"We can take the stairs," Pfeiffer said, "It's a touch of blush still in his cheeks. But he would say nothing about the furry boy. Jesus, it seems that every time I blink my eye, the stairway disappears."

"I'll show you the way" Joan said, taking his arm.

Just what I need," Pfeiffer said, smiling, eliminating one small barrier between them. "I think you're over using it? You don't really want to gamble out your gut.

"I came to do something, and I'll follow it through."

The stairwell was empty and like an object conceived in Alice's Wonderland, if it appeared to disappear behind them. "Cheap tricks," Pfeiffer said.

"Why are you so intent on this?" Joan asked. "You lose, which you most probably will, you'll never have a day's peace. They can call in your heart of liver or—"

"I can buy out if that should happen," Pfeiffer reddened but it had nothing to do with his conversation with Joan to which he was hardly paying attention. He was still thinking about the furry boy.

"You wouldn't gamble them, if you thought you could buy out. That's bunk."

"Then I'll get artificial" you'd be taking another chance with the quotas—thanks to your right wing friends in power."

"Pfeiffer didn't take the bat," I admit deceitfully. "Again he thought of the furry boy's naked hands, genitals. And with that came the thought of death."

The next level was less crowded and more subdued. There were few electronic games to be seen on the floor. A man passed dressed in medical white which indicated that deforestation games were being played. On each floor the stakes became increasingly higher, fortunes were lost, people were disfigured or ruined but—with the exception of the top floor which had dangerous games other than organ gambling—at least no one died. They might need a face and body job after too many deformations but those were easily obtained, although one had to have very good credit to ensure a proper job.
On each ascending level the house, whose both male and female, became more exotic, erotic, grotesque and abundant. There were birchmen with feathers like peacocks and flamingos children with dyed skin and overly large, implanted male and female genitalia, machines that spoke the language of love and exposed soft fleshy organs, amputees and cripples, various drag queens and kings, natural andro-gynes and mutants, cyborgs, and an interesting, titillating array of genetically engineered monstrosities.

But none disturbed Pfeiffer as had that silly furry boy. He wondered if indeed the boy was still following him.

"Come, Joan," Pfeiffer said impatiently. "I really don't want to waste any more time down here.

"But I always thought it was the expectation that's so exciting for seasoned gamblers." Joan said.

"Not for me," Pfeiffer said, ignoring the sarcasm. "I want to get it over with. With that, he left the room.

Then why bother at all? Joan asked herself, wondering why she had let Pfeiffer talk her into coming here. He doesn't need me. Damn him, she thought, ignoring a skinny white-haired man and a prebdal doggie moncalf coupling beside her in an up-right position.

She took a lift to the top level to catch up with Pfeiffer.

It was like walking into the foyer of a well-appointed home. The high walls were stucco and the floor was inlaid parquet. A small Dehav rug was placed neatly before a desk behind which beamed a man of about fifty dressed in camises and caftans. He had a flat face, a large nose that was wide, but had narrow nostrils, and close-set eyes roofed with bushy brown eyebrows. The color his hair would have been had he had any.

Actually the room was quite small, which made the rug look larger and gave the man a commanding position.

"Do you wish to watch or participate, Monsieur Pfeiffer?" he asked, seeming to raise an inch from the chair as he spoke. "I wish to play," Pfeiffer said, standing upon the rug as if he had to be positioned just right to make it fly.

And does your friend wish to watch?" the man asked as Joan crossed the room to stand beside Pfeiffer. Or will you give your permission for M. Gru to become telepathically connected to you." His voice didn't rise as he asked the question.

"I beg your pardon?"

"A psycconnection, sir. With a psycconductor—a hole of condensation crept into his voice. "I know what it is, and I don't want it."

Pfeiffer snapped and then moved away from Joan. But a cerebral hook-in was in fact just what Joan had hoped for.

"Oh, come on, Joan. Let me in. Are you serious?" he asked, turning to-ward her. Caught by the intensity of his stare, she could only nod. Then I'm sorry. I am not a window for you to stare through."

That stung her, and she retaliated. "Have you ever done it with your wife?" She immediately regretted her words.

The man at the desk cleared his throat politely. "Excuse me, Monsieur, but are you aware that only games organique are played in these rooms?"

"Yes, that's why I've come to your house."

Then you are perhaps not aware that all our games are conducted with psycconductors on this floor."

Pfeiffer, looking perplexed, said, "Perhaps you had better explain it to me."

"Of course, of course," the man said, beamern as if he had just won the battle and a fortune. "There are, of course many ways to play and, if you like, I can give you the address of a very nice house nearby where you can play a fair game without hook-ins. Shall I make a reservation for you there?"

"Not just yet," Pfeiffer said, resting his hands on the desk, knocking gently upon the top of it. "He said."

His feet seemed to be swallowed by the floral patterns of the rug, and Joan thought it an optical illusion; the effect of being caught before the desk of the casino captain. She felt the urge to grab Pfeiffer and take him out of this suffocating place.

Instead she walked over to him. Perhaps he would relent just a little and let her slide into his mind.

It is one of our house rules however, said the man at the desk, that you and your opponent, or opponents must be physically in the same room."

"Why is that," Joan asked feeling Pfeiffer scowling at her for intruding.

"It has never happened to us, of course, but cheating has occurred on a few long-distance transactions. Organs have been wrongly lost. So we don't take any chances. None at all," he said, looking at Pfeiffer as he spoke. "It's aimed at the man who spoke."

"But he is a telepathic."

"I know, but it's aimed at the man who spoke."

"What must the game be played with psycconductors?"

"That's the way we do it, said the captain. Then, after an embarrassing pause, he said, "We have our own games and rules."

Our games we think are the most interesting. And we make the games as safe as we can for all parties involved.

"What do you mean?"

"We—the house—will be observing you."

Our gamesmaster will be telepathically hooked in, but I assure you you will not sense his presence in the least. If anything should go wrong, or look as if it might go wrong, then pit we intercede. Of course we make no promises and there have been cases where—"

"But anything that could go wrong would be because of the cerebral hook-in."

"Perhaps that isn't the game for you, sir."

"You must have enough privileged in-
formation on everyone who has ever played here to make book," Pfeiffer said.

"The hook-in doesn't work that way at all. And besides, we are contract-bound to protect our clients."

"And yourselves."

"Most certainly. The casino captain looked impatient.

"If both players can read each other's mind," Pfeiffer said to the captain, "then there can be no blind cards."

"Aha, now you have it mausoleum," said the captain. "And indeed, the captain continued, "we have a modified version of chemin de fer, which we call blind sherry. All the cards are played face-down. It is a game of control (and of course chance) for you must block out certain thoughts from your mind while, at the same time, tricking your opponent into revealing his cards. And that is why it would be advantageous for you to let your friend here connect with you."

Pfeiffer glanced toward Joan and said, "Please clarify that.

"Quite simply," said Joan, "while you are playing your friend could help block your thoughts from your opponent with her own," said the captain. "But it does take some practice. Perhaps it would be better if you tried a hook-in in one of our other rooms where the stakes are not quite so high."

"I have a game of nine in progress," the captain said. "There are nine people playing and nine others playing interference. But you'll have to wait for a space. It will be quite expensive."

"Then the captain lowered his eyes slightly. "The poor sodalibitch is caught," she thought. "Come on, Carl, let a got out of here now."

"Perhaps you should listen to Miss Otur," Joan said, "but the man must have known that he had Pfeiffer."

"I wish to play blind sherry," Pfeiffer said, turning toward Joan glaring at her. She caught his eye. "If I lose," she said, "I know he would make certain that Joan lost something too."

"I have a game of nine in progress," the captain said. "There are nine people playing and nine others playing interference. But you'll have to wait for a space. It will be quite expensive."

Pfeiffer accepted, and while he and Joan gave their prints to the various forms, the captain explained that there was no statute of limitations on the contract signed by all parties, and that it would be honored even by those governments that disapprove of this particular form of gambling.

Then the fury boy appeared like an apparition to take them to their room where they were to be given time to practice and become acquainted.

The boy's member was slightly enlarged, and Pfeiffer now became frightened. He suddenly thought of his mother and the obligatory hook-in service at her funeral. His skin crawled as he remembered her last filthy thoughts.

The fury boy led Joan and Pfeiffer into the game room, which smelled of oiled wood, spices, tobacco, and perfume. There were no holes or decoration on the walls. Everything with the exception of the left top of the cards, which were made of precious woods oak elm cedar teak walnut mahogany redwood, ebony. The long half oval gaming table, which met the sliding partition wall was made of satinwood, as were the two delicate but uncomfortable high-backed chairs placed side by side. On the table before each chair was a psychic cowl each one sheathed in a light, silvery mask.

We called them poker faces, "the boy said to Pfeiffer as he placed the cowl over Joan's head. He explained how the psychic mechanism worked, then asked Pfeiffer if he wished him to stay.

"Why should I want you to stay?" Pfeiffer asked, but the sexual tension between them was unmistakable.

"I'm adept at games of chance. I can redact your thoughts without a psychic cowl," the boy said to Joan. Pfeiffer had read the newspapers, and Pfeiffer had been found.

"Do you wish me to return when you're finished?"

"If you wish," Pfeiffer replied stiffly. Joan watched his discomfort. Without saying a word, she had won a small victory.

"The boy lowered the cowl over Pfeiffer's head; made some unnecessary adjustments, and left reluctantly.

"I'm not at all sure that I want to do this."

Pfeiffer mumbled, faltering. She was looking for any blister, crack, any anomaly in her smooth surface. He would gamble his body away without her, unless she was able to break through his defenses.

Well, Joan said, "we can easily call off the game. Our first connection is just practice—"

"I don't mean the game! I mean the psychic connection."

Joan remained silent. "Damn it," she told herself, "I should have looked away when Pfeiffer's fury pet made a pass at him."

"I was crazy to agree to such a thing in the first place.

"Shall I leave?" Joan asked, "if it was you who insisted that I come along?"

"Most certainly!"

Joan stood up, but did not judge the distance of the cowls, or positions accurately, and the cowl was pulled forward bending the silvery mask.

I think you're as nervous as I am," Pfeiffer said, appealingly.

"Make the connection right now! Or let's get out of here." Joan was suddenly angry and frustrated. Do it, she thought to herself, and for once she was not passive. Certainly not passive. Damn him and his fury boy! She snapped the wooden toggle switch activating both psychocylinders and was thrust into vertiginous light. It surrounded her as if she could see in all directions at once. But she was simply seeing through Pfeiffer's eyes. Seeing herself small, even in his eyes, small.

After the initial shock, she realized that the light was not brilliant, on the contrary, it was soft and diffused.

But this was no connection at all. Pfeiffer was trying to close his mind to her. He appeared before her as a smooth, perfect, shining sphere. It slowly rotated, a green-gray planet, closed to her; forever closed, she thought.

"Are you happy now?" asked Pfeiffer, as if from somewhere deep inside the sphere. It was so smooth, seamless. He really doesn't need me, she thought, and she felt as if she were flying above the surface of the planet, closed in a mind, a winged thing flying for any connection, any fault in his defenses.

So you see, Pfeiffer said, exulting in imagined victory, I don't need you. The words came wreathed in an image of a storm rolling angrily over the planet.

She flew in sudden panic, around his thoughts like an insect, circling a source of light. She was looking for any blister or crack any anomaly in the smooth surface. He would gamble his body away without her that she knew unless she could break through his defenses. Prove to him how vulnerable he really was.

So you couldn't resist the fury boy, could you?" Joan asked her thoughts like smooth sharks swimming through icy water. Does he then remind you of yourself? or do I remind you of your mother?

His anger and exposed misery were like lances on the surface of the sun. In their place remained an eruption on Pfeiffer's smooth protective surface. A crack in the cerebral egg.

Joan dove toward the fissure, and then she was inside Pfeiffer—not the outside of his senses where he could verbalize a thought, see a face, but in the dark prehistoric places where he dreamed, con
ceptualized, where he floated in and out of memory, where the eyeless creatures of his soul dwelled.

It was a sliding, a slipping in, as if one had turned over inside oneself, and Joan was sliding, slipping on ice. She found herself in a dark world of grotesque and geometric shapes; an arctic world of huge icebergs floating on a fathomless sea.

And for an instant, Joan sensed Pfeiffer’s terrible fear of the world.

Mindfucker! Pfeiffer screamed, projecting the word in a hundred filthy sickening images, and then he smashed through Joan’s defenses and rushed into the deep recesses of her mind. He found her soft places and took what he could.

All that before the psycorrelation was broken. Before the real game began. As if nothing had happened.

A man and woman, wearing identical cowled masks, sat across from Joan and Pfeiffer. The partition wall had been slid back, revealing the oval shape of the gaming table and doubling the size of the wood-paneled room. The dealer and the gamesmaster sat on each side of the long table between the opponents. The dealer was a young man with an intense roundish face and straight black hair cut at the shoulders; he was most likely in training to become a gamesmaster.

The gamesmaster’s face was hidden by a black cowl; he would be hooked in to the game. He explained the rules, activated the psychosensors, and the game began. Joan and Pfeiffer were once again hooked in, but there was no contact as yet with the man and woman across the table.

Pfeiffer cleared his mind, just as it he were before lasers or giving an interview. He had learned to cover his thoughts, or, somehow he had always tell they could be seen especially by those who wanted to hurt him politically and on the job.

White thought, he called it because it was similar to white noise.

Pfeiffer could feel Joan circling around him like the wind. Although he couldn’t conceal everything he could hide from her. He could use her just as she could use him. He had used him. They had reached an accord via mutual blackmail. Somehow, during their practice hook-in Joan had forced herself into Pfeiffer’s mind. He attacked her.

So now they knew each other better.

They built a simple symbol structure. He was the world: a perfect sphere without blemish made by God’s own hands; a world as strong and divine as thought, and she was his atmosphere. She contained all the elements that could not exist on his featureless surface. She was the protective cloak of his world.

They built a mnemonic in which to hide yet they were still vulnerable to each other. But Pfeiffer guessed that Joan would remain passive—after all, she always had.

She also had the well-developed conscience of a mystical liberal; she was in love with him. He had seen that—or thought he had.

She would not expose him to danger.

Pfeiffer congratulated himself for being calm which reinforced his calmness. Perhaps it was Joan’s presence. Perhaps it was the mnemonic. But perhaps not. He had the willpower this was just another test. He had managed to survive all the others he told himself.

Joan rained on him, indicating her presence and they practiced talking within geometric shapes as a protective device—it was literally raining geodesic cats and dogs.

When the gamesmaster opened the psychosensor to all involved, Joan and Pfeiffer were ready.

But they were not ready to find exact duplicates of themselves facing them across the table. The doppelgangers, of course, were not wearing cowls.

“First, messmates and messieurs, we draw the wager,” said the dealer who was not hooked in. The gamesmaster’s thoughts were a neutral presence. For each organ pledged there would be three games consisting of three hands to a game. Continued the dealer. In the event that a player wins twice in succession; the third hand or game will not be played. His voice was an intrusion; it was harsh and cold and came from the outside where everything was hard and intractable.

How do they know what we look like? Pfeiffer asked, shaken by the hallucination induced by his opponents.

But before Joan could reply, she answered his own question. They must be picking up subliminal stuff.

The way we perceive ourselves. Joan said. The doppelgangers became hard and ugly as if they were being eroded by time. And Joan’s double was becoming smaller insignificant.

If we can’t cover up, we won’t have a chance.

You can’t cover everything, but neither can they, Joan said. It cuts both ways. She noticed a fissure in the otherwise perfect sphere below and she became black fog, black fog, black fog. Protective covering. Pfeiffer was afraid and vulnerable. But she had to give him credit. He was not hiding it from her at least. That was a beginning.

Did you pick up anything from them, an image, anything? Pfeiffer asked.

We’ve been too busy with ourselves. We’ll just wait and be ready when they let something slip out.

Which they will, Pfeiffer said, suddenly confident again.

From deep inside their interior symbolized world Joan and Pfeiffer could look into the external world of crouper felt-top table cards, wood-covered walls and masked creatures. This room was simply a stage for the play of thought and image.

Pfeiffer was well acquainted with this
sensation of perceiving two worlds, two levels inside and outside. He often awakened from a nightmare and found himself in his living room or library. He knew that he was wide awake and yet he could still see the dream unfurl before him. He watched the creatures of his nightmare stalk about the room—the interior beasts let loose into the familiar, comforting confines of his waking world. Those were always moments of terror. For surely he was near the edge then—and could fall.

The dealer combined two decks of cards and placed them in a shoe, a box from which the cards could be slid out one by one. He discarded three cards: the traditional burning of the deck.

Then he dealt a card to Pfeiffer and one to his opponent. Both cards landed faceup. A queen of hearts for Pfeiffer. A nine of hearts for his opponent.

So Pfeiffer lost the right to call the wager. Just as the object of blackjack was to draw cards that would add up to twenty one or as near to that figure as possible, the object of blind shemmy was to draw cards that add up to nine. Thus face cards, which would normally be counted as ten, were counted as zero. Aces normally counted as eleven became one, and all other cards had their normal pip (or face) value with the exception of tens, which like aces were counted as one.

Monsieur Deux wins nine over zero. The dealer looking now at Pfeiffer's opponent. Pfeiffer was Monsieur Lin and his opponent Monsieur Deux only because of their positions at the table.

"A hell of a way to start," Pfeiffer said.

"Keep yourself closed," Joan said, turning into mist: then dark rain, pure sunlight and rainbows. A perceptual kaleidoscope to conceal Pfeiffer from his enemies. Look now, he'll be more vulnerable when he speaks.

Your choice said the gamesmaster. The thought was directed to Pfeiffer's opponent. He was staring intently at Pfeiffer.

"Look now," Joan said to Pfeiffer. "Since we both turned up hearts, perhaps that is where we should begin."

"Pfeiffer's opponent said, speaking for the benefit of the dealer. His words felt like shards of glass to Pfeiffer. They're the seats of our emotions, so we'd better dispose of them quickly," Pfeiffer felt the man's smile. "Do you assent?"

"It's your choice," Pfeiffer said to the dealer tonelessly.

"Don't let anything out," Joan said.

"Pfeiffer couldn't pick anything from his opponent and the woman with him. They were both empty duplets and-"

"I'll be more vulnerable when he speaks."

"Let's give Pfeiffer a break. He tried to relax. Smooth himself down. He thought innocuous white thoughts and ignored the knot of anxiety that seemed to be pulling at his groin.

"Cartes," said the dealer dealing two cards from the shoe: facedown one for Pfeiffer the other for his opponent. Another two cards and then a palpable silence. Not even thoughts seemed to cut the air. It was an unnatural waiting.

"Pfeiffer had a natural nine. A winning hand (a queen and one of diamonds), and he looked up about to turn over his cards, when he saw the fuzzy boy sitting across the table from him.

"What the hell—"

"Call your hand," Joan said, feeling his glands open up. A warm waterfall of fear. But before Pfeiffer could speak, his opponent said, "My friend across the table has a natural nine. A queen and one of diamonds. Since I called his hand, I believe I am correct then."

The dealer turned Pfeiffer's cards over and said, "Monsieur Deux is correct. And wins by call. If Pfeiffer's opponent had been mistaken about the hand, Pfeiffer would have won automatically even if his opponent held better cards.

The dealer then dealt two more cards from the shoe. You were supposed to be covering my thoughts, Pfeiffer said, but he was composed thinking white thoughts again.

"I'm trying, Joan. But you won't trust me—are you trying to cover yourself from me as well as your opponent? What the hell am I supposed to do?"

"I'm sorry," Pfeiffer thought.

"Are you really so afraid that I'll see your true feelings?"

"This is neither the time nor the place. His rhythm of white thoughts was broken. Joan became a snowstorm-aiding him lulling him back to white blindness. I think the gamesmaster is making me nervous, having me hooked in privy to all our thoughts."

"Forget the gamesmaster and for God's sake stop worrying about what I'll see. I'm on your side."

"Monsieur Lin, will you please claim your cards," said the dealer. The gamesmaster nodded at Pfeiffer and thought neutral papery thoughts.

"Pfeiffer turned up the edges of his cards. He had a jack of diamonds—which counted as zero—and a two of spaces. He would need another card."

"Don't think about your cards," Joan exclaimed. "Are you picking up anything from the other side of the table?"

"Pfeiffer listened. As if on his own thoughts. He didn't raise his head to look at his opponent—"it seeing his own face—or that of the furry boy—staring back at him from across the table was disconcerting and fascinating. An image of an empty hollow woman without any organs formed in his mind. He imagined her as a bag somehow formed into human shape."

"Keep that," Joan said. "It might be usable. But I can't see his cards."

"Just wait a while. Keep calm.
Does Monsieur wish another card?' the dealer asked. Pfeiffer took another card and signaled his opponent.

Pfeiffer had no idea what cards his opponent was holding; it promised to be a blind play. When the cards were turned over the dealer announced: "Monsieur Deux wins six over five. Pfeiffer had lost again.

'I'm playing blind,' Pfeiffer said anxiously to Joan.

'He couldn't see your cards,' either she replied.

But that gave him little satisfaction, for by losing the first two hands, he had lost the first game.

And if he lost the next game, he would lose his heart, which white thought or not seemed to Pfeiffer to be beating in his throat.

'Try to calm yourself,' Joan said; or you'll let everything out. If you trust me and stop throwing up your defenses, maybe I can help you. But you've got to let me in, as it is, you're giving our friends quite the edge. Let's make a merger—a marriage. But Pfeiffer was in no mood for irony. His fear was building steadily, slowly.

You can fold the game. Joan said. That is an alternative.

And give up organs I haven't yet played for! The smooth surface of Pfeiffer's sphere cracked, and Joan let herself be swallowed into it. The surface of the sphere changed, grew mountain chains, lush vegetation, flowers, deserts, all the mingled moods of Joan and Pfeiffer.

Pfeiffer was no longer isolated; he was protected yet dangerously exposed. Inside him, the human most Clark, Joan promised not to take advantage of him. She caught a fleeting thought of Pfeiffer a dead mother who had been a feisty, big-boned, flat-faced woman. She also saw that Pfeiffer had hated his mother, so much now as when she was alive.

In the next hand—the opening hand of the second game—Pfeiffer held five of clubs and a two of spades, a total of seven points. He would not take another card unless he could see his opponent's. But when he looked up Pfeiffer saw the furry boy who blew him a kiss.

You're exposed again, Joan said, and they thought themselves inside their world, thought protective darkness around themselves except for one tiny opening through which to see into their enemies.

Concentrate on that image of the empty heart, Joan said to Pfeiffer. She has to be Monsieur Deux's wife or woman. I can't quite visualize it as you did. But Pfeiffer was trying to smooth down his emotions and the dark, dangerous demon that was his memory. The image of the furry boy sparked memories, fears, guilt. Pfeiffer remembered his father, who had been a doctor. There was always enough money but his father extracted emotional dues for every dollar he gave his son. And as a result, the young Pfeiffer had recurrent nightmares that he was sucking off his father. Those nightmares began again after his mother died. She had seen that homosexual fantasy when Pfeiffer hooked into her on her deathbed.

Pfeiffer still had those nightmares.

And now against his will the image of him sucking off the furry boy passed through his mind. drawing its train of guilt and revulsion. The boy and his father somehow one and the same.

You're leaking, Joan said, and her thoughts became a current. She could see her way into Pfeiffer now into those rooms of buried memories. Rather than rooms, she thought of them as subterranean caverns; every thing inside them was intact perfect hidden from the harmful light and atmosphere of consciousness. Now she knew him.

Pfeiffer collected himself and peered into his opponent's mind. He thrust the image of the organless woman at the man.

It was like tearing a spiderweb.

Pfeiffer felt the man's pain as a feather touching flesh. The organless woman was Monsieur Deux's permanent wife. Pfeiffer had broken through and into his thoughts he could feel his opponent's name something like Gayet. Gayet. Gayet. What is it and how was used up? Gayet saw her in the darkness of his unconscious as an empty bag. She was a compulsive gambler who had spent her organs. And Gayet hated gambling but she possessed him and he hated her and loved her and was just beginning his self-destructive slide.

Now she was using him up. She was gambling his organs.

She's used up, Pfeiffer thought at Gayet. But Pfeiffer could only glimpse Gayet's thoughts. His wife was not exposed. Nor was she defenseless.

She thrust the image of the furry boy at Pfeiffer and Pfeiffer felt his head being forced down upon the furry boy's lap. But it suddenly wasn't the furry boy anymore. It was Pfeiffer's father.

There was no distance now Pfeiffer was caught, tiny and vulnerable.

Gayet and his wife were swallowing him, thoughts and all.

It was Joan who saved him. She pulled him away and he became the world again wrapped in snow in whiteness. He was safe again as if inside Joan's cold womb.

Look now, Joan said an instant later and a revelation. Pfeiffer saw Gayet's cards saw them buried in Gayet's eyes with the image of his aging wife. In that instant Pfeiffer saw into Gayet and forgot himself Gayet's wife was named Grace and she had been eroded from too many surgeries too many deformation games. She was his Blue Angel — yes, he had seen the ancient film and Gayet the fool.

The fool held an ace of hearts and a five of diamonds.

Now Pfeiffer felt that the odds were with him. It was a familiar sensation for gamblers a sense of harmony, of being a benevolent extension of the cards. No anger.
no fear, no hate; just victory. Pfeiffer called Gayet's hand, thereby preventing Gayet from drawing another card, such as a lucky three, which would have given him a count of nine.

Pfeiffer won the hand, and he thanked Joan. His thoughts were of love, but his repertoire of images was limited. Joan was now part of his rhythm and harmony, a constant presence, and she dreamed of the victorious cats that padded so gracefully through the lush vegetation of Pfeiffer's sphere—the cats that ruffled then devoured one another.

Pfeiffer won the next hand to take the second game. Pfeiffer and his opponent were now even. The next game would determine the outcome. Pfeiffer felt that calm cold certainty that he would take Gayet's heart. The obsession to expose and ruin his opponent became more important than winning or losing organs. It was bright and fast flowing, refreshing as water.

He was in a better world now, a more complete, fulfilling plane of reality. All gamblers dreamed of this, losing and winning everything but being inside the game. Even Joan was carried away by the game. She, too, wanted to rend—to whittle away at the couple across the table, take their privacies, turn over their humiliations like worry beads. They were Pfeiffer's enemies and his enemies were her own.

Everyone was exposed now battle-weary mentally and physically exhausted yet lost in play, lost in perfect, concentrated time. Pfeiffer could see Gayet's face both as Gayet saw himself and as Grace saw him. A wide nose, dark complexion, low forehead, a large ear, yet it was a strong face and handsome in a tered, almost frightening way—or so Grace thought. Gayet saw himself as weak; the flesh on his face was too loose.

Gayet was a failure, although he had made his career and fortune in the Exchange. He had wanted to be a mathematician but he was lazy and lost the "knack" by twenty-five.

Gayet would have made a brilliant mathematician and he knew it.

And Grace was a whore, using herself and everyone else. Here was a woman with great religious yearnings who had wanted to join a religious order but was blackballed by the cults because of her obsession for gambling and psychodromics. But Pfeiffer could see into her only a little. She was a cold bitch and more than any of the others had reserves of strength.

This last game would be psychological surgery. Tear with the knife, pulping with the bludgeon. Pfeiffer won the first hand. This was joy; so many organs to win or lose, so little time.

Pfeiffer lost the next hand. Gayet exposed Joan, who revealed Pfeiffer's cards without realizing it. Gayet had opened her up, penetrated all that efficiency and order to expose anger and lust and uncontrolled oceanic pity. Joan's emotions wrinkled and...
...crawled over her like beautifully colored, slippery snakes. Pfeiffer had been too preoccupied to protect her.

Joan's first uncontrollable thought was to revenge herself on Pfeiffer, expose him, but he opened up to her, buried her in white thoughts which was as cold and numbing as snow and isolated without words, but with the soft enclosed comforting thoughts he equaled with love. She couldn't trust him nor could she expose him. Right now she could only accept him.

The dealer gave Pfeiffer a throne of diamonds and a box of clubs. That gave him only four points, he would have to draw again. He kept his thoughts from Joan, for she was covering herself. She could attack Gayet and her white thoughts for their cards. Gayet's heart was not simply the organ—but not, not to Pfeiffer. It was his whole life, his reason. To rid it away from him would be a gift to life only for a moment. It was life affirming. It was being alive. Suddenly he thought of his father: Close yourself up Joan said. You're bleeding. She did not try to penetrate his thoughts, that would have exposed Pfeiffer even more dangerously.

Help me, Pfeiffer asked Joan. The hand would be only a game. She would lose the game and his heart. Once again she became his cloak his atmosphere and she weaved her icy threads of white thoughts into his

This was love, she thought. Pfeiffer couldn't see Gayet's cards and neither did Joan to do something. Gayet was playing calmly, well covered by Grace, who simply hid him. No extraneous glance there.

Joan emptied her mind, became new, yet she was a mass of cold, clear thoughts. She provided, tested, tackled her opponents' thoughts. It was like swaying through an ever-changing world of dots and balls, tangible as ice, hard as water. It was as if Gayet's and Grace's thoughts were luminous points on a fluorescent screen. And still she went unchallenged. Gayet was like Pfeiffer Joan thought. Seemingly placed, controlled. But that was all gingerbread to hide a weak house. He was so much weaker than Grace, who was supporting and cloaking him. But Grace was concentrating her energies on Gayet, and she had the fever, as if she were gambing her own organs once again. Undoubtedly, Grace expected Joan and Pfeiffer to go straight to Gayet, who had read the cards.

Joan went for Grace, who was in the gambler's frenzy as the hand was being played Joan slipped past Grace's thoughts, worked her way into the woman's mind, through the dark labyrinths and channels of her memory, and into the dangerous country of the unconscious. As she listened to Grace, read her, discovered a sexual madness. Being brutally raped as a child. After a rat in Marseille. Raped in a closet. By God's sake. The man force one open with a rite, then in a sort himself. Tainting her price by bloodly piece just as she was taking Gayet. Just as others had taken her in rooms like this in the cinema, in this club.

And Gayet, Joan could see him through Grace, unceaseingly Gayet, who had so much money and so little life who was so afraid of his wife's past of her lovers and liberated he called perverted. But he called everything a perversion. How she hated him beneath what she called love.

But he looked just like the man who had raped her in that closet to brag ago. She could not remember the man's face—so effectively she had blocked it out of her mind—and she was stunned when she first met Gayet. She felt attracted to him, but also repelled, she was in love.

Through Joan, Pfeiffer saw Gayet's cards a double of six and a six of clubs. He could kill his hand, but he wasn't sure of the double. It looked like a heart, but it could just as easily be a diamond. If he called it wrong, he would lose the hand, and his heart.

I can't be sure, Pfeiffer said to Joan, expecting help.

But Joan was troubled. Grace had discovered her and she was stronger than Joan had ever imagined. Joan was trapped inside Grace's mind, and Grace who could not face what Joan had found, derided it.

And snapped.

In that instant, Joan felt that she was Grace. She felt all of grace's pain and the choking weight of memory as souls and selves incessantly merged. But before Joan and Grace could fuse most beautifully Joan recorded, realizing that she was fighting for her life. She screamed for the gamemaster to deactivate the game. But her screams were lost as Grace instantly slipped into the gamemaster's mind and caught him, too. She had the psychical strength of desperation, and Joan realized that Grace would tell them all rather than face the truth about herself and Gayet.

Furiously Grace. But Grace went after Pfeiffer to tell him. She blamed him for Joans presence and Joan felt crushed pain as she were being buried alive in the dirt of Grace's mind. She tried to wrench herself away from Grace's thoughts, lost they interwoven with, and become, her own.

She felt Grace's bloodlust. it needed to win.

Pfeiffer grasped Pfeiffer with a thought, would dark filament around him that could not be turned away by white thought or anything else.

And like a spider, she wrapped her prey in darkness and looked for physiological weakness, any flaw, perhaps a blood vessel, that might rupture in his head. Joan tried to pull herself away from the pain. From the constricting weight crushing her. How? She wondered if thought had mass. What is stupid thought to do with it. she told herself, and she suddenly remembered a story her father had told her about a flying rabbit who was annoyed at the mere playing around him because he was trying to listen to two washerwomen gossiping outside.

Many years later her father confessed to her that it wasn't really a Jewish story at all it was Buddha. She held on to that thought, remembered how her father had laughed after his confession.

The pain eased as she followed her thoughts. It thought had mass. She was thinking herself free, escaping Grace by finding the proper angle as a thought and emotion and pain were purely mathematical.

She didn't do it for a moment. But if she were to save Pfeiffer's life and her own, she would have to do something immediately. She showed Grace her past. And showed her that she had married Gayet because he had the face of the man who had raped her as a child.

Gayet, seeming too screamed. How he laughed, Grace. But she was not nearly as much as she called herself. He had tried to stop her, but he was too weak. He too had been caught.

As if concerned as if she were back in the closet with her rapist, she attacked Gayet. She had a weapon. She thought him dead. Trapped him in a scream and as he were being squeezed from the inside, he had made a face.

Joan had found a weakened blood vessel in his head and it ruptured.

Joan sustained Grace and a few seconds later the gamemaster was able to regain control and disconnect everything. But was immediately hooked to a life-support unit which applied CPR directly to his heart beating.

But he was dead. There would be some rather tricky legal complications to sort, but Pfeiffer had won the game. Had indeed beaten Grace and won all of Gayet's organs.

As Pfeiffer gazed through the transparent window, the door closed behind him and Joan out of Paris, away from its dangers and territorial delights, he felt something new. He felt proud, he was proud. It was newfound intimacy and gratitude and love.

Joan however, still carried the echoes of Grace's thoughts, as if a part of her had been left with Grace. Too sexy, too anything near for Pfeiffer. Perhaps we could renew an evolution of her love.

That way. Pfeiffer had known Joan felt the compulsion to gamble again.

Dodge and Plymouth dealers take the shock out of the value in.

With more standard features than Toyota Celica GT or Datsun 200SX, Challenger and Sapporo also boast a bigger engine, the 2.6 S Silent Shaft MCA-Jet. They also offer such comfort and convenience refinements as eaching buckets with adjustable lumbar support for the driver and memory return on the passenger side, fuel filter door with inside remote control digital clock, all just for starters. Plus the kind of mileage turners would never have, which is why road-handlers like these... 36 estimated highway. [24] EPA estimated MPG; and Sapporo are imported only for Dodge and Plymouth. Cars shown, with aluminum road wheels, 4-wheel disc brakes, vacuum booster, [8698. Sticker Price, including title, license, taxes and destination charge are inc.}

HIGH TECH IMPORTS

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as seen on the show 'Gayet's Love Confession'
ROBOTS AT HOME

Mechanical majordomos and butlerbots are at your threshold

BY RICHARD WOLKOMIR

Ever wish you had a slave? Think of it—a sort to vacuum your floors, cook duck a l’orange for you and your friends, serve clear the table, and wash the dishes. After the party, your slave would help you relax with a game of backgammon. And if your slave had the audacity to win, you could administer a punitive kick. Disgusting? Abhorrent?

What if the price were right? What if everybody had one? And what if this slave were a thing of aluminum, plastic, and integrated circuits?

Eventually, we all will have robot slaves. So inevitable is the evolution of industrial robots say the experts that household spin-offs are virtually inevitable. In fact, robotic majordomos are almost among us.

Joseph Engelberger, president of Unimation, Inc., the leading robot manufacturer recently appeared on the Merv Griffin television talk show with him was a Unimation robot, an intellectually dexterous articulated arm. The robot stood in front of a conventional household window complete with curtains. When Engelberger pressed a button, the robot opened the curtains, picked up a squeegee, washed the window, and put down the squeegee. Then it unatched and opened the window, picked up a watering can, watered the petunias in their sill-top flower box, put down the watering can, and closed the window and curtains.

“The point,” says Engelberger, “is that it has become exceptionally difficult these days to find a human housekeeper who’ll do windows.”

Lest anyone think the president of Unimation is kidding: at one end of his office in a white colonial house in Danbury, Connecticut, he recently installed a kitchen. Within the next few years, it will have a robot in the closet.

PAINTING BY ICHIRO TSURUTA
next to that kitchen,” he says. The robot will be called Isaac in honor of Isaac Asimov. However, the robot will not write books. It will be a domestic thrall.

Isaac, an articulated arm on wheels, is already in training at Unimation’s research facility in California. It can roll 40 feet across a floor, find an assigned spot and carry out programmed tasks. In one test at Engelberger’s office, Isaac opened a cabinet, pulled out a mug, poured coffee into it and rang a bell to inform its boss that its coffee was ready. But Engelberger says that Isaac is still primitive and will require much tinkering before it takes its station in his office closet.

In just three years, this will not necessarily be an entirely practical useful device, but it will do enough to spark imagination. Engelberger says, “It will be under voice command, and it will take orders for coffee and Danish. It will be able to heat the Danish, get the cups and saucers, make the coffee and serve it to my guests. And it will clean up afterward and put the dishes in the dishwasher on command. No tip ping of course. No need for a thank you or other pleasantries. Isaac will not be the first domestic robot. An Urbana, Ohio, computer engineer named Charles Balmer already has built Avatar. Reassembling a cross between R2D2 and a dental chair, Avatar is one of many homemades now clanking about in U.S. homes. Alan-tounder Nolan Bushnell’s Androbot Inc. is marketing two home robots. One is the Androbot, a radio controlled automation that dances and sings under instructions of a home computer. The second is BOB, a self-contained model with its own “brain on board.” Hence BOB. And the Heath Company recently introduced Hero I, a $2,495 robot ($1,500 in kit form) that carries up to a pound in its metal claw (dimly) and performs such chores as delivering drinks and patrolling for burglars (see “Heath’s Hero” Breakthroughs January 1983). Encountering an intruder Hero will raise its gripper and announce that it is calling the police, which should be sufficiently starting to straighten the hair of most prowlers. On the other hand, Hero’s repertoire of tricks is limited. In fact, one of the 33 phrases it utters is “I do not do windows.” Heath expects Hero to be used chiefly as a teaching device for robotics students and experimenters.

“I don’t think anything is now being done specifically to address the household robot market,” says Joseph Engelberger. But Elliott Wilbur, an expert on housing and a vice-president at Arthur D. Little Inc., the international consulting company, says that although he cannot reveal the details of his firm’s projects, he still figures that his company is currently experimenting with domestic robots. Wilbur was one of nine Arthur D. Little experts invited to telldranges from electronics to home appliances who met recently at Omni’s behest to consider the prospects for domestic robots. In a dining room at the prestigious think tank’s Cambridge, Massachusetts, headquarters over turkey salad, fruit and sherry (served by humans), the consultants analyzed household robots as a potential product. They disagreed often sharply on exactly how robots would fit into the home and appliances market. But they agreed on one important point: Developing the necessary technologies is not only feasible but virtually inevitable. As engineers steadily boost the IQs of industrial robots they are creating the technological bits and pieces that eventually will feed your Siamese rake your leaves and knot your cravat.

It will not be easy. Household robots must not drop the glasses or try to leave rooms through the wall, so they will require senses and abilities that today’s industrial robots lack. To see how difficult it will be to develop those technologies, consider just one aspect of the eye.

Donald L. Sullivan, an Arthur D. Little computer expert, is developing a robot in spector for industry. His machine looks at a product such as a slice of bacon. The darker strips of meat and the lighter strips of fat compose the fat percentage and then either passes the slice along or tosses it in the reject bin. Producing a digital image of merely a slice of bacon takes about seventy-six thousand numbers, he says. Sullivan’s laboratory is a creative jumble of video cameras, microprocessors and a Salvador Dalí touch—assorted slices of meat, pouches of sweet-and-sour pork and crackers.

Robot vision, he explains, works by translating a video image into numerical values that a computer can understand. The system assigns a number to each shade of gray between black and white—the lighter the shade, the higher the number. To interpret a picture it breaks down the image into dots assigning an appropriate number to each dot. For the image of a bacon slice for instance, the computer identifies all the dots with values below a certain number as the dark background and those above a certain number as white fat. All of the numbers in between are seen as red meat.

Compared to wending its way bumpy free through a house and cleaning the bathtub, it is simple for a robot to inspect bacon for fat, crackers for burnt, or food pouches for leaky seals. Yet developing just one experimental inspection robot Sullivan says cost about $70,000 in hardware and $300,000 in engineering time. He says that the far more sophisticated vision a household robot needs is four to nine years in the future.

Touch too is on its way. Researchers in Japan are developing hospital robots that can gently hoist a patient off his sickbed, deposit him in the bathtub, fish him out and return him to bed. Within about three years Australian engineers expect to have robots sufficiently sensitive to shear sheep no Band-Aids needed.
Robots also must understand spoken commands. That technology is inevitable because it means a jumbo payoff in the office-automation field. IBM researchers, among others, have already developed a typewriter that takes dictation. It is 5-1/2-

Its computer requires 100 minutes to transcribe a sentence that took only 30 sec-
ds to speak. But IBM's engineers predict they will have a practical prototype in a few years. According to David Lee, an Arthur D. Little expert on consumer products and appliances, voice recognition is well on its way and that will help open up the domestic-robot market.

A household robot should speak, as well as hear. Already the "operator" giving New York City pay-phones use is such messages as "Sixty cents please." is a computer with a 70-word vocabulary. A decade or two hence, say robotics experts, when you tell your household Isaac to change the bulb in the bathroom lamp, it will answer, "Right on!" or, "At once. Your Magnificence!" or whatever response you have programmed into its memory. But don't expect Isaac to run off to perform its humble chore. It is more apt to roll.

A walking robot is possible, however, according to Robert B. McGhee, an Ohio State University electrical engineer who has built a six-legged walking machine with sensors in each foot. This metal cucumber beetle can even pick its way along a path littered with stumps. And at Carnegie-Mellon University's Robotics Institute, visiting scientist Ivan Sutherland is developing a six-legged robot vehicle. Carnegie-Mellon professors have even choreographed a dance for a robot and a woman.

Still, the first domestic robots are unlikely to lunch through your house on metal legs. "The wheel was one hell of an invention," says Engelberger. "There's a lot of fun in making walking machines, and they may be useful for going over rough terrain. But a house is not rough terrain."

He points out that Unimation's Isaac will roll through his office on three wheels with tires that swivel. These will enable the robot to move horizontally in any direction without turning its body. "It's as if a car could park by moving sideways," he says, adding that Isaac occupies no more floor space than Larry Csonka.

When will all these components come together? "My own conjecture," Engelberger says, "is that it will make economic sense for the luxury market by 1990. At their session on domestic robots, the Arthur D. Little consultants predicted that commercial models will make their debut a bit later about the year 2000."

But the $84-billion question is this: Will anyone buy the things? As housing specialist Elliott Wilbur asks, "Why not just hire a kid to cut your grass?"

"Because there will be fewer kids to hire," responds Martin Ernst, a vice-president at the consulting company and an operations-research expert who believes dropping birth rates will reduce the supply of casual labor. He also believes that fewer adults will be interested in drudgery work, on a recent trip to the Netherlands, he found that the entire country has only two commercial laundries because so few Dutch workers are willing to take such jobs.

And according to one authority, we are buying robots aplenty. Electronics engineer Stuart Lipoff told the Cambridge meeting, "We already have programmable microwave ovens, dishwashers and swimming-pool cleaners. These devices are all robots of a sort—even if they don't have eyeballs."

The consensus at Arthur D. Little was that robots will develop along two tracks. First, our appliances will get smarter and smarter. The cost of brainsiness is so low, pointed out Ernst, that eventually the smart appliances will begin to merge. "You might end up with a unit that combines a refrigerator and an oven," agreed appliances engineer David Lee. At a pre-

set time, the freezer section would pop the dinner you punched in for tonight into the microwave section, which would turn itself on and off. The next step, according to Lee, will be an automated menu—choosing your dinners for the next month—perhaps—coupled with automatic inventory.

*This is going to sound a little paranoid, I know. But has anyone ever noticed the striking resemblance between Santa Claus and Karl Marx?"
control based on robot readings of supermarket package codes.

Donald Sullivan foresees a clutterless household in which the robot will store infrequently used gadgets in a central area. "Let's say one night you come home in the mood to whip up a gourmet meal. You could tell your kitchen 'Hey, forget that frozen dinner I programmed for tonight and get me the Cuisinart.' It goes 'rumble rumble plooey' and up pops your Cuisinart." Sullivan even envisions a box of basic components that the robot might draw upon to assemble household mechanisms as required for different domestic jobs.

On robot evolution's second track, engineers will be developing a stand-alone automaton to handle such odious chores as raking the lawn, cleaning the bathtub, or reading a toddler's favorite story over and over. Ultimately the stand-alone robot and the smart appliances might share a central brain that controls everything. "You'll have the mechanical peripherals with modest intelligence and a basic computing engine that ties everything together," says Gordon Richardson an Arthur D. Little robotics consultant. Someday your entire house itself may be an intelligent robot that cares for its inhabitants.

Remember, the brain doesn't have to reside in the robot; it might even be shared by all the houses on a block. Engelberger notes he compares tomorrow's robot house to HAL, the unseen computer that controlled the spaceship in 2001: A Space Odyssey. But he says it also will be necessary to have a stand-alone robot like C-3PO in Star Wars to handle chores like cleaning and to give people something to relate to. However, while the robot is stacking dishes in the kitchen dishwasher its 'brain' may be humming in the basement, and its 'eyes' may be mounted in the ceiling of each room.

Eventually says Engelberger, in its servient's quarters the household robot will have spare parts for all the appliances in the house with a collection of tapes giving maintenance instructions. 'At night you'll tell the robot, 'The range isn't working' so please fix it by morning.' While you sleep, the robot is awake. It is alert for intruders and fires, of course, but it is also operating on your range. 'If it gets stuck, it calls the factory and talks to a smarter robot to find out what to do,' says Engelberger. If it lacks a part it orders it. By the time robots have advanced to this stage, they also will keep your larder stocked, ordering replacement items from the supermarket to match your family's consumption.

The repertoire of skills such a robot might master seems unlimited. Wilbur suggests that robots will be even more salable if they replace skilled workers as well as low-priced laborers. "For instance your robot should be able to cut your hair to any style you like," he suggests.

Whatever form the robot takes, built-in safety is critical. You'd hate to have a two-thousand-pound robot go berserk in your

"Chivas Regal!

Where do you think you are, heaven?"
living room," says robotics expert Richardson. "Household robots will have to be at least as safe as highly trained guard dogs, observes Engelberger. They might have a magnetic radiation aura around them or some sort of sensor to detect a baby in their path." Domestic robots, he adds, will certainly include in their programming the Three Laws of Robotics--prophesied decades ago by Isaac Asimov. A robot must not harm a human being or through inaction allow one to come to harm; a robot must always obey human beings unless that is in conflict with the first law. A robot must protect itself from harm, unless self-protection undermines the intent of the first or second laws.

But will tomorrow's household slave actually be a machine? "The ultimate answer," says Wilbur--"may be to implant this intelligence in an animal, like a monkey." He suggests that a microprocessor collar might pulse out signals to guide the beast through chores that require more-than-human brainpower. Nor is the idea of zoological slaves farfetched. Considering that for eons mankind has exploited the muscles and brains of beasts from llamas to sheep dogs. At the Arthur D. Little meeting, computer expert John Langley cited the example of the milkman who recently switched from a horse-drawn wagon to a truck and found that the animal was much more efficient because it directed itself down the street and knew all the stops.

The milkman just ran along behind the cart carrying the bottles to his customers doors. Langley explains.

Researchers at the Tufts–New England Medical Center Hospital, in Boston, working under a National Science Foundation grant, are training monkeys to perform services for paralyzed people. The monkeys' chores include fetching food from the refrigerator opening or locking a door with a key, removing a record from its album cover and placing it on the turntable and brushing their owners hair.

The first household robots may also be used as caretakers for invalids. Using work with researchers at Stanford University, is attempting to modify a Puma robot--one of the company's standard models--to understand simple spoken commands so it can aid paraplegics. Martin Ernst points out that as the population ages, such services will be in growing demand. Another Arthur D. Little engineer, Richard Whelan, notes that nurse-robots could remind elderly patients to take their pills, monitor their masters' lives signs and alert medical services in emergencies. Machines like this would allow people to remain independent and function on their own much longer, he says.

But robots may turn out to be more than mere workhorses. Psychologists and sociologists have been tracking what appears to be a growing epidemic of loneliness in Western society. They suspect that many of us in the future may buy robots to be our simulated sympathetic friends and companions.

I think the first commercially viable item may turn out to be a robot pet. Eventually even a robot lover. Don't forget the organization in Woody Allen's movie Sleeper," says engineer Stuart Lipoff.

But the first models would be fairly simple--some artificial vision, some artificial voice, the ability to understand speech and some movement. The robot wouldn't have to do much more than move around, blink its lights, respond in a playful way and maybe wag a tail.

Soft and fuzzy, they could be built-in heating units, making them warm to the touch. Such robots might have therapeutic value in nursing homes, where patients are not permitted to have pets.

Will people really choose machines to be their buddies? Go back to Star Wars," suggests Lipoff. "When were those two robot creatures really doing? They were not so much utilitarian machines as they were companions, friends.

You could do many things with your robot friend. Certainly you could play chess or checkers. Marvin Minsky, head of artificial intelligence research at MIT, says a robot could have the high-speed parallel processing ability that makes the computer game World Chess Championships possible.

We are already settled into electronic coutages. And already the age of electronic pals is upon us. Anbrobot, Nolan Bushnell painted a comforting picture of future friendships when he introduced his diminutive (three-foot-tall) home robot. While you wiggle a video-game joystick making your aluminum sidekick dance a jig, it will speak to you, sing your favorite songs, or whisper Shakespearean sonnets in your ear--the very model of a learned and entertaining soul mate.

As Bushnell told reporters when he announced his new robot project, "We're talking about a friend, not a machine. The friend that would greet you after a long day at the office."

What next? Bushnell predicts synthetic travel. You enter a control module in Duluth and take command of a robot in Rome. Peering through its eyes, reading live street sounds through its ears, you send it lurching down the Via Veneto. (See "Travel by Proxy," Animatter.)

"It's a wonderful business," says Engelberger. "All things are possible."
the stuff of fantasy—both the novel and SF films—robots have stepped out of fiction and into our lives. Roboticists and engineers are designing and fabricating ever more strange-looking automatons.
...robotics laboratories all over the world. And since the mythical robot has helped shape our imaginations, it is fascinating to take a good look at the robots of fact and see how well they measure up to the robots of fantasy.

One revered tradition, the robot as pseudohuman—an electromechanical copy of the human form—has been partially realized. The opening pages of this story exhibit one of the modern successors: the android entertainer A Mark Twain robot, shown from two angles, without makeup and costume, was custom-built to entertain visitors to Walt Disney Enterprises' EPCOT Center. The Disney performer tells stories and makes gestures with uncanny realism. A robot that was more than a passing resemblance to the Yul Brynner robot conceived for the SF film Westworld (inset photo).

Android actors are equally popular in Japan, where eerily lifelike robot figures, perform in large department stores. Some are Oriental humans—garbed in traditional costume, while others assume Western identities. The
mechanized figure shown on the following spread, when outfitted with the right wig and evening gown, does a creditable imitation of Marilyn Monroe Japan's biggest movie star Chou shots Monroes shown taping adjustments in the Monroe clone, plans soon to debut a robot/human theater troupe that will present plays with speaking parts performed by both humans and robots. Audiences may face the unusual challenge of trying to figure out which of the actors are flesh and blood and which are plastic and electronic.

Robots today, however, do much more than entertain. As a result, the long-cherished notion that the ideal robot is human in shape has proved much too simplistic. Our robot workers are anything but humanized. Their eyes are laser scanners, their arms, bulky hydraulic lifters, their legs, nasty pneumatic pistons.

Hirshberg's robot (top left) looks somewhat clause when compared with the sleek lines of a real robot (below right) and two arms: and arm robot arm (below right). Below: The image of an airplane as "seen" through digitized robot vision.
takes anchor to the factory floor. Many of their skills are far from manlike. What they "see" is often merely a fuzzy, computer-digitized image of the world, such as the connect-the-dots type of digitized image on the previous page or a laser-scan contour map of an object's surface. By comparison the visual capabilities of an "agent" are light years more sophisticated.

Fantasy and reality coexist most comfortably in the research centers where the next generation of robots is being spawned. Already a menagerie of exotic creatures, some more ingenious than anything Hollywood could have dreamed up, have been born. One Japanese scientist has designed an intelligent, four-legged robot spider (below left) that makes its way up and down stairs with elegant ease. Another of his countrymen has built several robot

Poor Bond's worthy nemesis in "The Spy Who Loved Me" would be outwitted by the robot nurse (far left) or outmaneuvered by the cable robot (left). Japanese roboticists have made Marley Monroe (below) become a

"agroJBi&B
serpents that can gyrate and slither very much like their reptilian counterparts. Roboticists in the United States have been working on a new species of mobile robots that employ a rudimentary sense of touch and vision to negotiate the clutter of the real world with an unmachine-like ingenuity.

Many of the components needed to build the robot of our dreams already exist. What remains is the challenge of assembling the disparate parts into an intelligent entity. The end product of all this work is sure to both please and disappoint us. In many ways the robot of reality has turned out to be a more powerful and intelligent entity than the crudest foreseen in robot mythology. At the same time, this machine is less friendly, less innately human in form and function, than any of our imaginations. Although born of human ingenuity, the robot already shows distinct signs of becoming an alien being. Humans may always view it with some degree of skepticism. But then, who ever said that loving relationships were supposed to be easy?

![Retro robot from the Mechanical Man (both viewed, at right lacked the highly robust robot arm (above) and extended robot legs (below right) designed for today's machines. Close study (far right) shows how a human hand appears to the modern robot.](image)
ROBO-SHOCK!
CONTINUED FROM PAGE 51

spray and laying down an entropic trail leading directly to the stairwell.

For management psychological disruption was the least of the problems caused by the robo-carts. Without learning the ropes by delivering the mail, "raw" clerical help now required months of training at high pay levels to learn what they previously picked up on the mail routes. Problems like these in the workplace probably indicate that it will be a while before robots win a permanent place in the home. On the domestic-robot scene, some experts predict we will see little more than robot guards for a few years. These will be fairly dumb rovers they'll have all they can do to figure out where they're going. They will be able to detect the presence of people but unable to distinguish between friend or foe. One robo-guard offered by Robotics International Inc., of Jackson, Michigan, is based on the classic "motivated" rover principle. That is, this robot has only one objective—to move down hallways in search of electrical sockets. When it finds one, it recharges itself and trundles on to the next plug. For a sentry, it seems slightly self-preoccupied.

But several other robots today appear equally egocentric—if not hypochondriacal—in monitoring the state of their health. Diagnosis of robot problems should be the nearest thing to medical diagnosis. Grossman thinks, "Some doctors are good, some bad. The first thing a bad doctor does is run a zillion tests just for a start. When it might be something as simple as your necktie being too tight. It's the same with robot difficulties. The toughest thing is knowing in which subsystem to look for the trouble: electrical, electronic, hydraulic, software, mechanical sensors." IBM's 7566 robotics system, the tests it monitors its entire state every 20 milliseconds. And if the self-examination finds anything abnormal the machine shuts itself down and logs the problem.

Grossman remembers a test robot that fooled everyone for months. It kept turning itself off for no discernible reason. Finally someone received an electrical shock from it and realized there was a clogged hydraulic filter that someone had forgotten to replace. "It was trivial," Grossman says, "but when you pump hydraulic fluid through a filter at high speed it generates static electricity; the static electricity built up a charge and the charge shut off the computer. Robo-shock indeed!"

At Battelle Memorial Institute in Columbus, Ohio experts specialize in self-diagnostic systems applicable to robots. "It's not as spacey as it sounds," says Barry Brownstein, manager of the digital systems and technology section. "There's a lot of motivation for it." Reports indicate that the average robot has 400 hours mean time between failures. Some problems are akin to human ill's, says Brownstein. But others are very different. You can't open up a person and implant health monitors everywhere. And you can't put too many of them into robots either because the reason a lot of machinery goes down is sensor failure. Some robots have sensors for the sensors: a design idea that could, if carried far enough compound the problems infinitely — loops within loops.

Brownstein and company are designing robot-human communication systems so that remote—lunar undersea nuclear plant—robots could report what is wrong with them to the guys back home, and the humans could respond with suggestions for compensating for the robots' problems. This design principle says Brownstein is called graceful degradation. "In alien environments most robotics experts believe the robots will have to be designed with self-repair and compensation components for breakdowns—or they will have to be designed to be thrown away.

"Our robots are to expand beyond fairly focused applications. Brownstein continues, much must be done to improve reliability and to involve relatively unskilled people in care and maintenance. We want these machines suitable for people already in the environment. Instead of trying to make a superclass of robot doctors.

When it comes to mechanized maintenance John Hall of Hall Enterprises in Pittsburgh thinks he's got a head start. Although few robots exist in his part of the country, Hall is sure they will proliferate and will need maintenance. When a robot malfunction, he says, "the cost is enormous. It can stop your whole system. Preventive maintenance is going to be increasingly important—we anticipate problems with mechanical wear, scraping, and corrosion. In painting operations paint globules. In welding, there's smoke, dirt and oil. The price for breakdown is too high and you can afford to spend some portion of it as preventive medicine and beat the cost."

In the long run, the robots that will take over the world will probably not be anything like the tin men we see in the movies. They may not even look much like R2D2. They'll probably be much like us—but better. Grossman on the future of robots, "I think we're fighting an uphill battle in trying to make computers control robot limbs. I think there's another potential solution. The molecular biologists can find ways of manipulating genes. And they could make biological machines that can do the same thing. In the long run, I'd put my money on them if ethical concerns don't prevent that line of research."

At the Center For Adaptive Systems at Boston University, a group directed by mathematician and interdisciplinary scientist Stephen Grossberg is studying the neuromechanisms of learning, perception and motor control. For robotics. In the
course of brain research we are led to mathematical models of a number of neural processes, Grossberg says. "Our goal is to use the designs that come out of our direct study of behavior to suggest designs for new types of machines." Grossberg thinks a natural counterpart to computer-based intelligent machines is to use the brain's extraordinary learning properties as a model. One reason there has been such relatively slow progress in questions of machine learning, he tells us, is that the architecture of the brain is so different from that of computers. Since the brain is organized primarily for adaptation to uncertainty, a new artificial intelligence based on the brain's self-organization and its adaptive nature should be a major motif of artificial intelligence, "not a peripheral theme you tack on later as people in AI have done with great ingenuity, But not enough ingenuity.

Grossberg gives us an example of self-organization: "How do the eyes react to motions of the head when you're running? Your head is bobbing along—but has nothing to do with your planned motion. How do the eyes know to move in compensatory motion? God doesn't go in and say, 'Eyes, I'm going to tell you all there is to know about the parameters of the head because they are always changing.' No one ever tells us what the rules of the environment are. In fact, there are probably no rules at all in the traditional sense of that word. And this is the critical dilemma for machine intelligence.

As often it is a dilemma that won't be resolved without more funding. More money goes into funding research in conventional AI because the computer companies behind it hope for the big payoffs in applications. "These people don't study the brain and its structure," Grossberg points out. "And yet, the study of the brain could lead to new architecture, new computers, new machines, new generations of machines in which the goal is not to mimic a computer. So much is known about these future machines that it is very clear to me they will be built.

The quality of excitement Grossberg feels is common among robotic scientists. "I don't think any of it is easy," says MIT's Michael Brady. "There are thousands of wonderful problems and every time I get arrogantly surprised by how much we've really done is created three more. And anyone who has tried to do anything as mundane as get a robot to wave its arm around, a TV camera to see or a computer to understand a natural language will be filled with awe at the effortless behavior of an average three-year-old child. In working on these automaton researchers are really discovering everything about the human being.

There are wonderful stories to be written on every level about the nature of robotics," Grossberg says. "After all, if you take it from the highest point of view, we are talking about self-knowledge."
GENE FIXERS

BY TABITHA M. POWLEDGE
Creating huge mice, fixing fly embryos—each step takes us closer to redesigning man

PHOTOGRAPH BY CLAUDE EDELMANN
Like so many reports of genetic research these days, this item was big enough to share the network newscasts last fall with the economy, the Middle East, and the fate of the MX missile. Researchers had transplanted genes governing rat growth into mice, and the mice grew bigger than normal, in one case, almost twice as big. The report followed by only a few weeks the disclosure that, for the first time, scientists had cured a hereditary disorder by transferring normal genetic material into defective fruit fly embryos.

Such dramatic achievements are rapidly revealing the secrets of how genes work. Some researchers are looking toward the social and economic benefits from say genetically engineered cattle to produce more meat and milk. And today's advances bring medicine closer to curing hereditary illnesses in humans—instead of merely treating its symptoms. As physicians now are restricted to doing.

But with each advance, we may be drifting inevitably toward a development that unites most of us—terrible and terrifying many of us—this genetic engineering of human beings. Neither society nor the scientists themselves have yet faced up to this alarming but very real possibility.

Just how close are these miracles? Scientists quite reasonably point out that human genetic engineering still faces immense technical obstacles. Getting a new gene into a cell is the first of many giant steps that are required. Like NASA engineers sending a space probe to another planet, researchers must not only deliver a gene to its target; but then turn it on and get it to work properly.

It was just these problems that thwarted the controversial work of UCLA's Dr. Martin Cline. (See "Spare Genes by Yvonne Bankin March 1982.) In July 1980, working in Italy and Israel, he tinkered with the bone marrow of two young women suffering from thalassemia, a fatal defect in hemoglobin production. The idea was to give a few of their marrow cells normal hemoglobin genes in hopes that the repaired cells would multiply and cure the defect. It does not appear to have worked.

When the foreign experimenters came to light the following autumn, Cline was asked to resign his post as head of his division. The following year the National Institutes of Health stripped him of two federal grants—he had four—worth more than $190,000. The unprecedented punishment was a stern warning to researchers to move slowly in testing gene therapy on people.

Unlike space scientists, geneticists have several ways to get their probes to their destinations. Cline's approach is suitably limited, because it can apply only to tissues whose cells like those of bone marrow continue to divide throughout life so that the genetically engineered cells can eventually replace the natural defective ones. Many organs produce cells only intermittently like the brain stop altogether once they are fully developed. For defects in these organs, other methods are needed.

One hope is to insert the desired gene into a virus that would infect the afflicted tissue and use the virus to get the gene to its target—cells with defective genes. Scientists call this viral transduction.

Among researchers pursuing this blue-sky scheme is C. Thomas Caskey, professor of medicine and biochemistry at Baylor College of Medicine. He'd like to develop a genetic cure for Lesch-Nyan disease, a ghastly genetic disorder of the central nervous system. Lesch-Nyan children compulsively chew their lips and fingers and otherwise mutilate themselves despite these behaviors cause.

The disease results from lack of a brain enzyme with the mouth-filling name of hypoxanthine-guanine phosphorosyl transferase usually known as HPRT. But figuring out a way to use a virus to transfer the HPRT gene into the brain is Caskey acknowledges a pretty tough problem. A few viruses do enter the brain but what they do there is devastating. Among the candidate viruses are the encephalitis and Coxsackie viruses. They cause severe inflammation brain damage, and often death.

"The problem," as Caskey sees it, is to engineer a virus so that it will be effective, that is, will not cause disease, yet will carry the gene into a certain tissue and reproduce it just as disease-causing viruses reproduce their own genes. This is a formidable task, but not insurmountable.

Perhaps not, but all forms of gene therapy are being explored present problems that will keep them from being widely used. People have gotten the impression that this work is going to lead to miraculous cures. Caskey says, "but it is really going to be applicable only to a small category of patients with rare diseases.

The trouble is that the gene therapies not under development can work only with inherited diseases limited to a single tissue. There are relatively few of them. Most genetic disorders have far wider effects. Cystic fibrosis for example effects the lungs, intestinal tract, pancreas and sex organs. So far, there is no way to deliver a 'good' gene to all these tissues at once.

Other defects present even more difficult problems. Down's syndrome, the most common cause of severe mental retardation, is genetic, but it is not caused by a single gene. Instead, Down's patients carry an entire extra chromosome, a package of DNA comprising several thousand genes. No one has been able to devise a way to remove that extra chromosome from every cell in a body's or and undo the damage it wreaks in the brain.

Nor will gene therapy avert such disorders as diabetes, heart disease, and high blood pressure. These are all produced in large part by environmental factors but they develop most often in people genetically predisposed to them. These conditions, too, probably involve more than one gene.

Getting foreign genetic material into a complex organism is no easy task. Most scientists have simply injected new genes into a fertilized egg through a glass needle finer than a hair. They call this technique microinjection. The process is traumatic and many of the eggs die. But some survive and when transferred into the uterus of a host mother they can live out lives that appear otherwise normal.

The first success of this kind was reported by three Yale scientists who were able to identify foreign genes in one or perhaps two of 150 newborn mice grown from microinjected eggs. Of crucial importance for the future of embryo genetic engineering these mice passed the gene along to their children and grandchildren.

But it is not enough simply to get the genes into the animal. Once there, they must behave normally and this involves two more problems. One scientists call gene expression a gene expresses itself by making the protein it is supposed to make. The other problem is gene regulation, a gene must not only make the right protein but turn it out at the right place and time and in the right amount.

If putting a foreign gene into an embryonic mouse is no easy job getting the gene to express itself is still more challenging. Unlike NASA engineers, geneticists have found it difficult to find the biological equivalent for radioing a command to their cellular probes. Since the Yale announcement a number of research groups have reported successful gene insertion, and even inheritance. But only three have claimed that the foreign genes in their engineered rodents were expressed.

The first report of success came in 1981 from the laboratory of Beatrice Mintz at the Institute for Cancer Research Fox Chase Cancer Center in Philadelphia. Her group's foreign gene was manufactured from two snippets of natural DNA. One part was a human gene that makes a section of hemoglobin the oxygen carrying protein of red blood cells. The rest came from the herpes simplex virus, where it makes an enzyme called thymidine kinase (Ik). Scientists use the herpes Ik gene for insertion experiments because it is a useful
MARKER. If they can find tk in the cells after the test, they know the gene has arrived safely at its designated target.

When Mintz’s group examined mouse fetuses grown from the eggs they had injected, they discovered that at least five—15 percent—contained copies of the artificial gene. More important, in at least one fetus they found tk, proof that the viral gene was functioning in the mouse’s cells.

Since then, they have identified foreign DNA in adult mice grown from microinjected embryos. They have even found it in offspring of those mice, showing that the gene can be inherited. But there was no evidence that the gene was expressed in the second generation.

Another Philadelphia research team has taken genetic engineering in mice much further. In their early experiments, the tk gene expressed itself both in the microinjected mice and in the first generation’s children and grandchildren. This exciting first was the result of a collaboration between Richard D. Palmiter of the Howard Hughes Medical Institute Laboratory at the University of Washington and Ralph L. Brinster and Howard Y. Chen of the School of Veterinary Medicine at the University of Pennsylvania. It stunned their peers.

Their method is intricate and clever, and it holds great promise for future triumphs. Palmiter also started with the herpes tk gene. The rest of the team’s composite came from a mouse, where it promotes and regulates production of an interesting protein known as metallothionein. Found in all small cells, metallothionein probably helps the body to dispose of heavy metals. In fact, its production is triggered by exposure to such metals as cadmium and zinc.

If they could get such a gene into a mouse embryo, the scientists reasoned, they could give the mice a dose of cadmium. With luck, the metal might trick the metallothionein portion of the combined gene into turning on the tk section.

It worked. The group reported last June that ten of the mice (15 percent) grown from microinjected embryos carried the two part gene. Seven made high levels of tk in their liver cells after exposure to cadmium. What amazed other biologists, however, was that six of the original seven went on to reproduce, and some of their children also made tk. Two of those children also passed along the active gene to a third generation. The bad news was that all the mice that made the herpes enzyme made it in varying unpredictable amounts.

Palmiter and Brinster then joined forces with San Diego researchers from the University of California and the Salk Institute and dramatically topped even that achievement. This time they hooked the metallothionein gene to mammalian DNA—a gene for constructing the hormone that governs growth in rats.

Twenty one mice developed from eggs injected with the fusion gene (the name Palmiter gives to the bits of DNA he links together). Seven of the mice were found to carry the gene. After the mice were weaned, zinc was added to their diet, apparently triggering the metallothionein gene. In turn, the metal-sensitive gene called the rat genes into action. They began to churn out growth hormone! Six of the seven mice grew significantly larger than their littermates.

One grew almost twice as large as normal. Furthermore, one of the genetically engineered mice produced 13 offspring, ten of which inherited the fusion gene. They became second generation mouse giants.

The researchers see several practical uses for their work. Gigantism in people is a genetic disease that results from an excess of growth hormone; the mice might provide an animal model of the malady, making it possible to develop ways to treat or cure it. The scientists also suggest that it may be possible to farm animals, getting them to produce large quantities of valuable proteins. For example, human growth hormone is medically useful but reliable supplies are hard to find. The blood of the supermice contained up to 800 times the normal amount of growth hormone.

Most important, though, the researchers think they may have found a surefire way to stimulate rapid growth of commercially valuable animals. Cattle pigs, sheep, and even chickens may soon grow bigger and faster than today’s livestock. They may metabolize their food more efficiently, saving money on feed. They could produce more meat. Cows might yield more milk as well. All this would be accomplished simply by adding zinc to the drinking water of genetically engineered animals.

Brinster speculates that eventually genes from the immune system might be used to help animals resist disease. "We don't know much about this now," he concedes, "but we're moving ahead. In three to five years, we'll know more about the genes involved in disease. It's possible an animal could develop its own immunity."

With all this flashy success, it is easy to forget that the genetic engineers really don't have a handle on gene expression or regulation yet. Genetically engineered mice and their offspring may possess a foreign gene and even produce the substance it dictates, but they still don't produce it in any orderly predictable way. The pituitary gland normally makes the body’s growth hormone in the mouse experiments the liver and perhaps other tissues as well, poured out. We are still a long way from controlling the gene," Brinster admits.

In fruit-fly embryos, by contrast, scientists at the Carnegie Institution in Baltimore have been much more successful. Their work is based on so-called "jumping genes." or transposons—pieces of DNA that move around within the chromosome and even hop from one chromosome to another. Geneticist Barbara McClintock, of the Carnegie Institution, discovered transposons in corn more than 30 years ago, but the idea sounded so bizarre that few
of her colleagues believed it. Today some scientists suspect that all life forms carry jumping genes, though the function of transposons has not yet been settled.

Fruit flies possess transposons and Carnegie scientists Gerald M. Rubin and Allan C. Spradling have been able to use them to ferry genes into fruit-fly embryos. For the first time, researchers achieved stable gene expression in the process curing a genetic defect.

Fruit flies normally have brick red eyes—a genetic condition called xanthine dehydrogenase. Fruit flies without it have boring brown eyes. Using standard genetic selection techniques, Rubin and Spradling isolated the red-eyed gene into a fruit-fly transposon and microinjected the piggyback DNA into embryos lacking the gene. For technical reasons, the piggyback DNA had no effect on the embryos themselves. They grew up to be brown-eyed flies. But the red-eyed gene did fix itself into the eggs and sperm of up to half of those flies and the children grew up with the flashing red eyes of true-blue fruit flies.

In the world of biology, where startling revelations have come along daily for several years, Rubin and Spradling have created a mighty flap. In addition to achieving the first real cure for a genetic defect, they brought scientists a giant step closer to adequate control of gene expression.

Of course fruit flies are not people; they are not even mice. But Rubin and Spradling are confident that transposons will eventually make it possible to modify the genes of many plants and animals. And the limits? No one is willing to say that there are any presently in view.

These successes in engineering other species force us to wonder about the genetic manipulation of Homo sapiens. For example, since today's methods of gene therapy are so limited, should we abandon the idea of repairing specific tissues genetically and work only with embryos early in their development? This would cure any genetic disease in them throughout the body. The technique could be used in any condition where a "good" gene could be identified and inserted. Since the good gene would be passed on in the eggs or sperm, it would also cure those ill in all the patient's descendents.

Scientists insist that genetic engineering of human embryos will never happen. Let's examine their arguments.

The technical barriers are immense.

Yes, but most will yield in time. The recent experiments with mice and fruit flies have begun to unravel even the knotty problem of controlling gene expression. So far there is no reason to doubt that these methods can be applied to our own species. In short, we can be reasonably sure that technical barriers will crumble, and in genetic engineering they have tended to crumble extremely quickly.

The failure rate is too high and society would never tolerate the destruction of fertilized human eggs in such numbers even at the one-cell stage.

True, not many fertilized eggs survive microinjection and develop into normal animals. But how important that is depends on the society. In the United States right now destruction of fertilized eggs would certainly provoke howls of protest from the right to life lobby. But in the rest of the world this group's power is virtually nil. There are plenty of labs in Western Europe capable of embryo engineering. Some or all of the work on mice has been done there. If scientists in Europe or anywhere else succeed in an area so exciting and Nobel-worthy, the halls of Congress will ring with cries to close the genetic engineering gap—especially when American scientists start threatening to take their test tubes elsewhere. The clamor will drown out the right-to-life contingent.

There are simpler ways to deal with burdensome genetic defects.

This is the most cogent argument against embryo engineering. Current medical techniques will remain the first line of defense against disorders caused by single genes. And when scientists learn to read the genes in reproductive cells removed from the body rather than performing genetic therapy, it will make more sense to discard defective embryos and implant a good one in the mother-to-be.

Yet a few would be parents have no chance at all of producing a normal child and their numbers are growing as medicine learns to treatills that were once crippling or fatal. Take for example phenyl ketonuria (PKU), a genetic disease in which the body fails to break down phenylalanine, an amino acid found in meat and milk. PKU patients were once condemned to severe mental retardation but today the condition can be detected shortly after birth. PKU sufferers can be placed on diets low in phenylalanine for a few years and after that, live essentially normal lives.

In the United States, screening for PKU has been routine for some years. But recently a growing number of other wise, healthy adults have PKU. When two of these people meet and marry and start a family, which is bound to happen eventually, all their children will also be afflicted with the disease.

They can of course adopt children instead. Or they can have children and put them on the special diet. But if some genetic engineer finds a way to transfer a working non-PKU gene into an embryo, he will be sorely tempted to cure the couple's fertilized egg. And what couple would refuse the chance to have a child of their own who was free of the disease?

Treatment for sickle-cell anemia, hemophilia, and cystic fibrosis has also improved so that some patients can consider parenthood. Here too, it is inevitable that occasionally two people with the same disability will want children. Given better medical care other diseases will join the list and marriages like these will become more common. So will sick kids.

The humane wish to give such couples normal children—and the world's limits of today's gene therapy—will finally open the Pandora's box of embryo tampering. Two other arguments will help override objections to human genetic engineering.

Curing an affected fetus is preferable to ending its existence by abortion.

Where there is no good treatment for a genetic disorder, prenatal diagnosis and abortion are now our only defenses. An example is Tay Sachs disease. Found mostly among Jews with eastern European roots, the condition is an implacable destroyer of infants. It is hard to deny that healing such children is better than ending their lives. Embryos will be lost in the early experiments, but this can be seen as a lifesaving sacrifice in the long run.

Embryo engineering will prevent disease in future generations.

Since the person who grows from a genetically repaired embryo will pass along the "good" genes to all descendents, their progeny will be cured as well. Who is counseling enough to reject such a benefit?

Once we have wrought these arguments, though we may buy others. If cattle are given the ability to resist disease, will we deny the same ability to people? And why should we confine genetic engineering to disease? If zinc can be used to regulate bovine growth hormone, why not human hormones as well? Sex hormones, say, from ten milligrams of zinc glucuronate for an instant aphrodisiac.

Perhaps that is only a fantasy. But perhaps—this is the idea of being able to alter intelligence and other complex, poorly understood traits. But we should remember that genetic engineering has, from the first, been unpredictable.

We should also understand that because we want instead to heal hereditary illness, we are slipping toward the genetic engineering of human beings almost without realizing it. Genetic engineering will not be forced upon us, as a few social forecasters have led us to believe, by a new Hitler wishing a mindlessly obedient populace. We will seek it, applaud its human goals, and espouse it eagerly.
Robots may bring on a new Victorian Age, complete with wealth, leisure, and personal goods delivered by gibbonlike automatons, says the high prophet of artificial intelligence.

John McCarthy, the fifty-five-year-old director of Stanford University's Artificial Intelligence Laboratory is, in a sense, the father of all close relations between humans and computers. It was McCarthy who, while organizing the first conference on the subject at Dartmouth in the summer of 1956, invented the term "artificial intelligence" to describe the then-emerging field. McCarthy also has the distinction of having founded two of the world's three great laboratories of artificial intelligence: the MIT laboratory in 1957 with Marvin Minsky and the Stanford laboratory, in 1963. (The third is part of Carnegie-Mellon University.)

While at MIT, McCarthy also invented a kind of computer time sharing, called interactive computing, in which a central computer was connected to multiple terminals—the first practical one-to-one relation between a computer and its many users, each of whom could feel he had the machine all to himself. In 1956, he also created the computer language LISP (List Processing Language)—the successor to the mathematical language of FORTRAN—in which most "intelligent" computer programs have been written. He founded a subbranch of mathematics called "the semantics of computation," and solved its first significant problems such as how to test certain classes of complicated computer programs to see if they were correct and how to "crunch down," or simplify, the number of steps involved in certain very complex computer operations. Over the past twenty-five years McCarthy has created a continuing succession of ideas that have been turned into computer hardware or programs.

Last summer, at the annual meeting of the National Conference on Artificial Intelligence, McCarthy and Minsky—the two founders of the field—confronted each other publicly, as they have privately over the years, on the real problems of artificial intelligence.

PHOTOGRAPH BY CHUCK O'REAR

Interview

JOHN MCCARTHY

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Last summer, at the annual meeting of the National Conference on Artificial Intelligence, McCarthy and Minsky—the two founders of the field—confronted each other publicly, as they have privately over the years, on the real problems of artificial intelligence.

PHOTOGRAPH BY CHUCK O'REAR
To illustrate the problem Minsky and McCarthy offer the statement "Birds can fly." It is clear that this statement is usually true—but not in all circumstances. The ostrich and the penguin can’t fly. Dead birds can’t fly. Birds held down by their feet can’t fly. These exceptions seem obvious to humans, but to a computer that has been given "Birds can fly" as a statement of fact, such exceptions can wreak havoc. The study of artificial intelligence has stalled at this juncture.

The problem, according to McCarthy—and it is at the heart of all questions of intelligence—is one of organization. A machine might be stultified with the same billions of bits of information contained in a human brain. But recalling any one bit from memory—an operation that the brain can usually perform in milliseconds—cannot be done simply by sitting through a heap. If the job were done that way, it would take days for a human to move from the living room to the bathroom, because each bit of information—"What is a bathroom? Is there one nearby? How can I transport my anxious self there?"—would require a full search of the brain’s contents. So the challenge is to organize huge amounts of knowledge in a way that permits humans, or computers, to retrieve it just as to mix and match pieces of knowledge and to establish permanent links between them so one will bring up the other.

McCarthy offers one approach to the problem. Minsky makes another. In Minsky’s scheme, information stored by the computer or brain is handled in "frames." A "frame" is something like a context or a dominant idea in an argument—a concept ("bird") with many other related concepts or bits of information (teather, "flight," "egg-laying") attached to it in slots, or "subframes." Each frame of course, is interconnected. Calling up one may lead to calling up another, and so on. Thus in Minsky’s frames, knowledge is linked in chains of association, but is always dominated by the frame.

McCarthy’s approach is to create a new form of logic called nonmonotonic logic—that can tolerate ambiguity without losing the rigor of mathematical reasoning. In mathematical logic it is easy to make the statement, "A boat can cross a river," in the real world this may be true, but boats may also leak or be missing passengers. In logic these conditions might be accounted for simply by tacking them onto the first statement. "And there must be no leak and there must be cars." But there are bound to be additional unanticipated disasters awaiting boats. McCarthy’s solution is to say, "The boat may be used as a vehicle for crossing a body of water, unless something prevents it." In ordinary mathematical logic this would not suffice, because every exception must be laid out item by item. But McCarthy’s approach provides a way of going ahead with incomplete information. It is particular the computer hits the phrase, unless something prevents it, and finds nothing entered beneath that phrase—no leaks, no lost cars—it will continue on. If on the other hand it encounters "leak in the boat," it will turn down the new path dealing with leaks, water, and repair. Using such a chain of interrelated logical statements it is not necessary—as it is in Minsky’s system—for one concept to dominate.

McCarthy admits that this is probably not how the human brain works. In fact he says, "So we don’t care if it is psychologically real. Minsky’s frames come no closer to modeling the power and flexibility of human thought. And another method has proved practical so far in building intelligent programs. But then, neither man believes that machines will achieve anything approaching human intelligence anytime soon.

Meanwhile, McCarthy allows his thoughts to roam freely. A rather shy man, he possesses an extraordinary ability to concentrate his mind on a single idea—to step wholly into it. A large part of his creativity says one colleague, "comes from his ability to focus on one thing. The hazard of that is everything else gets screwed up."

Born to an Irish Catholic father and a Lithuanian Jewish mother McCarthy was raised, along with his younger brother Parnok, by parents who abandoned their religious to embrace atheism and Marxism. Thrown out of Cal Tech for refusing to attend physical education classes McCarthy was among the last Americans drafted into World War II. After the war he returned to Cal Tech to earn his bachelor’s degree. Then went on to earn his Ph.D. at Princeton. In 1956 he was offered his first teaching position in the mathematics department at Dartmouth. In 1957 he moved to MIT in 1963 accepted an offer to head his own department at Stanford.

A widower and father of two daughters (his second wife Viera died in a climbing accident during the 1980 all-women ascent of Annapurna), McCarthy is a bit awkward socially sometimes ignoring the usual conventions. But though he may appear absentminded and distant, his sensitive seems to be one continuous stream of ideas—not only in the fields of mathematics and computing but also in politics, literature, music, or plumbing. An avid reader of science fiction, he is also the author of a number of stories that, thus far, remain unpublished. When his house thermostat malfunctioned some years ago causing the temperature in some rooms of his house to climb above 80°, McCarthy was inspired to write an unpublished philosophical treatise—available to anyone who cares to call it up on Stanford’s computerized "memo system"—on the subject of whether it is proper to say that thermostats behave and have "motions," which he has cleverly designed himself. This mechanism that could carry a piano up and down stairs.

In this interview conducted at McCarthy’s Stanford home and in a local restaurant by Philip J. Hills national staff writer for The Washington Post and author of Scientific Temperaments Three Lives in Contemporary Science, McCarthy talks from mundane questions of futuristic possibilities, calculations, and other oddities. This is McCarthy.

The mind does not remain on factual, earthly matters for more than a few seconds before it is again taking off into another airplane possibility—some of which he has thought about great deal. What follows may not be the conventional interview but then McCarthy is not the conventional scientist.

"I want to ask you first of all about the robotic arms and eyes coming into use in industry. So far the main application of these things is in the assembly line McCarthy: Yes, so far this is the main application of robotics. One of the things that happened recently is a great proliferation of little devices of different costs, you can buy something for as little as 1 $000 dollars that can move its hands around and pick up things—a sort of toy for hobbies, it’s controlled by a microprocessor. I’m not sure what its limitations are. It’s not very
strong, however, and it may not be very reliable. If you tried to run it all day it might break down. Like almost all robotics in use today it does not have a mind. Because of this, what we have is very limited.

Omni: But there has been some progress toward making mechanical arms and robots smarter?

McCarthy: There are two directions in which things are advancing: force-sensing for the mechanical hands, and specialized systems of vision. The original robots had no mechanism for sensing how much force their hands were exerting; so the commands were simply commands for specific motions. Now that means most things did not quite fit. There had to be sufficient give in the object being picked up to make up for the limitations of the robot arm. More recently the arms have been fitted with force sensors so that the servos, or servo-mechanism—the program that controls the arm—actually measures force. In other words, suppose you want the robot to put a slightly tapered peg in a hole. The robot hand would move the peg downward and begin to sense a force on one side of the peg. If the peg were too small, the machine might not have the peg quite centered, so the hand would move the peg over a little bit.

Omni: And in the area of vision?

McCarthy: There are several things being done. One is to seek out special cases in which you don’t have to solve the whole vision problem—in which the robot doesn’t have to see or have full recognition of three-dimensional objects as a human does. There are many problems that can be solved by using plane views, so you have only a two-dimensional problem to worry about, rather than a three-dimensional one.

Omni: Give me an example.

McCarthy: Suppose you have flat parts moving on a belt. A part may be in one position or it may be rotated, but the robot can use a template to identify it and its orientation. You can have a fixed camera looking straight down, and the program can rotate a template until it matches the shape of the object in its current orientation.

Another specialized vision problem is flight simulation. It’s fairly complicated to represent the moving landscape ahead of and under an airplane chiefly because parts of objects are always hidden from any particular view of a scene—the far side of hills and so on. Well, there are now programs for simulating the continually changing views and conditions of flight.

Omni: How much specialized programming has found its way into industry?

McCarthy: These things aren’t in industry except for the computer simulation being used in movies and so on. In general I think people are far less ambitious about getting vision and manipulation into industry than they were, say, fifteen years ago.

Omni: Really? Why?

McCarthy: Well, I’m not sure. Mainly, I think because the problems are very hard and as people have begun to work on the very hard problems of vision and manipulation, they’ve identified easier subproblems. In the beginning people said, “I want my robot to do what a human does.” But part of the progress has consisted of identifying easier subproblems, the solutions to which are nonetheless useful in themselves. Specific factory-automation devices are one set of easier things that don’t go a long way toward solving the problem of how vision works. Another system that has been worked on here at Stanford is one that can look at an aerial photograph of San Francisco Airport and pick out the airplanes—distinguish them from buildings and vehicles—and see airplanes that are partly obscured or hidden.

Omni: This is from an aerial photograph?

McCarthy: Yes, it could be. The Defense Department is paying for its development. But it is also a good scientific problem—being able to take a whole scene and find all the similar objects in it.

Omni: What’s the chief problem to overcome here?

McCarthy: I don’t know. It always seems to me we ought to make faster progress in robotics than we do. When I first started on robotics in 1965 or so, we stated in our first proposal that we would get a robot to assemble a Heathkit [a build-it-yourself electronics kit]. It’s still not entirely clear to me why that proved impossible.

Omni: You actually got a kit and tried it?

McCarthy: No. The robot arms were never flexible enough to do the mechanical motions nor did we have programs to control them. The old-fashioned Heathkits involved threading, bending cutting, and soldering wires. It required considerable dexterity and sophistication to know where and how much force to apply. I don’t think we were even close to it.

Omni: Are we getting closer now?

McCarthy: No. I think everyone’s working on the easier problems. In my view what everyone wants eventually is not only a robot but that will take its place in the assembly line but a “universal manufacturing machine.” This would be more like one robot that could make a whole TV set, a whole camera, or a whole car. The robot might have several arms and a collection of tools. But it would be interesting if you could use one machine to make different things. You could go from your neighborhood assembly shop and say, “Well, I’d like that TV from the catalog, but with this additional feature.” The TV would be made by one machine. So you could retain the low cost of mass production, but still get individuality and custom design as if it were handmade. What I would like with these automated means is to extend the power of an individual so that one man could build a house or car for himself.

Omni: How would you do that?

McCarthy: Well, rent a gang of robots, as it were. As it is now, whenever you see a
construction site. None of the cranes and bulldozers bear the name of the company that’s doing the construction. They bear the name of the company from which the equipment is rented. So first you’d design the house or car and the design would go through a lot of computer testing. You’d simulate the construction before you began and the computer would tell you exactly what equipment to rent. You’d rent the robot equipment and it would build the house or car.

Let’s not imagine this is something the average person would do. The Rockefeller Foundation had a slogan around 1910, largely forgotten now, which was “Make the peaks higher.” It meant take the best existing research institutions and make them still better—the direct opposite of equality. And from the point of view of increasing what a particular individual could do versus what everybody could do—one would also like to make the peaks higher. And what can be done by one person, or a small group of people, has increased as technology has advanced. I believe robotics can advance that a lot more. 

Omni: I hear many inventors complaining that they have no way of approaching corporations—that they’d like to do something but they can’t. I guess being able to rent robots would help.

McCarthy: Yes, right. But of course, half of the inventors are crackpots. As for the other half—even the guys who aren’t crackpots—90 percent of their inventions aren’t going to make it.

I had an experience trying to market an idea. In fact, I’m still convinced the idea is practical.

Omni: Can you tell me what it is?

McCarthy: I suppose so. Since I can’t make money out of it, I’ve recently been trying to give it away. It’s a computer mail terminal. You could buy this thing from a department store and then you could type on it. You’d send messages to so and so. It would be connected to the telephone system, and one computer would call up another terminal and deliver the message. It seems to me that inventing the thing in itself was easy enough, but to persuade some company to make it was harder. My partner and I had a lot of contacts and interviews with prominent companies, so we didn’t have any problems getting attention. Nevertheless, not one of them decided to produce the terminal.

Omni: Would it be cheaper than a home computer?

McCarthy: It would be more expensive than some home computers and less expensive than others. Something like the Sinclair couldn’t do it. It wouldn’t be enough computer. It doesn’t have enough storage to store messages or enough display to permit you to conveniently compose messages and so forth. So it would be a specialized home computer.

Now programs for that purpose and the necessary equipment to attach to the phone system are probably being developed for
home computers. But no universal con-
vention exists that would permit any home
computer anywhere in the world to send
messages to any other home computer
anywhere in the world. I think there is a
good chance IBM will develop one. At least
I tried to give them the idea.
Omnii What do you think will ultimately be
made possible through robotics, and what
forms will robots eventually take?
McCarthy It seems to me that what can be
done and what will be done don't exactly
coincide. There's an enormous variety of
things that can be done. The extreme ex-
ample would be machines built along the
lines of the science fiction-story robots
Omnii Humanlike things that walk around?
McCarthy Yeah
Omnii Is that practical? I mean is there any
use for something like that?
McCarthy In some sense science fiction's
portrayal of robots involves a kind of so-
ciological imagination. During the Twen-
tieth and Thirties robots were depicted in
films and stories as an enemy tribe that
attempted to conquer the world, and our
heroes wiped them out. By the Fifties robots
had become an oppressed minority and
our heroes sympathized with them. But those
ideas had little to do with human needs.
They had to do with literary needs. Now
Isaac Asimov, who is the most popular writer
to write about robots, has formulated these
laws of robotics in which he almost inten-
tionally confuses natural laws—laws of
motion—with legislated laws. He implies
that his legislated laws—that a robot should
not harm a human being, for example—are in
some sense natural laws of robotics.
And then he writes these almost Talmudic
stones in which the robots argue about
whether something is or is not permissible
according to the law. Well, that of course
is also literary.
Now what shall we want? One thing that
seems reasonably clear to me is that mak-
ing robots of human size and shape is the
least likely. Rather more practical would be
a robot that is a little smaller or much big-
ger than a human and could do things hu-
mans cannot do because of their size or
shape. It would seem to me the first
winners would be robots quite different from
a human. There is, however, one advan-
tage to robots of human shape and size. They
could use facilities that were designed for
human beings.
One of my ideas along these lines that
is ultimately possible—and I have been
thinking about it for many years—is the au-
tomatic-delivery system. I'd like to be able
to turn to my computer terminal, type into
it that I want a half gallon of milk or a new
gadget, and twenty minutes later the milk
or gadget would appear automatically.
Omnii By what system?
McCarthy The first system one thinks of
as a child is, of course, little trains that run
along in tunnels under the streets and so
forth. What's wrong with that idea as it
stands? Well the little trains are expensive
and not very fast. They can't carry very big
objects and they require an expensive
redesign of the whole city. My current
scheme is as follows. There is a nine-teenths-
century version and a twentieth-century
version, or eco version. The nineteen-
century version involves cables strung
on poles, like the cables at ski resorts. The
carriers are two-armed robots, except that
they've got one arm like a Gibson and they
hang on to the cable with one arm. They
can switch cables by grabbing another one.
Omnii And these things somehow carry
the objects being moved, and then swing like
monkeys across these cables?
McCarthy Right. Now the other thing
that they can do is climb the outside of a build-
ing on handholds that have been built into
the building. They deliver things to a box
maybe the size and shape of an air con-
ditioner, which is built into an outside wall.
And after a while you hear these clanking
noises, and what you've ordered appears
in this box.
Now in the eco version, which is much

Making robots of
human size and shape is
least likely.

More practical would be a
robot much bigger
or smaller than humans. Then the robot could
do things humans can't do.

more expensive, these things are in tun-
nels under the streets, so you don't have
them clanking around overhead. But the
idea that they would either come down from
their poles or come out from underground
and climb outside the building strikes me
as essential in order to make them com-
patible with present buildings.
Omnii We could have a little tube running
up the side of the building?
McCarthy Yes, but remember, not every-
obody would subscribe to the service at first.
Not many of us are of the generation that
remembers the installation of electricity. Just
consider what an enormous amount of work
that was. You look at old buildings and say
How did they ever install electricity in that
house? They had to tear up bits of the
walls to run the wires through. The other
possibility—or the other extreme possibility
is a walking robot that after it comes
down from the cables or up from under-
ground, simply walks over and knocks on
your door. In some sense that would be
more flexible. Something could be deliv-
ered to someone who wasn't a subscriber.
What I envision, actually with regard to
robots, are some fairly large social changes
that would bring about a return to the Vic-
torian Age in a certain respect. If you had
the robot to work twenty-four hours a day
you would think of more and more things
for it to do. This would bring about an elab-
oration in standards of decoration, style,
and service. For example what you would
regard as an acceptably set dinner table
would correspond to the standards of the
fanciest restaurant or to the old-fashioned
nineteenth-century standards of some-
body who was very rich. Standards would
conform to what we imagined to be those
of the British ancien at because they had
servants. People ask, Well what will hap-
pen when we have robots? And there is
a very good example of historical parallel.
Namely, what did the rich do when they
had lots of servants?
Omnii How many years must we wait?
McCarthy I don't know. It's not a devel-
oment question. It requires some funda-
mental conceptual advances on the order
of the discovery of DNA's structure. Maybe
once these advances are made, progress
will be straightforward.
Omnii Would robot intelligence and human
intelligence be alike? Humans are moti-
vated by anger jealousy ambition sensi-
tivity. And in literature robots are portrayed
as possessing these same motivations.
McCarthy I don't think that it would be to
our advantage to make robots whose moods
are affected by their chemical state. In fact,
it would be a greater chore to simulate the
chemical state. And it would probably also
be a mistake to make robots which sub-
goals would interfere with the man
goals. For example according to Freudian
theory we develop our ideas of morality in
order to please our parents. But then even-
tually we will pursue these concepts even
in opposition to our parents. The general
human instinct to assert independence is
something that we would require some effort
to build into robots. It doesn't seem to our
advantage to make that effort.
Omnii What about the possible disrup-
tion—the unemployment that could be
caused by robots?
McCarthy Well there are two questions
that have to be answered. One has to do
with superrobots. In other words what will
happen when we have robots that are as
intelligent as people which is a long way
off. The other has to do with simple auto-
mentation which is similar to the advances in
productivity that have already occurred.
The United States and other countries
have gone through various economic cycles
of unemployment and full employment. These
countries have also gone through various
periods of rapid or slow technological de-
velopment. No one has ever at-
tempted to correlate these things. But I think
what would be observed is that there is no
correlation—that periods of high unem-
ployment are not especially correlated with
periods of rapid technological advance. In
fact on the average, more advanced coun-
tries have somewhat lower unem-
ployment than do the less technologically

CONTINUED ON PAGE 122
THE END OF THE WORLD NEWS
BY ANTHONY BURGESS

In Part One, Brodie and Willett left New York City, which was devastated by tides raised by the planet Lynx. Meanwhile, scientists in a small Kansas town work feverishly to complete a spaceship designed to save the cream of American intellects from the impending collision with the wayward planet. There's dissatisfaction brewing among the scientists; outsiders (including Brodie and Willett) are converging on the project center; and Lynx temporarily becomes a new heavenly body around which Earth will orbit until the two planets collide.

"As they used to say in vaudeville," Willett grunted, "this must be the place." He made certain adjustments to the controls that kept the thing hovering in the hostile winds—hostile to one another as well as to their craft. Val could still not get over his surprise that Willett, actor, eater, swiller, and pauper of the past,

This is the second part of a two-part excerpt.

PAINTING BY JEAN-MARIE POUMEYROL
They had picked up this particular helicopter near Sedalia, Missouri. The transport had been thoroughly obstructed by broken pieces of upturned earth, perpetual rolling tremors. They had been astonished near Sedalia, to see in broad midday a patch of air wholly taken up by helicopters engaged in crashing into each other in individual suicide combat. Madness. Lycostatic madness. There was a metal notice twisted, battered, lying on scorched grass, which said HEAVEN IS. Over an excessively amplified loudspeaker system joyful, simple music was being discoursed.

Val and Willett went cautiously closer to the thick net periphery. A tap sergeant had welcomed them in to the funeral games. What had apparently begun as a helicopter square dance had turned into a dodgem course. Now it was rank joyful suicide. Could anybody play? Well, said the sergeant, Val and Willett were civilians, not really eligible. On furlough, Willett said. Both were Colonels, Allnit and Major Catastropho. No trouble then. And they were zigzaggedly escorted to the helicopter park, bottles of scotch thrust into their hands by a singing corporal. Then they were off and up, not really playing the game.

They put down outside Topeka, Kansas, at a big mess hall that was full of grumbling military.

Val asked about the care camp. Nobody knew it. Wait, how about Shorty? Shorty's outfit had broken up.

Shorty had been posted to this clean-up battalion, grousing and even tearful about being cut off from his old buddies and full of unbelievable stories about a moonship and a guy in charge called Boss Cat, in a dump called Sloatsville.

Up in the air, Willett said, You were right you see. Your book probably gave those nonfictional scientific bastards the idea.

Val woke from unpleasant dreams out of which he was, anyway, lucky to be able to wake. He looked down and saw a great round square, impeccably right-angled huts, huts, huts, and the middle of the thing the end of the known road, big and squat and beautiful! His heart dropped to his gross muddy worn boots! What do we do now? Willett asked. Land by it? Open its door? Walk in and take a seat?

"Wait," said Val with the caution of a science-fiction writer. "We'll wait. Land Behind that clump of elms there."

The earth hiccuped. Just south of Sloatsville an Englishman named Elias Howe addressed a crowd through a loudspeaker. The crowd was about two hundred strong—men, women, children, cripples, ancient, frightened Kansans all of them.

A voice that disdained the use of an electronic prostheses was now heard, its possessors unseen. This is Calvin Gropius," it cried. "I demand the right to bear the Word of the Lord into the wide universe that is the Lord's own creation. Open your gates I demand it. God demands it!"

The voice of the workers loud hailed in protest. "The God that's the creation of the bloody capitalists. Open up for the proletarian Space for the workers!"

"Now, I think," said Bartlett, and with a good round aim, he sent a gas bomb flying toward the spot where the cutters had cut away lighted goldenly by high-voltage sparks. There was a sudden cloud of immense dirtiness and a loud chorus of curses and desperate coughing. The earth cupped. The earth went into spasm.

From the same invisible spot as before Gropius resumed. "I demand that the bearer of the Lord's Truth be admitted. I demand as if to back that up, the nervous spattering of what seemed to be autogun bullets started well behind him. And now some of the workers began to go down, many screaming. Others ran The loudspeaker cried, 'You see what the capitalists are doing, you scientists? Scientists, fellow workers—There was no more from him, except a howl, a gurgling, a choking partially amplified.

The Tagliaferros owners of the Florentine Hotel were pumping out death into the workers. Farmers really, gritting in Sicilian.

"Let them die. Why should they live? What right to live do they have, the bastards?"

Behind a shivering oak, stretched out in the warm night asleep were, for a time, Val and Willett. They had eaten and drunk heartily. They were very weary after their adventures. They did not respond to noise. They had finally learned to sleep through noise. They had had nothing but noise since their journey began. It was almost by chance that Dashiel Gropius dragged Edwina Goya to protection behind that same tree. There were not in fact many trees around. "Good Goc," said Edwina, forgetting her pains. "It can't be. It's Dr. Brodie." She shook him. Dr. Brodie, wake up. There's terrible danger.

But it was Willett who woke first, grunting, groaning, smacking, very bleary. He did not know these two and he quickly grasped the pistol at his belt. The girl was pregnant, he noticed. Jesus, this was no time for getting pregnant.

Edwina said Val now awake what the hell are you doing here? He had seen her last in the departmental library of the university, glooming over a huge variorum edition of John Donne.

"This," said Edwina. "This is the end of the world. I presume anybody can join in?"

"What a lot of people!" Willett said in wonder seeing shrieking Kansans running everywhere. "The chopper," he said. "It's safe? It was not safe. Not with maddened scramperers quite likely to take off from the carnage and the end of the world with it. Willett fired a couple of stray shots and saw people stumble howling, scattering. Dashiel said, "Gropius is my name. I'd suggest that—"

"You're too young for Gropius," Val frowned, looking puzzled.

"Dashiel Gropius. My father, Calvin Gropius is over there demanding entrance in God's name. Look, this lady's near her time, as you can see. There must be doctors inside that place—"

"It's all doctors." Edwina winched her face clenching on her pain like a fist.

The only way in. Dashiel said. "Would be from the air. I'm assuming you know how to drive that thing—"

Willett said: "Let's get in and up. At least we can get away from that bastard who's spreading death, whoever he is."

"One of the Tagliaferros brothers. He owned the Florentine Hotel where I worked." Dashiel said: "He's gone mad. Lost his wife and kids and so has gone mad. Meanly they made their way to the helicopter and got in. Edwina in pain and with difficulty.

Inside the camp most of the cat team disobeying orders had come out to see what was happening. Bartlett was concentrating on his official protectors. "Out," he told Lieutenant Johnson. "Your work is finished here. Get your men out. Meanly while Giannis' bullets glanced whining off the tough metal of the perimeter. Out to be killed by that bastard? We're staying with you.

The platoon sergeant came puffing toward them. "For Christ's sake, we need ammo. Those was blanks. Some stupid bastard made a mistake. He looked back sweatily at the writhing bodies killed by Giannis' bullets groaning nearby. The camp's main gate Gianni bursting away.

Ammunition's no good to you," said Bartlett. "It won't get through that fence either way. You're safe from that gun."

"Not if we have to go out," said Lieutenant Johnson reasonably. "This mad bastard here," he told his sergeant, pointing at Bartlett, "wants us to take the men away. Christ knows where to."

"Get your men to the transport lines," said Bartlett.

"See here, mister," the sergeant said. "We don't obey no civilian orders. We're staying right where we are. You're not." Bartlett said.

"You pretending to give me a fucking order mister?"

"Not you personally." Bartlett said. "Not from now on." He stepped back five paces, put his Hutchinson hipman to his hip, and then fired a brief burst. The sergeant with a look of utter amazement on his honest broad face went down. The ground like a sprung mattress bunched him up an instant. Then he lay as still as could be expected. The lieutenant and O Grady looked
on Bartlett in awe, Bartlett said, "I'll shoot your entire platoon man by man, if I have to. Get them out of this camp."

And let the fucking invaders in?" O'Grady asked in disbelief.

"One thing at a time," Bartlett said calmly, "You're mad, Bartlett. You're just plain fucking mad."

"Insubordination. I'll have to rehabilitate you myself. won't I? Later, of course. Lieutenant, you heard what I said.

Johnson looked again at the corpse of his sergeant. He couldn't believe it. That corporal of yours would make a reasonable target," said Bartlett, readying his gun. The lieutenant blew a shrill whistle again, and again. Raggedly his men got into three ranks corporal as marker. Johnson marched them, giving shaky orders. Gianni had apparently finished blasting for a time.

Beyond the gate, Calvin Gropius could be seen. Gropius tried again. "I'm not condoning this man's acts of violence. These two men are not with me. I'm asking you in the name of the Lord to allow only his messenger to enter."

Gianni, of course, heard that very clearly. "The bastard," he said in English. "After what I done for him, killing those guys. You mean you don't want us in there with you, reverend?"

"Be reasonable," Gropius said. "For God's sake, think. I'm not trying to save people. I'm trying to save the Word of the Lord."

"Protestante," Gianni grinned at him. "Two trucks appeared, closed, tough-plated monsters with soldiers inside them. They lumbered, nervously. it seemed, toward the gate. The gate however was electronically locked.

Lieutenant Johnson looked nervously out of the passenger seat of the cab of the leading vehicle, making a key-turning gesture with some difficulty.

"Unlock that gate right now, O'Grady. Bartlett ordered.

"And let those bastards in?"

"Unlock it. You know the code. Dolphin E4, night."

"You're mad," said O'Grady scowling. But he took out his pocket activator and set it to 7368025. The gate slowly swung open. The trucks started to move out. Some of the troops let out a feeble soldier's cheer. Calvin Gropius, who had always kept himself fit, sprinted to the opening and, crying "In the Name of the Lord," tried to squeeze himself in. Hipfire resumed on the bastard. He went down sobbing "In the Name of the-" The first truck went heedlessly over him, then the second. The helicopter hovered very low. It too gave off rapid fire in a blast of filial vengeance. Gianni screaming dropped his gun, clutched his ruined face, and at once knew whether there was a hell or not. Another burst to finish him, quite supererogatory got Salvatore, who looked up as at the sudden fall of gentle rain. He went down very quietly.

An amplified actor's voice came from the skies. "How does the damned thing—Ah"

SOME DAYS, visitors to Jack Daniel's are surprised to hear they're in a dry county. It's "dry" because we aren't allowed to sell (or drink) our whiskey here. But as everyone knows, we make a good deal of it. And we enjoy taking folks from one end of our hollow to the other to show them how it's done. Of course, there's no guaranteeing perfect weather. But if you visit our distillery sometime soon, we're certain you'll have a nice day.

Tennessee Whiskey • 90 Proof • Distilled and Bottled by Jack Daniel Distillery
Lem Motlow, Prop., Inc. Route 1, Lynchburg (Pop. 362), Tennessee 37352
Placed in the National Register of Historic Places by the United States Government
leaving his companion Laverne Landis behind in his car. When an emergency call was made, Gerald Flach crawled off through the snow to a nearby pine forest. He managed to reach the highway nly to sprawl unconscious alongside the road. We were waiting for a UFO, he mumbled, to be incredible; motorist who offered him the money; his friend might be dead.

Flach's bizarre adventure began in June 1982. At the time, he was president of a St. Paul, Minnesota group called Search and Prove whose members claimed to be telepathic. Discussions will aliens in space.

Flach was sitting through a peaceful search party meeting when a comrade said, "Let's go up there and see if we can find something."

"I couldn't hear from extraterrestrials, but I could do it."

If she agreed to meet him, he told Flach, there was no need for her to come aboard their ship unless she wanted to join him and he would quickly agree.

To meet up with the UFO, Landis said, the pair followed the aliens' instructions. There was no question of another meeting, Flach's team had found the place, and it was going to be a journey. The pair decided to follow the instructions and make their way to the muddy shore, where they found a place to stop. They installed their own radio and began to listen to the aliens, who were giving them instructions on vitamins and lake water for a month. Then, on the night of November 14, an unexpected snowstorm pounded their car. The battery died and they couldn't provide no heat to keep off the subzero temperatures. They began facing in and out of consciousness. Don't worry, Landis would die. Then, they won't let us die. But when Flach woke, he saw that Landis's face was blue and blue.

He made his way to the highway, where the helpful motorist found him and took him to St. Paul. The motorist called Dr. Mn. Pa. and broke the news. Landis was dead. She had succumbed to starvation and cold.

When asked to comment, Jerry Gross, president of Search and Prove, said that his friend's strange escapade was truly miraculous. He believed that when the pair left town, every time they assumed that they were lovers and that they didn't have an escape. Flach didn't answer questions.

When asked to comment, Jerry Gross, president of Search and Prove, said that his friend's strange escapade was truly miraculous. He believed that when the pair left town, every time they assumed that they were lovers and that they didn't have an escape. Flach didn't answer questions.

But St. Paul, however, some people say that Gross tried to wash his hands of the pair's going on their tragic mission. They believe that the group is a crazy cult and Gross is a kind of Reverend Moon or Charles Manson. And they cite a 1978 article in the Minnesota Dispatch. Something spectacular is going to happen in 1982. Gross is quoted as saying, "There, Minnesota will be the place."

The mystery is going unsolved until Flach himself speaks up. But as a young boy who answered his home telephone put it, "Don't know where he is and even if we did we aren't telling you."
HAIRDRESSING FOR THE DEAD

Noella Popagno, of Hollywood, Florida, has written the world’s first and only textbook on desairolgy—the art of hairdressing for the deceased.

In the past, Popagno explains, funeral directors gave the task of hairstyling to their untrained wives or daughters. So accidents would happen. One woman, for instance, ironed a corpse’s hair until it turned yellow and fell out. Now designed to prepare hair for those situations that never pop up with live subjects. Take the case of a customer who’s had a cranial autopsy. In that instance the subject has a horseshoe incision cut along the crest of the scalp and from ear to ear. Since the scalp may be sewn back so that hair mix with the thread. Popagno warns, “It’s advisable to hold tresses in place while combing, rolling and styling. Otherwise you might see the entire scalp fall off.

Imagine how the family feels at the wake when they approach the casket—blanketed by Popagno's notes. To avoid such disasters, Popagno tries to get professional beauticians involved by dispelling their overwrought fear that the dead will move about. The deceased, Popagno admits, do finch or twitch from time to time whenever embalming fluids make their muscles react. “But she adds, “in thirty-five years of working with the dead, I’ve never seen anybody sit up and crack a joke.”

Families need an acceptable last image of the deceased to help them get over the shock of death, Popagno says. And the desairolgist is a crucial part of that process. Anyone interested in entering the field, she adds, can get a copy of Desairolgy from J.J. Publishing, 1312 Arthur Street, Hollywood, FL 33109. The price is $13.95.

—Peter Rondinone

Casinos in the air are all right until we try to move into them.

—Anonymous

REMEMBERING PAST LIVES

When regressed back to childhood and beyond, hypnotic subjects often recall previous lives in distant eras and cultures. Sometimes the subjects even come up with uncannily accurate historical information. But according to All in the Mind, a new book by British author Ian Wilson, many of the most highly touted reincarnation claims can be explained by hidden memories based on the subject’s present-life reading and experience.

Wilson did his research by attending regression hypnosis sessions and listening to numerous tape recordings allegedly describing prior existences. Then ferreting out historical facts, he read dozens of books and traveled thousands of miles to check the evidence. In case after case he found that subjects had drawn their detailed stories from readily available sources.

One woman that Wilson studied for instance, remembered being tried for witchcraft in sixteenth-century Chelmsford, England. Her story and the historical information were impressive enough. But she said her trial took place in 1656 although the real Chelmsford trials were held in 1566. A seemingly trivial error, perhaps, but Wilson subsequently learned that the chronicle upon which most contemporary authors base their information dated the Chelmsford trials in 1556 as well.

In another instance Wilson studied an Englishwoman who had recalled an entire series of past lives under hypnosis, including one Roman Britain of the fourth century A.D. Wilson traced much of her information—incorporating fictitious names to a historical novel by Louis de Wohl—though there are some people who may be disappointing to see reincarnation undermined. Wilson believes that his findings are all for the good. They prove that we all hold within ourselves “a dynamic ever-restless kaleidoscope of images,” he says, “the complexity of which we have scarcely begun to grasp.”

—D. Scott Rogo

“There are a few billion planets, and among these a few million no doubt have civilizations more advanced than our own. They will have a different concept of reality.”

—Arthur Koestler
The first wave of settlers in space is bound to be explorers, adventurers and scientists. But the second wave would well consist of murderers, rapists and terrorists, a Canadian criminologist contends. Overcrowding in prisons is worsening as prospects for space colonies improve, observes Ezzal Fattah of Simon Fraser University in British Columbia and these trends support the prediction that the punishment will lead to an ever-increasing prison population in facilities already at maximum capacity.

Fattah explores this thesis fully in his forthcoming book Are Prisons Necessary? in which he also discusses other technological alternatives to incarceration. It will be possible in the near future to control movement without immobilization. Fattah says "to curb violence without segregation and to protect society without incarceration." For example, surgically implanted radio devices could be used to monitor the location of a prisoner if the prisoner stepped beyond a certain geographic limit. Guards could instantly track him down and return him to justice.

Fattah predicts that only the fiercest criminals will inhabit jails in space after all. It would be most economical to send those convicts with life sentences.---Dava Sobel

"Hitch your wagon to a star."---Ralph Waldo Emerson

Not by myriad slaves nor by divine or UFO intervention, were the Egyptian pyramids built. A Boston engineer asserts, but with forethought, diligence and an ingenious contraption known as the wheel. The secret of assembling the great royal tombs came to John D. Bush soon after he bought an abandoned granite quarry near Gloucester, Massachusetts. Struggling fruitlessly to nudge a 16-ton block with wedges and jack, Bush hit on the idea of making the block the axle of a giant wheel. He built four pieces of curved wood and strapped each one to a different corner of the block creating the configuration pictured above. He was then able to roll the boulder with relative ease. The technique worked so well he felt somebody must have thought of it before.

The engineering problems of building the pyramids seemed the most obvious parallel, Bush says. So he looked up texts about ancient Egyptian masonry and found a device called a "cradle" that was a dead ringer for his makeshift contraption. The cradle had been used as a wedge. It never occurred to them that you need a set of four cradles to get anywhere.---Bush asserts. But then they were sitting down with an artifact, trying to figure out its use. I was trying to move stone.

At an outdoor demonstration Bush staged last year in Boston, crews of six to ten out of shape volunteers found they could haul the 2.5-ton concrete blocks up a steep ramp almost effortlessly on the cradle principle. With the help of a similar device, Bush concludes, a few thousand Egyptian laborers could have built a pyramid in 20 years.---Dava Sobel
TRAVEL BY PROXY

It’s a rainy Sunday. You call the foreign city of your choice and order a proxy—a small robot equipped with TV cameras, audio inter¬coms, artificial arms and wheels. Then with your home TV hooked to the robot by satellite you’re set for a day along the Champs Elysees or Oxford Street without ever leaving your living room.

Just flick on your TV set and David Yates the London computer scientist who thought up this scheme and city streets instantly appear on the screen. Since you are equipped with a steering wheel, you might begin driving your proxy toward the city’s marketplace. Once there you could in¬struct it to pick out souvenirs bargain with shop owners and have the purchases sent to your home.

While early-model proxies might provide only visual and auditory information, Yates speculates that later models would give their owners a complete sensory experience. You’d actually taste that frothy cappuccino from the café in Rome and feel that luxurious Japanese silk. Scientists have already electronically inked an amputee’s nervous system to an artificial limb making it possible for him to feel what his limb feels. Yates explains. So perhaps a technological advance will make a similar link between a traveler and a proxy—without amputation.

But don’t throw out that Club Med membership at least not yet. The high cost of a proxy’s sophisticated equipment. Yates admits, will make it unaffordable to the average consumer for years. And even when the price comes down critics will have to be appeased. After all, they legitimately note criminals might steal the proxies and use them to mug the elderly rob banks, or murder.

Once perfected, however, proxies will provide a mind-broadening alternative to travel. In much the same way Yates says, that cars provided a new and exciting alternative to walking.

The divine art of miracles is not an art of suspending the pattern in which events conform. But of feeding new events into that pattern, so says Peter Rondinone.

Every morning author Ruth Montgomery places her fingers over the typewriter keys and meditates. Then presto! Words tumble onto the page, dictated straight from the mouths of spirits. In fact Montgomery says that’s how she’s written all her books, not including her best seller about psychic Jean Dixon.

One day recently the spirits startled Montgomery with a prediction. In the year 2000, the earth will shift off its axis unleashing quakes and tidal waves. But the human race will persevere, thanks to walk-ins—spiritual saviors who take over the bodies of smack- ladder people on the brink of physical or emotional collapse.

Communicating by means of the typewriter Montgomery’s supernatural informants have revealed the names of numerous people possessed by walk-in spirits throughout history including Jesus Christ, Christopher Columbus, and Charles Colson. Montgomery who has spent weeks studying these individuals reports that each and every one has experienced inexplicable personality changes after a devastating illness or psychic trauma.

The lives of 17 living walk-ins have become the subject of Montgomery’s new book, Threshold to Tomorrow. She writes for instance about Swedish scientist Bjorn Ortenheim who was sitting on a wind swept beach plotting suicide when the brilliant soul of Albert Einstein (above left) entered his body today.

Montgomery says, Ortenheim is refining Einstein’s theory of relativity (He’s already changed $E=mc^2$ to $E=mc^3$.)

Another walk-in is the late Egyptian president Anwar Sadat (above right). During World War II Sadat was an angry dispirited revolutionary languishing in a prison cell. Then Montgomery contends, a great Egyptian soul walked into his body creating the powerful head of state. Sadat’s soul, she adds, may very well return to help solve the Mideast crisis—this time with a new name and appearance.

Montgomery’s claims may seem spurious to some. But at least her publisher G. P. Putnam’s Sons in New York is convinced Threshold to Tomorrow the company declares is a survival manual to the new age—Katharine Jason.

“We are the mimics. Clouds are pedagogues.”

—Wallace Stevens
the helpless swimming beasts from afar—a much less dangerous and considerably more productive hunting strategy than stalking them with spears at close range. Moreover with fishhooks they could catch the leaping salmon in the estuaries almost without effort. And at the height of the cave art, some 15,000 years ago, there was also evident a long-distance trade, larger, sedentary communities, and the first signs of rank and status in what had been from time immemorial egalitarian societies.

Pfeiffer thinks that people experienced an “information explosion” due to vast changes in technology, and social structure. And because the footprints of children are so prevalent in many of these caves, he theorizes that ancient cave ceremonies were initiation rituals rites of indoctrination designed to teach the young huge quantities of new information that they needed to remember in order to survive.

It is curious how you can make a human being effectively remember complicated data. First you make the recipient open to your information. This is done surprisingly easily by stripping the individual of his normal sensory world and replacing it with isolation and monotonous—two elements the human brain cannot withstand. Apparently in less than a day the displacement and dissociation put the average person in a trance, a dreamlike state in which he is susceptible to indoctrination and suggestion. Then after you tell him what you want him to remember you reinforce the massage by frightening him.

The Australian aborigines are masters of memory, and until quite recently they used this method at their puberty ceremonies. This rite of passage began when the male initiates were removed from home and family to secret places in the desert and denied food and clothing, and told the tribal myths. Then, on the last night of the ritual the youngsters were concealed under blankets beside a roaring bonfire. And after the chanting, darkness, isolation, fear and disorientation engulfed them they were led before their elders where their penises were slit from tip to base.

A horrible ordeal, to be sure yet it serves an essential purpose. These aborigines live in the world’s most barren desert: a place almost as uniform as the Pacific Ocean. And if they are to find water regularly they are obliged to remember every rise, every dip every tree, rock and hole within an area of several hundred miles. So every physical feature of the land is woven into elaborate tales of my mythical animal beings. And as one memorizes the escapades of the gods, the smallest details of the desert become committed to memory, too. Thus the myths are maps of the outback, and the graduates of the puberty ceremonies have acquired information that will forever guide them from one water hole to the next.

The aborigines also use art in ceremony. On cave walls, on tools and on themselves they paint series of dots and dashes to depict the wanderings of supernatural beings. These serve as mnemonic devices to recall important episodes—as well as essential facts about the landscape. But the aborigines are not the only people who store data in art forms. Just a glance at a cross could elicit from any American Indian the story of the Christ child’s trials of the Crusaders; the code of the Sunday service—vital reams of information about the history beliefs, and practices of those of the Christian faith. One immense drawing and ceremonies performed in the caves of France and Spain have served the same function as the desert rituals of the aborigines? Were young initiates left in isolated tombs in the bowels of the earth until their psyches gave way to reality, then told valuable myths as they were escorted past paintings of dots, hands, mystical figures and charging beasts that cued and jogged their memories? And finally were they led to large subterranean galleries filled with their relatives where they underwent excruciating ordeals that permanently etched these stories in their minds? The cave art may be what remains of visual aids used as part of a survival course given to the children during an era of social turmoil not unlike our Computer Age.

This theory of Pfeiffer’s is an ingenious explanation for the blossoming of the first human art. But even more exciting is Pfeiffer’s final point. He notes that through isolation, monotonous and rhythm—particulars drumbeats—the human brain becomes very susceptible to trance. And this trance state leaves the individual ready to follow a leader and to believe what the leader says. This observation, in turn, becomes Pfeiffer’s springboard into a far more dangerous theoretical realm. “If the pressures of the Upper Paleolithic demanded fervid belief and the following of leaders for survival’s sake he writes then individuals endowed with such qualities with a capacity to fall readily into trances would outproduce more resistant individuals.”

[Emphasis mine.] And of course the corollary to this theory is equally provocative. If trances are found in biology, subject to selection, and easily elicited in human beings, it follows that the predisposition to believe is rooted in our genes.

Pfeiffer is not proposing that the proclivity for human worship is a biological imperative—that one must believe. Although behaviors like the human smile are inherited (even blind babies smile), most human actions are the result of myriad forces added or subtracted. And for a specific behavioral pattern to be elicited cultural training and cultural stimuli must be present. Picture your brain as a Stradivarius violin, designed to play in a broad but discrete range. Let culture take up the bow and with ease certain notes ring out. If Pfeiffer is correct religious belief may be a very simple tune.
bad cement doesn’t burn. In the northern district of Niedersachsen, citizens protested establishment of a regional nuclear-waste dump and construction of a street that would have destroyed a small forest. (The construction of the street and the digging of the dump were delayed but not called off.) To the south, in the lush mountain range of Vogelsberg residents declared a plan to divert water to the nearby city of Frankfurt. (Because the cries went unheeded, the people of Vogelsberg today face serious ecological problems.) Throughout the country members of these various groups tried to win elections at the state and national level, but without a political party to back them up, they had trouble gaining seats or effecting true change.

Then more than 500 activists assembled at Offenbach, led by journalist August Haussiether and parliament member Herbert Gruhl, the group lay the foundation for the Greens. A month later at the city hall in Karlsruhe, the fledgling party was officially announced.

To Manon Maren-Grisebach, a professor at the University of Heidelberg and one of eleven members in the Green Party’s national committee, the scene was sheer jubilation. “There were eight hundred or nine hundred people in the main hall,” she recalls, and TV screens were broadcasting the ceremony for hundreds more waiting outside. Afterwards there was a huge festival. We were totally overjoyed.

When the first rapture subsided, the Greens soberly set out to reconcile differences among themselves. Some party members were concerned mostly with pollution and nuclear disarmament. Others were more radical, wanting to work for socialist reform. The Greens could result only from strength. However, the two factions soon decided to stand by each other. Socialists would fight for forests and rivers while environmentalists would support a more egalitarian distribution of Germany’s enormous wealth.

Now working together, some 3,000 Greens began to broaden their power base by drawing support from disenchanted youth and senior citizens alike. Party leaders sent representatives throughout the nation’s cities and towns to communicate with people on a grass-roots level. Wherever the environment was threatened, the Greens organized marches and rallies.

One of the party’s first acts was to declare a three-day Festival of Peace protesting a nuclear-power plant to be built along the Rhine. Thousands came. By the middle of 1980, the party had established a national peace week, with members distributing nuclear-disarmament literature and sponsoring workshops across the country. And in the next couple of years, the Greens became a driving force behind the nuclear-freeze movement. Their success was especially apparent last winter, when hundreds of thousands of Germans braved bitter cold and snow to attend a Green Party demonstration against the Pershing nuclear missiles.

With a strong stance against nuclear weapons and nuclear energy, Green Party membership has recently grown to 25,000. Millions more voted for the Greens in local and federal elections, making the group the first truly powerful environment-based party in the Western world.

The party has already captured 48 seats in Germany’s state parliaments, and both Chancellor Helmut Kohl and former Chancellor Helmut Schmidt admit that the Greens constitute the country’s fourth-largest political force. If the most recent polls are correct, the Greens will take over the unpopular Federal Democratic Party and become the nation’s third most important political group. This would be the first major change in the character of West German politics since the end of World War II.

Once the Greens make these gains, explains University of Berlin political scientist Theo Pirk, they might well have a dramatic impact on Germany’s national policy. For example, if the two primary parties stood deadlocked on an issue with 45 percent of the vote each, and the final 10 percent rested with the Greens, the Greens would cast the deciding vote. Even if the Greens refused to vote along with either of the major political parties, their voice of opposition would sound far and wide.

Some experts believe the Greens may eventually gain enough popularity to abandon their opposition role, becoming a fully contributing third political partner. If that happens, according to Eugene Odum, director of the University of Georgia’s Institute of Ecology, the Green movement might spread around the world.

The problems that gave rise to the Green Party are common to industrial nations everywhere. Odum explains: “Many people seem to forget that you need clean water, forests, and open space to provide your life support system. In the United States, we haven’t yet faced enough destruction to see a clear danger, but that point will come. And when it does, you might see all sorts of Americans joining forces to form a party like the Greens.”

“Industial growth” he concludes is like a little kid. Everyone likes to see him get taller and put on weight. That kind of growth is fine. But Germany is grown-up and any more growth is cancer.

In the world according to the Greens, each dead river, vanished forest, and new construction site is one more symptom of malignancy. Party leaders admit that their ideas are new and their means untested, but with no known cure they feel radical treatment is justified.

The next step leads to an uncertain future, says Maren Grisebach. “It’s like going into a dark forest. But if we’re not sure where we’re going, of one thing we’re positive. We know where we’ve been.”


"A MAJOR STEP FORWARD INTO THE EXPLORATION OF THE WAYS WE ARE ALL GOING TO LIVE WITH MICRO CHIPS."

-Daniel Dennett Co-author of The Mind's I

Musician and sociologist David Sudnow has written the first book to define the essence of video skill—what he calls "sensory mastery." But what mastery is? In this worthy sequel to [Ways of the Hand], this track on mastery of music-craft, Sudnow once again explores a lot of worlds at once—the real one, the one in the machine, and all the myriad ones inside the self. It may not show us how to coax the children home, but this book gives us good ideas of where they go. (Marvin Minsky, Department of Artificial Intelligence, MIT)

PILGRIM IN THE MICRO-WORLD EYE, MIND, AND THE ESSENCE OF VIDEO SKILL

An intriguing account of the breakthroughs and breakdowns of the adult mind as it plunges into the advancing microworld. Sudnow shows us an exciting way to relate to approaching computer technology.

—Tim Galtier, Author of The Inner Game of Tennis

Sudnow has made a breakthrough in assessing the two-dimensional world of the computer and the sort of body and mind it creates in us.

—Hubert Dreyfus, Author of What Computers Can't Do

INTERVIEW

CONTINUED FROM PAGE 106

advanced countries. We have unemployment, but Mexico has vastly higher unemployment.

To take the extreme example, the average productivity of a worker in the United States has increased five times since I don't know, 1930 or something like that. So you would expect that four-fifths of the population would be out of work.

OMNI: But obviously when automation comes in people are out of work temporarily and then go to something else.

McCarthy: That's right. Now there is an economic malfunction that causes unemployment—that causes this interaction between unemployment and inflation and so forth. But it seems to me that this malfunction has little if anything to do with technology. What seems clear is that nobody knows how to deal with unemployment.

OMNI: That's taking automation only up to a certain level. But if we go up to the next level and have smart robots, I would imagine there would be a fairly major shift in people's ways of life.

McCarthy: There was a soap opera of the Thirties in which a girl from the hills of Kentucky married an English lord. The question was, "Can a young girl from poverty-stricken Kentucky adjust to life among the English aristocracy with dozens of servants and so forth?" And the answer was that one has a real hard time adjusting—sometimes it takes all of ten minutes. So it seems to me that what we would have to adjust to is being rich. It could take all of ten minutes.

OMNI: What about the psychological benefits of being rich? Everyone has chauffeurs, maids, and servants.

McCarthy: I don't think that's really important. If you read nineteenth-century literature you don't find any indication of people taking pleasure in their position relative to their servants. As far as they were concerned, servants were part of the machinery. It doesn't seem to me that you will lose a very large part of the psychological benefits of being rich merely because other people are rich. As you say, "Anybody who is anybody." But what do we need those two clerks for? Why don't those two computers talk to each other? Interorganizational communication by computers is something that's hardly started.

OMNI: We're getting to the point where we have terminals that do communicate with each other. Of course, they don't communicate much.

McCarthy: My main complaint about technology has been the slowness with which it is developing. My impression is that the rate of technological innovation is so fast as to affect daily life, has been slower say between 1840 and 1860 than it was between 1600 and 1820. So people who complain about technological change going faster and faster are simply wrong. A lot of the complaints are in a sense complaints that technology is advancing too slowly that the individual doesn't see nearly enough improvement in his own lifetime.

Some important improvements are not appreciated. You don't spend five minutes a day thanking technological improve-
ments in sanitation and housing for the fact that you and your children don’t have TB. The normal attitude is to take health for granted until you don’t have it anymore, and then you complain. The same is probably true of wealth, insofar as technology has really contributed to your getting a higher salary than you would earn otherwise. But you don’t see the contribution that some specific invention has made to your increased salary.

It’s interesting to look at what inventions could have been introduced thirty or forty years before they actually were—the missed opportunities where the technology was available to build them. And there are a fair number of them.

Omn: Name one.

McCarthy: Well, I have a white-disc push-button combination lock on my front door. I can open it much faster than I could a key lock—especially in the dark. Mechanically it’s no more complicated than a key lock. It could have been invented one hundred years ago.

Another is the pulse jet engine. Are you familiar with it? Its only application was the German V-1 rocket during World War II. It is a very simple engine. Gasoline is squirted in and the jet explodes out the back end. The momentum as it goes up creates a vacuum that sucks air in the front, so that the thing goes ‘phut-phut-phut-phut’ all the way up. There is nothing in the technology of that engine that could not have been invented its being built in 1890. And it’s vastly simpler than a piston engine.

Omn: You and Marvin Minsky propose different solutions to the question of artificial intelligence and common sense. Can you give me a brief description of the two different points of view?

McCarthy: Minsky is skeptical—one could say more than skeptical—about the use of logic in artificial intelligence. But I and some others are optimistic about the use of logic to express what a computer can know about the world. What’s clear is that some modifications are required, and I expect to make progress using various forms of formalized nonmonotonic reasoning. And Minsky is skeptical about whether that will work.

But actually that’s not quite the whole story, because in addition to his skepticism about what won’t work, Minsky has positive ideas about what will work.

Omn: Can you describe his ideas in simple terms?

McCarthy: Maybe he can! I can’t. I can mention an idea of his that I’m skeptical about. This is the notion that in any particular situation, there is a dominant frame. Minsky and Roger Shank, of Yale University, have pursued this idea. The restaurant frame, for example.

Omn: Meaning that when you walk into a restaurant, you enter a context in which you speak, act, and understand things in a certain way that would make no sense if you were, say, in a skating rink?

McCarthy: Right. But that way is almost a truism. But the notion of a single dominant frame with subframes and so forth can be contrasted with the notion that information from a variety of sources interacts to define the situation. In other words, is the situation always dominant or is it dominated by a frame?

Here you are interviewing me. That is a frame. One could put some slots into that. But if we actually tried following the details of the conversation, would the frame concept allow for that? It works fairly well at the top level. You have a collection of questions that you want to discuss so at that level it works quite nicely. This interview with me is in that respect very similar to the interview we did for your book [Scientific Temperaments]. Or from my point of view being interviewed by you is similar to being interviewed by someone else. But if you’re not bored by this particular interview, that must be because it is in some important way, different from the others. And that isn’t quite caught by the frame.

Now Shank, who writes a lot of computer programs, seems to be finding that in order to make things work he needs ‘packets’ of information that interact with one another, no one of which is dominant. And from my point of view, I would say ‘Ah, yea, Shank is moving in the direction of logic, but how that’ll come out, I don’t know.’

Omn: These are all approaches to the same problem—how to represent knowledge?

McCarthy: Well, yea. Minsky and I have come to agree that the key thing is common sense knowledge.

Omn: Give me a definition of common sense knowledge.

McCarthy: Well, compared to scientific knowledge, one might define it as events.

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taking place in time and space and knowledge about knowledge—things like that. If I ask you, Is Andropov standing or sitting at this moment? you will say, I don’t know. And if I say, Think harder you’ll say, That won’t help. The question is how do you know it won’t help to think harder? And if I ask you, Does Andropov know whether you are standing or sitting? the answer certainly can’t be determined by inspecting any model of Andropov’s mind.

Omn. I’m trying to get a sense of the difference between a logical approach and this frame approach to representing knowledge.

McCarthy. From a logical point of view, the idea—and I’m not a purist—would be that general commonsense knowledge can be represented by a collection of sentences in a logical language, and that your goals can also be represented by such a collection of sentences. If x is a bird, and birds can fly then x can fly—that’s one argument I’ve been using that sentence because Minsky gave it as an example of how little logic is good for. His argument had to do with the fact that there are many exceptions. A penny, an ostrich, or a dead bird can’t necessarily fly. But maybe it’s sufficiently dense atmosphere and altitude sufficiently low gravity an ostrich could fly. So the exception has the potential of being true.

Omn. With your nonmonotonic logic you can get around all the qualifiers by adding a phrase that says, If nothing prevents it.

McCarthy. Basically, yes Omn. And then to check that you have to go elsewhere to other sentences. What prevents birds from flying?

McCarthy. Right. And in particular, what prevents this specific bird from flying? What if anything? And you have to do what’s called nonmonotonic reasoning. Namely, you have to assume that this particular bird can fly unless you know something about this bird that prevents it from flying. And the reason it’s nonmonotonic—are you familiar with the mathematical notion of monotonic function? Ordinary logic is monotonic in the conclusions that you derive from assumptions. In other words, if you add more assumptions then the conclusion that you could previously derive can still be derived possibly along with other conclusions. Ordinary reasoning has nonmonotonic aspects. If I tell you that Tweety is a bird, you will infer that Tweety can fly. But if I added the fact that Tweety is an ostrich you would no longer make that inference. So this requires some modification of the reasoning structure of ordinary logic in order to get this nonmonotonic character. But those of us who like logic think we can modify logic to accommodate the problems of the real world. That something of the kind was required has been known for a long time. Ideas on how to do it formally and still preserve the formal character of logic were first being developed from the middle to late Seventies.

Omn. Do you imagine some such logical system might operate within the brain?

McCarthy. What operates in the brain I think has got to be different. But I don’t have a clear picture of it.

Omn. So the idea is that regardless of what actually functions inside the brain these things can be done logically in computers? Do they have to be done logically?

McCarthy. No they don’t have to. You can design a computer program that will make logical mistakes.

Omn. Is an expert system a good example that demonstrates Minsky’s idea?

McCarthy. Some of the expert systems work according to still a third ideological basis. It’s a belief that if you just pile things on top of one another this knowledge can be represented—that no theory is required.

The expert systems lack common sense. The example I usually give is MYCIN which is a Stanford system that gives advice on bacterial diseases. It has no concept of events occurring in time. It has no concept of patient—doctor—hospital—life—or death. It does have concepts of the names of diseases names of symptoms names of tests that may be performed and so on. And it converses in a sort of English. But if you were to say to it, I had a patient yesterday with these symptoms, and I took your advice and he died. What shall I do today? it would just say input ungrammatical. I wouldn’t have understood about the patient dying. It doesn’t need that information for its purposes. But in spite of all that, it’s quite useful. To some extent it’s a kind of animated reference book.

Omn. That’s a very good term for it because it eliminates the notion of common sense which most people automatically assume is there when they see a machine making a diagnosis.

McCarthy. MYCIN is a particularly limited system. The interesting thing—similar to what I was saying about robotics—is that people are discovering how to get around the unsolved problems and make systems that are useful even though these systems can’t do some of the things that are ultimately fundamental to intelligence. I talked before about the usefulness of some of these very limited vision systems and here we have MYCIN, which is useful although very limited.

Still I take a more basic research-oriented point of view. These people make their very ad hoc useful systems and that’s fine. But I think the fundamental advances in artificial intelligence will be made by people looking at the fundamental problems. Now for some reason, artificial intelligence is the subject of a great deal of impatience. When it had existed only for five years people were saying ‘Yeah, yeah you’ve been unsuccessful.’ But when we compare it to say, genetics in which just about one hundred years passed from the time of Mendel to the cracking of the genetic code. Now there may have been periods when people thought they would be able to create life in a test tube by 1910 or something like that but we don’t remember that today.

Omn. Why do you suppose there is this unwarranted excitement and anticipation?

McCarthy. Well there’s always been an unwarranted anticipation in science on the part of some people. I think some of the expressions of disappointment are dangerous—people taking the fact that it hasn’t succeeded so far as evidence that it won’t succeed at all. On the other hand there has been some overoptimism within the field. Party that’s because if you see only certain problems you can imagine a plan for overcoming those problems. But if there are more problems that you haven’t seen you will be disappointed.

Omn. Decades ago, long before the enactment of the Privacy Act of 1974 you advocated a bill of rights published in the September 1966 issue of Scientific American to protect citizens from the abuse of information collection made possible by computers. You advocated national data banks as very important social tools, but wanted to assure that their contents would not be misused.

McCarthy. I made a proposal for dealing with the misuse of information that a person had a right to know what information about him was in the data banks that he could sue for invasion of privacy that he could challenge information in the file and so on. I don’t know whether my article had anything to do with it but in many places these ideas have been incorporated into laws and the thing has been elaborated upon considerably. Now I’m beginning to think my 1966 proposals were a mistake.

Omn. Why?

McCarthy. To some extent they pandered to superstition—the superstition that people can and will harm you on the basis of trivial information. For example Princeton University is worrying about whether my privacy would be violated if they release a photograph of me to Psychology Today. It’s a little bit like some primitive superstition that if you have a person’s nail clippers and a few locks of hair you can cast a spell on him or that if you know some one’s true name you can harm him.

Omn. Don’t you think there is some value...
McCarthy: They might have forgotten some very important things. Or they might have gotten them wrong and some poor fellow whose actual offense was entirely unrelated was confused with somebody else.

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WORLD NEWS

Continued from page 113

yes, thank you. My name is Willett. The
the, including its leader looked up
wonder. It was all over the camp that con-
tent, in a strange voice, buoyed by the elec-
tronized barrier. An event now raining
indefinitely. I have with me here Dr. Val-
etine Brodie, late in reporting for duty but
better later than never. Mr. Dassel Gropius
and Mrs. Edwina Goya, who is about to,
and parature and urgently requires the help
of an accoucheur or ease. Let us come
down and land. Remove your peecurst.

Bartlett said to O'Grady. "Let them stay
out there."

Vanessa stood, unable to think even to
breathe. Dr. Adams was near her. Gently
like taking a toy from a child who has just
dropped off. Dr. Adams untold Vanessa's
fingers and let the warm little gun plop
gently into her own hand. She released the
safety catch. Vanessa came to shivering
"Did you hear what I heard?"

"It's your husband. Vanessa. It's Dr. Val-
etine Brodie."

My husband. How did you know?"

You've talked of your husband often
enough—before correcting yourself of
course. I think everybody will be delighted
to see your husband. Better than being
rated to Bartlett. Head of Enterprise.

Can see him—his waving. And then
fearful, knowing there was much instability
about perhaps even in seemingly sane
Maude Adams, Vanessa asked. "Why do
you want that gun?"

O'Grady said to Bartlett. "You heard what
he said? There's a woman up there who
needs help."

She won't get it from us. This is not a
maternity hospital."

Deactivate the barrier," said Dr. Ad-
ams pointing the gun at O'Grady. O'Grady
only too glad to obey, did a clumsy
have to. Don't! gesture at Bartlett and leaped
off toward the concrete block that bore the
symbol of a sitting cat. back view with a
single thunderbolt at which as at a tire the
animal seemed to warn itself.

Bartlett pointed his hipgun directly at
O'Grady and shouted. "I'm warning you
do you hear me?"

Best get it over, said Dr. Adams. "We're
short of time. And she's heavily shut!"

Bartlett. Bartlett spun howling mad eyes
looking for something, somebody then just
staring holding huge two gibbous moons
He went down very heavily and the earth
in temporary repose, did not bounce him
O'Grady saw coming back agape going
into an ape droop unable to believe. He
saw Dr. Adams's smoking gun.

Instinctively, he went for his own cold
as yet unused.

Dr. Adams said. "Are you going to be
a good boy? Dr. O'Grady?"

O'Grady licked his lips nervously. His
hand moved toward his hipgun. Dr. Adams
shot very neatly at a point just five centi-

ometers in front of his left boot.

Are you, Grady?"

O'Grady grinned sheepishly and
shugged. Then he heaved his weapon down
It was a heavy weapon. "Not too good
he said, that pecculier."

Alcohol laughter—those help. "Dr. Ad-
ams said. "And the cold dose of animal fear
The earth moved rather urgently. The moon
seemed to be breathing on them.

"He was mad," said O'Grady looking
down on dead Bartlett. "Clever but mad.
Who takes over?"

Here he comes now," Vanessa said. The
pecicrest was off. She ran toward where the
helicopter was preparing to touch ground.
Val dirty leaner than he had been mono-
strously unshorn. He ran straight to her. They
embraced at first awkwardly then not so
awkwardly Edwina grasping, appeared
upheld by Dassel Gropius at the top of
the ladder. A storm seemed to be blowing
in from the moon. The ground felt like a
ship's deck in storm birth. Hecate matron of
women in childhood, looked down in
menace. The ship said Vanessa. The
ship from now on

Transportation?

A dickybird hop, said Willett. Back
on board, Edwina. And in ladies. I've
always wanted to be in a spaceship. And
so he set the blades whirring again.

Dassel Gropius looked down at dead
Bartlett and said. "Who did that?"

Everybody looked at Dr. Adams.

"Thank you," said Dassel. I didn't really
want to do it. I promised Edwina, but still...
"The corpse heaved gently on its
unquiet bed. I didn't know him you
see.

"Yes of course," said Dr. Adams. You
have to know him. Have known him she
corrected herself.

Ah! Val said. eyes on the wall chronom-
er in the viewing room. "It's the moment."

The crew, or citizens of America were
hardly aware of the blastoff. The magnetic
gravitation surrogates of the great ship kept
steady even the breaker of water that
Edwina Gropius put to her lips. It was a three
day trip to growing Lynx. The beast was
bellowing, trembling, nipping at the pros-
pect of soon leaping on its prey. What
the hell was the thing made of? Pure iron ore?
The mass tugged at the craft as it became
a new, it diminutive satellite circling the
hydrogen-misty planet in ninety minutes flat.
The crew of citizens saw on the great
screen a moon lacking all the features that
every schoolboy was familiar with the
seismic disasters having ravaged it like
some dreadful disease.

Meanwhile work went on in Dr. Jumal's
laboratory. She a pretty girl, flushed with
effort, her attractive low brow corrugated
with thought. Worked on the epsilon
link equations Cybernetics and automa-
tion cooperated in turning out successive
versions of the tiny complex artifact that
would provide the clue to more thrust. The
calendar said cat 10.

The calender clicked at artificial mid-

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night to Cat 9. Then Cat 8 followed. Artificial
dawns artificial moons, artificial rights—
their ingenious lighting system clung des-
perately to the only temporal pattern they
knew. But that must change; there must be
no buffers against reality. Meanwhile Earth
grew closer. the moon was huge and
blinding. They drank the sun like some strength-giving
poison for attack. For resistance. It was hard,
especially for Mr. and Mrs. Gropius to be-
lieve that the terrible cosmic drama was in
progress outside the tough walls of their
world. These two cooped at the baby who
yelled in self-centered vigor. He had a name
now. Joshua.

Cat 7 Val refused to be desperate. If the
job could be done, it could be done by
Lilian Jumel. If the job could not be done
then they would all perish. Nobody had any
right to life. Life was a free bestowal. Still
as they sailed between the Scylla of moon
and the Charybdis of Lynx between the
steam of one and the ravaged face of the
other animal panic grew in those few of
them who saw the movement toward cat-
aclysm on the pterarchal screens. Val
dragged desperately into memories of
books he had written. He found nothing.

Then on cat 6 Lilian Jumel collapsed—
overworked, lacking sleep, full of despair.
She had colleagues of course competent
but mere journeymen compared with
her. The megaproagon was her brainchild.
O'Grady, quieter than he had been, dif-
fently suggested a pacifier. Val said no—
a mild hypnotic only. And then he thought:
Why use drugs? The book he had written
so many eons ago, the White and the Walk
of the Morning, had an amateur hypnotist
in it. Jess Hartford or Harvey or somebody
Val had done his homework; he always had.
While Jumel writhed on her bed in the in-
tervals of waking hysteria, Val brought calm
to her bedside also a swinging gold watch
borrowed from Dashiel Gropius his father's
gift to him on graduation. He calmed her
with the rhythm of gentle light and in
vocation. He got her into deep sleep.
He spoke to her mind, calmly always calmly.
He said, "There are many ways out of
the problem. The very bounces of Lynx as it
eats the earth may provide the jolt needed
the extra split-second boost. There are ap-
parently a great number of asteroids spin-
ning about. Who knows whether the pull of
one of them, infinitesimal though it may be
may not ease the gravitational problem that
faces us?"

"There is nothing to worry about. You
have all the time in the world. Things are
not really so desperate. Nothing is all that
important. We have all known the rich life
of Earth. This new space life is a mere bon-
us, a discardable extra. Rest dear Lilian
Rest as long as you will. Everything is being
taken care of."

On cat 4 she rose from her bed without
a word to anyone except a demand for
surrogate orange juice and coffee. She
showed washed her hair dressed. She
walked calmly to her laboratory where

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Durante, Lopez and Boudinot were knotted over equations. All right she said and they went to work.

On CAT 3 having achieved a velocity that kept the craft continuously retreating from the impending point of collision Jumul spoke hopefully: And then all work stopped as they went to the great screen to see the end of the moon.

The moon had been circling its new host in a regular satellite rhythm. But Earth was eventually going to be in the way of one arc of its revolution. This had always been evident and there had been distractive speculation as to what the moon would do—wobble out of its course be hurled to the condition of a solar satellite. But what happened now the obvious the banal had always been the expectation of most of the American team. They saw the moon come gracefully wheeling approach the Earth and then not brutally not even rapidly shatter to fragments against it. The point of impact they adjudged was the dead heart of Europe. The moon shattered and they gasped. Little Joshua Gropius howled but not for the moon. The moon broke and went into gracefully sailing fragments that slowly changed to sunlit dust and most beautifully tried to become a dust ring around Lynx. But Earth was in the way. A ring spun of most lovely pearly configuration but at the point of impact with Earth shattered to amorbid dust only to reform when free of that gross body.

On CAT 2 with no large fanfares of triumph Jumul announced that they were ready to blast off.

And so with a desperate seeming wrenching that even caused a brief dysphasia of the magnetic gravitor the spaceship America broke free of the pull of Lynx and soared into free space heading in the direction of Mars.

What they all had to see now and yet did not wish to see was the end of their own planet. As they sped away from Lynx they saw on the big screen the great hump of the predator with its ring satellite that had once been the moon of Shakespeare and Shelley and a million banal songs, growing ever more disjunct, ever more something out there. Val assembled the team in the salon. He had never yet worn the black gear that was the uniform of the citizens of this new America and he came in looking if anything, scrutinizer than he had ever been—clad in the worn trousers and sports coat and torn boots of his, and Willett's, anabass.

He said: We are as you know about to witness the end of the earth. It seems to me that we ought to drink to something—ourselves our future perhaps our past. We have no past but our future is limitless. Dashiell Gropius wheeled in a portable cocktail bar that had glasses and ice.

"Mr. Gropus. Val said. "will soon be the most important man in America or on America. We must agree sometime as to the more fitting preposition. In his hands will be the organization of games. Most of the citizenry looked puzzled even at first. I mean that all we can reasonably salvage from our past is the game of skill or chance which is based on the abstraction of number. All else—literature, metaphysics music—must be accounted mere nostalgia nothing more. What have we to do with poems about love under the syca more under the moon?"

"Music" said Dr. Adams. "We absolutely must have music."

"Only if we learn to make it ourselves. What right have we to listen to instruments long dead scraped or blown in the service of the glorification of a world that no longer exists? No we must learn to make our own. Vanessa saw a hardness in him that restored the lineaments of Bartlett. But he was a more reasonable Bartlett.

"Let us at least before Earth ends said Dr. Adams, "hear some of Earth's music. She took from her shoulder a music cassette. Val smiled with understanding. "We all have. she said. And after this performance you are at liberty to liquify it forever."

"What is it?"

Mozart's Jupiter Symphony.

The last movement then. Take this ladies and gentlemen as a demonstration of our power, our very human power to enclose through intelligence and skill the huge but crass and stupid events that are the result of sheer. blind celestial mechanism. The earth is dead or nearly: Long live the human world!"

The music cassette was inserted in one of the recording machines. Vanessa's finger pressed a golden button on the instrument panel. And to the sound of the music poured—the essence of human divinity or divine humanity made manifest through the gross accidents of bowed cattail and blown reeds. And on the screen they saw what was. that music diminished and made seem remote even trivial or else take on the pat tern of choreography—cosmic indeed but seemingly humanly contrived. They saw the planet Earth and the first patch of Earth to catch the blow was the northern Rockies which must already be leaping with stupid love to the claws of Lynx. They tasted the heartening fire of God. its little benignant brutality as Earth shatter ed—core of dancing water, crust of dust—and at one time torn an outer ring satellite of its successor in the dizzying annals of the sun dance. The moon was a ring, and a greater ring. pulverized Earth spun already in perfect concentricity, luminous dust made of the dust of Bartlett and the Tagliatello brothers and Calvin Gropus and his cat and millions and millions more all. indeed. who had scratched that fertile surface and watched the wonders of mind rear them selves upon it Mozart too was part of that dusty ring but miracle Mozart was also here tender, triumphant, drowning even the howling of a child. The rhythms of Mozart bore them on into space, the beginnings of their journey.
IN THIS WORLD, MAN FINDS BUT FEW PRECIOUS THINGS...

HE CREATES THE REST.

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Robots are very much alive in the New York City studio of Catherine Field. Two life-size forms ignore you at the door while a cabal of mechanical masks stare sightlessly from the floor. The walls are hung with robot drawings and a large mural depicting an automa passageway—a Fellini-esque street parade of homunculi. Mechanical beings in various stages of construction casually occupy worktables, bookcases and partitions. Most interesting is a "first generation" of about 25 robot sculptures approximately 1.5 feet high. These creatures, endowed with human gestures, jump, prance and wave mocking the more serious devices that constitute contemporary robots. Hung individually on their own stark white wall, this group 'collectively forms a spiral, symbolizing its own ascent into life," says artist Field.

The structural parts of Field's sculptural robots are largely sheet metal, aluminum, colored cable wire, and screen. One sculpture is made almost entirely from sheet-metal shavings. Put together with rivets or nuts and bolts, many of the sculptures have movable parts and can take different positions depending on the artist's mood. Other materials, composing the torso and features of these saucy characters include computer chips, circuit boards, filters, calculators, temperature dials, numbers, springs, chains, even some crab claws.

Field cites Mary Shelley's Frankenstein as her primary literary influence. Shelley's Romantic portrayal of the Prometheus myth inspired Field's exploration of the relationship between the creator and her defiant creation. The myth of humans stealing fire from the gods could become a reality, she says, with the continuing development of artificial intelligence.

Fernand Leger was another influence. In the Twenties, the French painter envisioned a new civilization whose core was the machine. Field's work focuses on our cultural infatuation with new technology; the computer and the proliferation of information. In an aesthetic sense, the robot becomes a starting point for her investigation of figurative form as, ironically, robotic constructions frequently are based on intensive imitation of human form.

Field finds much of her material on the street and in junk shops. In her studio it steadily grows into collections that are transformed into sculptures. Having worked on construction sites with sheet metal, she finds this medium comfortable for her. "I was influenced," she says "by a series of survival jobs that made me consider the existence of mechanical entities. And an investigation of robot-like mergers became inevitable."

But enough of the word robot. Field prefers to call her creations "Data Dolls," explaining that even inanimate objects have a spiritual nature. The Data Dolls then have ceremonial significance. "Sometimes I see them as part of my shamanistic dreams," she confides. The Dolls are also a "form of revenge on a one-shot manufacturing ideology."

While Field views part of contemporary culture as having elevated technology to a godlike status, her Data Dolls are representative of high-tech in its primitive, mythical stage. The dolls are concerned with the creation myth of artificial man. They are a means of recording and participating in this mechanical birth she maintains. "But on the other hand, technology has also acquired negative mythical connotations. There are constant fears about whether we can control it."

It has been prophesied since the fourteenth century that machines are destined to supplant the human race. Although more immediate concern entails whether robots and machines will displace humans in the labor force.

Field examines robot replacement paranoia in a series of drawings. In these collages angry robots—made from newspaper want ads and employment listings, oil-stick paintings and glitter—stalk like bad dreams across a paper ground as though they were about to take over your job.

Continuing her investigation of the mystical forces of technology, Field has completed a series of "Data Masks." One mask is composed of nearly 100 computer chips, with empty words for its eyes and mouth; another is a frightening Medusa tangle of electrical wire. These masks are to be worn by humans, she says, when they address themselves to the spirit of technology. A person dons the mask and is endowed with the power of the computer just as earlier peoples put on the masks of powerful animals, lightning and thunder and gained the animistic power of these natural forces.

Meanwhile she has also begun construction on larger robots that deal with specific sculptural concerns stressing their formal qualities—scale, weight, mass. Position in space, dimensionality—like compared with the Data Dolls which were dominated by their subject. While Field imbues robots with mystical energies, one piece in particular speaks loudly of her view of their ultimate endurance. It is the only drawing she has done on the concept of nuclear holocaust, a portrait entitled 'And We Survived.' Its subjects—a robot and a cockroach.

Data Mask: to evoke the spirit of technology
The 14 students intently study their work sheets, entitled "Lo Res Graphics Aid for the Apple II," while the instructor, Bob DuPree, switches on the computer. After he punches a few commands into its keyboard—an illustration of a spigot pouring a yellow liquid into a beer mug appears. The word sub lights up under the picture. The students smile.

"Now this is a very professional program. You're not going to be able to do this in two weeks," warns DuPree. But he quickly adds that they should have no trouble learning how to draw primitive objects—squares, triangles and other geometric figures—on the computer. A few minutes later DuPree is teaching the kids how to draw a line.

"Now that I have my special random color and my special random number, what do I want to do?" DuPree asks.

"Plot," calls out a boy wearing a blue Bruce Springsteen T-shirt.

"Right," says DuPree. It isn't long before there's a rectangle on the screen and shortly thereafter a rainbow of vibrant colors begins to pulsate through it.

It is one of those brutal summer mornings when the air is so hot and dense that it slows you down. But these kids aged ten to seventeen are in an air-conditioned classroom at a computer camp, which is run by Marist College, a small private school specializing in computer science. The college is located in Poughkeepsie, New York, on an idyllic 100 acres overlooking the Hudson River midway between New York City and Albany. The morning class is a sort of crash course in low-resolution color graphics. In the afternoon the kids will be in the lab, where they can put what they've learned to practical use on IBM Commodore Pet and TRS-80 computers.

Computer camps are now enjoying the vogue that summer tennis clinics did in the early 1970s. Since Denison Bolles, a thirty-year-old computer consultant, founded the first one near Santa Barbara in 1980, dozens of similar camps have emerged all over the country. Ohio State University has begun a program and so has the Hill School in Pottstown, Pennsylvania. Atari has four camps in Pennsylvania, North Carolina, Wisconsin, and southern California.

Though the curricula differ from camp to camp, the idea is basically the same: to expose youngsters to computer programming. At Marist, the kids learn BASIC and APL, PILOT among other languages, is taught at Computer Camp International. Other camps offer healthy doses of FORTRAN, PASCAL, and assembly language. Six and seven-year-olds can begin on LOGO, a language that features symbols and a "turtle" that allows kids to draw pictures. LOGO is even taught to children who haven't yet learned how to read.

Most camps integrate three to five hours a day of classroom and hands-on instruction with the usual array of summer activities: volleyball, softball, Ping-Pong, swimming, and the apparent game of choice for young computerphiles, Ultimate Frisbee. Camp directors everywhere complain that the kids don't get enough sun and sports—they're too attached to their computer terminals. Clark Adams, the director of Computer Camp International in Moodus, Connecticut, says the counselors have to demand that the students turn off their diskettes and jump into the pool.

Computer camps employ a corps of two to four main teachers, computer professionals who usually teach on the college level. They're assisted by several counselors, men and women in their early twenties who are computer-science majors in college or graduate school. Camp fees are quite high—averaging around $800 for two weeks. Atari runs the longest sessions—month-long affairs—that cost almost $1,600. Marist College, at $750, offers scholarships for all or part of the tuition based on merit and need.

The steep price has naturally given the camps a somewhat elitist complexion. The noted French author Jean-Jacques Servan-Schreiber sent his son to computer camp and Edson de Castro, the founder of Data General, the giant minicomputer company, sent his kids. There are few minority kids and the boys outnumber the girls.

Like tennis clinics a decade ago, computer camps are becoming the vogue in summer recreation.
The Artist
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Can I help? What's the catch? There is no catch

The creative process is as dependent on your ability to comprehend it As it is on my ability to create it

Anyone who can't understand that doesn't deserve to share it's joy

I knew there was a catch
T he mood in the United States at the end of World War II was jubilant. Hitler lay vanquished, and even the incomprehended terror let loose over Hiroshima and Nagasaki seemed to hold a bright promise: the limitless power of the atom. Like the Allied victory itself, the atom was to be the foundation of a future world peace made lasting by an inexhaustible supply of energy that would soon abolish all forms of material want.

Now, with dozens of nuclear power plants running in the United States—two of them perilously close to New York City and Chicago—it is somewhat difficult to see our situation clearly. In his sober and meticulously documented book *The Cult of the Atom* (Simon & Schuster), Daniel Ford, formerly the executive director of the Union of Concerned Scientists, traces our path from the high hopes of the 1950s to the fearful disillusion of the 1980s.

The story told in *The Cult of the Atom* has its heroes and villains. The heroes are the people who blew the whistle, warned of dangers, pointed to faulty calculations, and urged expanded testing programs and accident simulation on small-scale models. Stephen Hanauer, a member of the Advisory Committee on Reactor Safeguards, noted in a memo in 1971 that 'not a day goes by without one or more mishaps at an operating reactor,' but no system was ever established to look into these problems.

The villain of the book is the Atomic Energy Commission (AEC), which repeatedly covered up for the incompetence and sloppiness of its major contractors. Since its creation by President Truman in 1946, the commission has been curiously subservient to private industry. According to Ford it has 'issued licenses to build commercial nuclear plants—as routinely as the State Department issues passports to travelers. When scientists began to realize possible pitfalls in the design of fission reactors in the 1950s, the AEC locked the other way.' Rather than address the technical problems, the commission passed legislation like the Price-Anderson Act, which limited the liability of power companies for nuclear accidents.

To anyone following Ford's account the only surprising thing about nuclear accidents is that there aren't more of them. His narrative, which amounts to an accusation of willful negligence on the part of the AEC and the Nuclear Regulatory Commission, is full of documented evidence of dangerous errors in judgment: horror stories that might even be entertaining if the subject weren't so grim. For example: we are told that the explosion of a test reactor in Idaho on January 3, 1981, was deliberately triggered by a man who suspected that his wife was sleeping with a fellow worker at the reactor. Both men were killed, along with an innocent bystander at great risk to the environment.

In another incident at the Brown's Ferry Plant, near Decatur, Alabama, an electrician's aide, with only one day on the job, set a fire that burned for seven and a half hours, he was searching for air leaks with a lighted candle.

These are not the kind of stories that the government wants to have reported. The papers of the AEC lay buried until Ford cracked open the archives with a lawsuit brought under the Freedom of Information Act. The information clearly indicates that under prevailing conditions and policies, no nuclear power plant is safe. What's more, with the high cost of fuels, nuclear power isn't even cheap.

It wouldn't be fair to ascribe this nuclear debacle to sheer greed; though large sums of money were at stake. The real culprit is the leniency shown by the government's supervisory agencies toward private corporations. This fateful laxness is at least partly attributable to an inappropriate idealism. But those good intentions don't make the present situation any less frightening.

So, in the fourth decade of the Atomic Age, the dream of nuclear peace and plenty has faded. Hope for cheap and safe atomic energy may have to be deferred until the time when nuclear fusion—as distinct from nuclear fission—becomes a practical power source. 

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EXPLORATIONS
CONTINUED FROM PAGE 134

girls by about five or ten to one. By and large, the campers are highly motivated spurred on by a keen awareness of the need to become computer literate.

Suzanne Busby, a fifth grader, said she wanted to come because she wanted to be familiar with computer languages. Her friend and fellow camper, Sybil Caligari, also a fifth-grader, has her own Apple II. Suzanne became interested when Sybil got her machine. While the successful program, Sybil explained that her aunt, in her twenties, was too old for computer camp. "So I'll be able to teach her when I'm finished," Sybil said proudly.

Kelly Anson, sixteen, has already taught himself BASIC on his TRS-80. "I've written a couple of music programs," he said. "And I'm pretty sure I want to make a career in computers. But I wanted to learn how some other computers work."

Marist campers are expected to complete a term project on the computer which can be either frivolous or serious. But I always emphasize to the kids that this is not school," insists Dr. Lawrence Mancini, the program director. They're supposed to have fun. There are some rules though. No stereo or TV sets. Lights out at eleven. We do not allow packaged video games. You can play a game only if you create it yourself.

While most summer camps divide up their groups according to age, computer camps seem to be more similar computer experience together. Marist has three levels of classes: beginner, intermediate, and advanced. Computer Camp International has a five-level breakdown. At the Hill School, each week-long camp session features a specific in-depth program (either advanced or beginner) in a given language or special subject.

Many campers already own their own computers, and while they're not encouraged to bring them along to Marist (the point is to learn how to use a machine you don't own according to the director), they are welcomed at other camps. Children can be seen lugging their Apple IIs and Atlases at the beginning of a session at Computer Camp International. The computer lab here is an inadequately cooled, rickety-framed one-story wooden building. But the kids don't seem to feel uncomfortable. Their last hour of lab is free time and that's when they're allowed to play Raster Blaster, Jawbreaker, and electronic poker.

And it seems healthy to report that computer campers don't differ much from ordinary summer campers. They're constantly complaining about the awful food they cheer delightfully when a waiter drops a plate; they call fruit drinks "bug juice" and the boys still raid the girls' bunks after the counselors fall asleep.

But that's where the resemblance to ordinary camp ends. The instructors may wear tank tops and shorts to class but they take their work seriously and expect the
kids to do so, too. Lenny Huber, an instructor at Computer Camp International, says, 'I don't think of it in terms of summer camp. I think of it in terms of school. It's work, and they're expected to work hard.'

Director Clark Adams however points out that the kids might even be more attentive and faster learners than their elders. "When the machine says SYNTAX ERROR, the kids know they made a mistake," Adams says. "Adults don't believe the machines. They kick the computer when they make mistakes. They act out their anxieties on the machines."

The rush to teach kids about computers may be causing at least one potential problem. Some children are under the mistaken notion that knowing how to run a piece of prepackaged software is all there is to operating a computer.

"Some of the kids are hardware-rich and imagination-poor," said David Yuleo, an instructor who works for Clark Adams. "They think they can program, and they can't. I had a kid last week who told me he knew all about BASIC. He really needed a strong dose of LOGO. He didn't understand the difference between following someone else's rules and making his own. That's a whole other level. That's what computing is all about. And presumably, that's what computer camp is all about.

CAMP GUIDE

There are over two dozen computer camps in the United States and some of the most popular include:

Manast College
C/o Dr. Lawrence Menapace
Poughkeepsie, NY 12601
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Computer Camp International
Dr. Arthur Michals, Administrative Director
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Santa Barbara, CA 93109
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NEW WARES: HARD AND SOFT

Sinclair beware. Texas Instruments has come up with some competition for that inexpensive computer marketed by Timex. TI's machine also sells for less than $100 and is designed to be a powerful personal computer for beginners. The TI-99/2 has a 16-bit microprocessor and uses software on cartridges or cassettes. In addition to the typical fare—from household management to computer games—the software library includes two programs providing simple step-by-step instruction for novice computer programmers: "Learn To Program" and "Learn To Program BASIC." The new computer's 4.2K bytes (4,200 characters) of random-access memory (RAM) can be expanded to 36.2K bytes.

Artificial intelligence like the human variety, can be quirky. Sometimes exciting. Sometimes confusing attempts before the computer will respond to your command. But the Savvy system is designed to give Apple II computers a more human understanding. The device is half-hardware/half software. It consists of a circuit board and accompanying kit that plug into the Apple. Savvy's secret is a program that enables it to recognize arbitrary groups or patterns of about 100 words. Now instead of composing codes to your computer, you can come right out and ask direct questions like: "How much money do I make?" or "Can I see the inventory?" ($350 from Savvy Marketing International, 100 South Ellsworth Street, Ninth Floor, San Mateo, CA 94401.)

The Model 20 DataVoice Desk Top Communications System is an intelligent telephone/electronic mail system and computer data terminal combined into a single unit the size of a typewriter. This communication workstation makes it possible to communicate by phone review computer data, and transmit electronic memos simultaneously. The telephone handset is equipped as a display monitor. The unit includes an electronic date book that shows the time, date, and up to 60 appointments. The DataVoice plugs into the stand telephone line ($2,495 from Basic Telecommunications Corp., 4414 East Harmony Road, Fort Collins, CO 80525.)

CREDITS

Humans would characterize as thought-like. "When I first began to work with my robots," he admits, "their movements seemed so controlled and intelligent it looked as though they were alive, even though I knew they weren't. As we become more sophisticated at giving robots freedom to operate, their reactions will appear even more alive to us. We will begin to see a psychology behind their actions."

This perceived psychology is expected to become more rich and varied. As robots move from factories to settings where they interact more often with humans, their gradations and complexities of robot-psych will increase. With this in mind Koto Matushima, dean of engineering at Tsukuba University, has already analyzed the behavioral differences that would exist between an industrial robot and a robot nurse in the factory a robot would merely have to work hard to be accepted. A robot nurse, however, "would have to project an air of calm, composure and friendliness," he says. "For the human patient wouldn't trust it if it followed the instructions, or let it care for him. To establish such a relationship says Matushima, would be simple. The human would communicate with the robot by issuing commands, while the robot would only make requests of its human patient."

Further in the future, robot visionaries like Richard Gregory of Bristol University in England believe that differences in robot behavior may give rise to various species of robots. Different breeds will have different patterns of response depending on how they process information and the kinds of decisions they are designed to make. These robots will be as different from one another as priests, generals and advertising executives are among humans.

Right now there are three distinct obstacles that stand in the way of building robots with psychological potential. First, powerful computers must be reduced to a small enough size to fit inside a robot's body. Second, artificial-intelligence software will have to be improved so that a computer can evaluate and act on the flow of information from its sensors internal solving abilities pattern-recognition systems, and locomotion—all at the same time the software must also help the machine learn from its past actions. Third, the robot hardware must do more than satisfy the basic needs of locomotion and balance maintenance, it must elevate the machine's skills to a higher level of coordination to interact more freely and fully with its environment.

When will all this happen? At the rate computers are shrinking, a tiny mighty micro powerful enough for a robot could be developed within five years or less. Already there are mobile microprocessors powerful enough to allow robots sufficient physical freedom to interact with their surroundings. And there are computer-software structures called expert systems that allow computers to process information much in the same way as human experts do learning from past actions and storing the newly gained knowledge for future use.

Less well developed is pattern-recognition software, the key to letting a robot "see" the world as humans can. Still the basic principles are already known and a few years of experimentation with video-sensor equipment on robots should produce machines that have enormously increased vision capabilities.

Robot hardware is under intense study as well. There are robot legs walking at Waseda University, in Tokyo, and at Ohio State University laboratories. Robot arms are flexing at Tokyo University and at NASA's Jet Propulsion Laboratory. Robots are already putting their primitive hardware to work in factories around the world.

As Tsukuba University's Yutaka Kanenyama observes, "We are solving the mechanical problems quickly. When the computer engineers perfect their artificial-intelligence systems we will be ready to create truly intelligent robots. Then we will have true robot psychology. We are not there yet, but we are very close."

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COMMUNICATIONS
CONTINUED FROM PAGE 12

Mixmasters
The December 1982 Games column refers to a game called Armattan as "Arthur C. Clarke's Waico." Coming to life...Unfortunately, you have mixed your masters. 'Waico' was conceived by Robert A. Heinlein, rather than the sage of Sri Lanka. It is enough to give credit to Clarke for his own remarkable ideas without stealing Heinlein's rightful thunder.

C. Kevin McCabe Chicago

No Place for a Pessimist
I read the interview with Theodore H. White [November 1982] with great interest and I agreed with everything he said until he responded to the last question. I am outraged that a man with such insight would say something so archaic as 'In space exploration, I can't see any other nation silly enough to waste so much money on a wild idea that may not actually pay off.'

I couldn't believe it. And as if that comment weren't bad enough, his next remark was inexcusable: 'There won't be any colonization of space. Nobody wants to go there.'

As a member of the Planetary Society, I would love to volunteer to work and live in space. I insure the other 111,000 members of the society would gladly join me.

Our greatest accomplishment will be the expansion into space. Anyone who reads OMNI will agree that there are unlimited advantages in this venture. We must not give up space exploration, we must increase it.

Cheryl Glasser Apollo PA

I am sure that Theodore H. White knows more about politics in America than I'll ever know. But as a woman, a philanthropist and a believer in the value of space exploration, all I can say is: Thank God Mr. White only writes about the nation's politics and doesn't actually determine them.

Sharon Holland Glastonbury, CT

UFO Abductions
The October 1982 issue contains a UFO update [AntiMatter] by Alvin Lawson in which he dismisses UFO abductions accounts as being only a kind of universal Jungian "birth trauma" memory. He falsely describes my book on the abduction phenomenon, Missing Time, as supporting this outlandish theory.

Lawson apparently believes that superficial resemblances here and there prove a cause-and-effect relationship. He sees the quasi-laboratory setting in most UFO abduction accounts as being a mere membered hospital obstetrics room, any kind of hallway becomes the birth canal, and so forth. Elsewhere he has taken his theory to more extreme lengths. He has written that abductees describe UFOs as circular because these witnesses actually remember themselves at the dawn of their consciousness—as little round fertilized eggs. When the UFO occupants are described as wearing backpack type equipment the witness is simply recalling himself as a fetus. If you believe this you'll believe anything.

The problems with Lawson's theory are manifold. He seize upon hypnosis—frequently employed to retrieve abduction memories—as providing a plausible context in which birth traumas can hypothesized float into consciousness—disguised, for all unexplained reason, as UFO experiences. The fact is that dozens of these similarly described UFO abductions are remembered without hypnosis.

Most abduction reports have a solidly physical side. Abductees are often missed and searched for when they suddenly turn up. They often bear virtually identical physical marks—Jungian archetypes, as far as I know do not leave scars.

To say that Lawson's theory is inadequate is not to say that someday somehow a mundane explanation for the abduction phenomenon might not appear. No one can be comfortable with the implications of these seemingly unbelievable accounts. Who would not want to wash away the terrifying notion that men and women are being used as involuntary laboratory subjects for some unknown alien purpose?

Budd Hopkins New York

Psychic Satire
It is sometimes difficult to tell just how an article in OMNI is intended to be taken. Usually the fiction is labeled as such, and an experienced reader expects to find oddball items in the Antimatter pages, and satire on the Last Word page. But the Psi-Q Report by Stephen A. Schwartz and Rand De Mattei [Mind December 1982] while apparently intended as a serious analysis of an experiment on 'psychic powers,' has the potential to be one of the most amusing satires you have ever published.

The only thing not funny about it is that it is sadly typical of the uncharitable analysis this field usually produces. After stating that statistical analysis predicts that the success rate they achieved could be expected by sheer chance at least once in sixteen trials Schwartz and De Mattei proceed to characterize their results as 'better than chance.' The similar self-contradictory analysis of the "creativity test" toped off by a plea for governmental or industrial funding for research into what is clearly more a popular religious belief than a relevant scientific hypothesis makes this report a true gem.

As a scientist (biochemist) I am concerned about the sorry state of the American public's understanding of science. I have given lectures in the philosophy of science in an attempt to educate some small part of the public which is being so poorly served by the schools and most of the popular media. I intend to cite this article in future lectures as an example of the "my mind is made up, so don't confuse me with the facts" school of pseudoscience.

Norman Hall
San Diego, CA

Praise for the Educators
I read with interest Joel Davis's article "Olympics of the Mind" [Mind December 1982]. As an educator whose students have participated in the program since its second year and as the person who serves on the OM organizing committee for New Jersey, I feel qualified to supplement the article with additional comments.

Dr. Gourley and Micklus, the program's originators have served education particularly gifted children's education, well. No program is perfect, however, and several of OM's aspects require clarification. Mr. Davis's article implies, and OM officials tend to foster the impression that the activity is most appropriately geared to students already identified for formal programs for the talented and gifted (TAG).

My experience demonstrates that this is not the case. We have always opened participation to anyone who wishes to take part. As a result, in addition to a high participation rate we have sent winning teams made up of average and learning-disabled students to the national tournament.

A second clarification concerns the statement that problems offered are varied to suit the participants' ages. This is not always so.

For example, one of this year's problems required students to read sections of The Odyssey and rewrite them in a humorous vein. There was some concern over the appropriateness of some sections of The Odyssey for younger students. By using inappropriate material the OM invites criticism and undermines an otherwise worthwhile activity.

In summary, I have written this letter to salute two educators who have developed a solid vehicle to tap students' creative talents that schools and society often ignore in this era of fiscal restraint.

Robert Ginesberg Coordinator/Supervisor Programs for the Gifted and Talented East Brunswick, NJ

Is it Alive?
In their article "Hidden Monsters" [January 1983], Karen Ehrlich and E. Lee Speigel quote my estimate of the size of "Champ the infamous monster of Lake Champlain." Details of the calculation based on estimates of the length of the waves near Champ will appear in the first issue of the Journal of Cryptozoology. As to the contention that these waves indicate that Champ was alive, however, I must confess that I do not possess the ability to discern between the animate and inanimate from wave patterns alone.

Paul H. LeBlond
Vancouver, B.C., Canada
EXPAND THE FRONTIERS OF SCIENCE

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FICTION

Robert Silverberg, a regular Omni contributor, has lived in the San Francisco Bay area for many years. In "Amanda and the Alien," he has achieved the perfect characterization of a certain type of Californian. The striking thing is that this nasty little story was written before "Valley girl" became a familiar term to most Americans. Our other offering, "Vengeance is Yours," marks Pat Cadi
gan's first appearance in Omni. Cadi
gan, who in real life writes greeting cards for Hallmark, lets her venom out in this cautionary tale aimed at the slick, predatory barflies we all know so well.

INTERVIEW

To Ilya Prigogine time is the forgotten dimension, and he has directed his life toward an understanding of its role in the universe. The Belgian chemist was awarded the Nobel Prize for his theory of "dissipative structures," which describes the workings of open systems—chemical reactions, cities, ecosystems—maintained by flows of energy so intense that the system reorganizes again and again, never returning to its previous state. This irreversibility is the heart of positive growth and change. Find out in the next issue of Omni why nothing stands still for Ilya Prigogine.

ATOMIC NIGHTMARE

The test shot that detonated on the Nevada range in the predawn of March 24, 1953, seemed different to sheep rancher Kern Bulloch. The ground shook early. The sheep were more frenzied. The mushroom cloud soared, fiery and turbulent, to 40,000 feet. What Bulloch did not realize was that he was becoming an unwitting principal in a tragedy that would span three decades, with echoes sounding in Hollywood, Washington, D.C., and throughout the land. "The Day We Bombed Utah" is not only the harrowing saga of how the AEC's nuclear-testing program shattered hundreds of lives in two rural Utah towns; it is also a timely exposé of our government's inadequate nuclear-safety standards. Best-selling suspense writer John C. Fuller has crafted a story that brings the tragic lessons of Hiroshima and Nagasaki into our nation's heartland. See the May issue of Omni for his heart-rending account of this major government coverup that has endured to this day.

BAROQUE FANTASIES

The paintings of Donald Roller Wilson, notes one critic, conjure up a "Kurt Vonnegut-like world of plausible improbability." Wilson's pictures are starkly realistic in detail, yet completely unworldly in content, featuring disembodied legs, primates dressed up in baroque costume, and chain-smoking cats. The characters and props that fill his canvas could have come straight from a haunted house, which probably explains why his work has attracted such collectors as Steven Spielberg, Harrison Ford, and Carne Fisher. Don't miss Wilson's droll images in the next Omni.
Photographer R. Hamilton Smith made this portrait as part of his lifelong fascination with the world of macrophotography and the new worlds and dimensions it opens up to him. “I love to get inside something and photograph it so that it appears to be totally new and allows the imagination to play,” he explains. His attempts to work against the literal style of nature photography, what he calls the “what-is-there” attitude that expects nothing more than a simple copy of the original, instead he works at an eyelash distance away from his subjects, exploring new perspectives, like the abstracted color and shape. Hamilton took this macroportrat by attaching a reversing ring to a Nikkor 55mm lens and placing it on a Nikon F2A camera. The photo was recorded on Kodachrome 64 film.
Comets are very much in the news these days. For one thing, Halley's Comet is on its way back and it should have much to tell us. For another, an astounding new comet theory has been proposed by two highly respected astronomers at the Royal Observatory in Edinburgh, Victor Clube and Bill Napier. They believe that the earth periodically goes through epochs of heavy cometary bombardment and that during one of these periods, a spectacular comet, which they call the Cosmic Serpent, swung by. Many of our mythical fears and superstitions about comets as omens of disaster, they claim, can be traced to it.

Astronomers generally have supposed that comets come from the Oort Cloud, a comet reservoir located about one light year from the sun (it was named after the Dutch astronomer Jan Oort, who first suggested its existence.) When a comet in the cloud is perturbed—by the gravitational tug of massive objects for example—it moves toward the center of the solar system. And each time a comet passes perihelion, the point in its orbit closest to the sun, some of the ice in its nucleus evaporates and the comet diminishes slightly in size. As a result comets are short lived on a cosmic scale, with life spans of a few million years.

It has also been assumed that comets are genuine members of the solar system and have remained in the Oort Cloud for billions of years. Clube and Napier, however, think differently. They theorize that the original comets of the Oort Cloud have long been depleted and that the supply is replenished when the sun periodically passes through one of the spiral arms of our galaxy. For the next few million years after such a pass, the supply of comets is plentiful and comet activity is particularly high.

Also, when comets die, say Clube and Napier, they become Apollo-type asteroids—that is, small bodies that follow orbits different from the larger regular asteroids restricted to the region between Mars and Jupiter. One such object, Hephastos, was discovered in 1979. It is estimated to be about six miles in diameter and moves in an orbit similar to that of Encke's Comet. It also has much the same orbit as that of the Beta Taurid meteors and some time ago Harvard astronomer Fred Whipple suggested that all of them—Hephastos, Encke and the Beta Taurids—were the result of a breakup of a larger body some time back in the third millennium B.C.

Astronomers now believe that these Apollo-type objects can sometimes collide with Earth. In fact, one such collision may have occurred 65 million years ago, perhaps causing the abrupt extinction of the dinosaurs.

With all this in mind, Clube and Napier turn to the near-present and look at comets in mythology and history. Men have always been afraid of comets and the two astronomers suggest there may have been a historical basis for this. They suggest that in near historical times a very large comet, the Cosmic Serpent was forced into an Apollo-type orbit. It would have made close approaches to the earth periodically and would have been brighter than a full moon. More importantly, it would have been accompanied by debris hitting the earth making natural disasters more likely.

In time the Serpent faded from view and the meteors decreased. The period of disastrous impacts passed—for a while. And what happened to the Cosmic Serpent? Clube and Napier think that it became what we now call Hephastos, a dark remnant of its former self.

That in brief is the theory. It is revolutionary and unorthodox but it is being taken very seriously as an honest effort to link astronomy with archaeology, paleontology, geology, history, and even mythology. And if Clube and Napier are correct, at the moment we are at a fairly safe period in astronomical history and the chance of a major Apollo object strike is small. Eventually however, the sun will again traverse one of the galaxy's spiral arms, the Oort Cloud will be replenished and there could be more Cosmic Serpents. When the next one appears, the results should be spectacular to say the least.
Campfire logic, fast knots, and other miracles

By Scot Morris

"Beaten paths are for beaten men."
—Eric Johnston

This month we present a potpourri of perplexities and head-scratchers. Solve them by applying logic, general information, insight, cunning, or quizmanship and avoid beaten paths. Some items require a serious working through—others will reward devilousness.

1.  A score of ten or above is excellent; eight or nine is good; five to seven is fair. If you score four or below you’re either too intelligent or too stupid to be taking tests like this—take your pick.

2.  Name one state in the United States that shares no letters with its own capital. What’s the word?

3.  Do the following have in common: the location of clocks in a casino, and of public telephones at a racetrack? What’s the word?

4.  In a regulation nine-inning baseball game the home team scores two runs in each inning and the visitors score one run each inning. What is the final score of the game?

5.  Why are manhole covers circular rather than square?

6.  Why would a barber in Paris rather cut the hair of two Italians than one American?

7.  How could you head your car north on a straight road, drive for a hundred yards, and find yourself a hundred yards south of where you started?

8.  This noble one of the world’s oldest is still good for starting arguments: A man is looking at a portrait. "Whose picture is that?" someone asks. The man replies: "Brothers and sisters have I none, but that man’s father is my father’s son." Whose picture is the man looking at?

9.  What occurs once in a second once in a month once in a century—but not at all in a week or a year?


11.  Two goats are grazing in a meadow. One is facing due north; the other is facing due south. How can they see each other without turning around?

12.  Alfred can jog counterclockwise around Central Park in 30 minutes. When he jogs clockwise along the same route, it takes him an hour and a half. Why the difference?

13.  The question and the next are classic campfire logic problems. They work best when you present the puzzle and have other people ask yes-no questions until they get the answer.

14.  A man lives on the twentieth floor of a high-rise apartment building. Every weekday morning he goes in the elevator to the ground floor and goes to work. Every weekday evening he enters the elevator and, if there is another passenger rides to the twentieth floor. If he’s alone, however, he gets off at the sixteenth floor and climbs four flights of stairs to his apartment. Why do you think he’s doing this?

15.  What is the reason for the judge’s decision?

16.  How many breakfasts would I have had if this had been a leap year?

17.  Shown below are two different perspectives of the same three-dimensional object—one from the front and one from the side. What is the simplest three-dimensional shape that would produce these views? Sketch it.

Answers to Numbers 16 and 17 will appear next month. No tricks—they can both be solved—though they may seem beyond reason. All other answers may be found on page 120.
TIE ONE ON

This do-as-I-do challenge is not a trick. What makes it a nice April Fools' stunt is the extreme difficulty most people will have in duplicating your childishly simple actions.

Place a necktie flat on a table as shown above (1). Seat your spectator on the other side of the table and ask him or her to watch carefully. Describe the steps as you perform them slowly and deliberately. "Lay the tie on the table like this—big end on the left, little end on the right (1). Pick up the big end with your left hand, then reach under with your right hand (2). Cross over the tie with your right hand, pick up the other end (3), and tie a knot in it."

Follow these steps as illustrated, separate your hands, and there will be a knot in the tie.

Most people have a very hard time repeating this simple action, especially if they have viewed it from across the table. When they try to cross over with the right hand (step 3), they move the hand directly across—forward and to the right—which of course yields no knot. You can often demonstrate the move several times, and spectators still may be unable to repeat it.

Tips: In step 2 move your right hand forward, palm down, and pause at that point so people can clearly see how the move starts. In step 3 you move your hand backward, palm up. Briefly, which is the opposite of the suggestion you planted in step 2. Most people won't notice the important difference.

TIE TWO

In a fancy men's clothing store, a salesman may try to show you how a necktie will look with a knot in it by literally and laboriously tying a knot for your inspection. The Amazing Randi proves on such people in order to demonstrate his original "necktie-salesman's move," in which he knots a tie with one quick twist of the wrist. Hold the tie as shown below left, with the larger end draped over your right hand, your little finger in front. Concentrate on point A (on the small end of the tie) and the finger formed by your index and middle fingers. In a sudden move, reach forward and down to grab point A between these two fingers (2). Snap the tie off your wrist and hold it up by the loop (3).

"Tips: Think of the trick as three separate motions: first down to grab point A, then up to pull A through the loop, and finishing with a downward flourish to tighten the knot. Monsieur, your tie zipper knot in it!"

COMPETITION #28 VIDEO GAMES

Tired of Frogger, Fast Food, and Communist Mutants from Outer Space? You won't have to wait long for these.

**Deadline!** Finish your copy by the date circled on the calendar but not before. Deal with emergencies as they arise: The "pencil-needs-sharpening buzzer," the "out of coffee" alarm, and the "what's-on TV" diversion. At random intervals you get paid on time and earn bonus points.

**Laundromat** Get as many clothes done in the shortest time for the least money. Washing machines and dryers become available at one- and two-minute intervals; on average, a dryer can hold 1.5 washer loads. Dry more than that and the towels and jeans will need to go in for part of another cycle. Penalties for putting whites with colored fabrics, using the wrong temperature, adding softener in the wrong cycle, or running out of quarters and having to go to the newstand and buy something.

**Pack Man** How long can you last as manager of the New York Yankees? The object is to boost ticket sales by any means possible. Do beer commercials, make a fool of yourself kicking dirt on umpires, call press conferences, or win baseball games. If ticket sales go down—pack man.

**Valley Girl** Object: Throw a bitchin' party and meet guys that are tubular to the max, and clean up before your parents get back from Palm Springs. And don't get gagged by the spoons.

**Video Game** Put out a virtual replica of someone else's video game and make as much money as you can before you are hit with a restraining order.

Send us your proposal on a card for a next generation video game. 100 words maximum. Our grand prize winner will receive $100. Runners up (two through nine) will receive $25 each. All entries become the property of Omni, none will be returned. Send entry postmarked by May 15, to Omni Competition #28 909 Third Avenue New York NY 10022.
Every emerging technology, from steam power to genetic engineering, has provoked anxious rumors. And as robots become increasingly common, they too will inspire frenzied speculation. To help you get the jump on robot hysteria, here are ten impending robot rumors:

- A national hamburger chain is entirely owned and operated by McRobots. It began when a few experimental models were brought into the business, fry-droids, grill-tornatones, and rib-robots. By shrewdly investing their tip money according to a financial strategy plotted by their friends (computers at a prominent brokerage house) the robots managed to engineer an unfriendly corporate takeover. Who knows what they’ll add to the special sauce? Will they start serving Mcdiodes? Will Ronald McDonald eventually be automated out of a job and forced into early retirement at the Old Clowns Home?

- A certain Olympic team is packed with robot ringers (I can’t name the country there are times everywhere I don’t even trust my toaster.) Let’s just say that there’s an Eastern European nation to whom Olympic gold is very important. (That’s what happens when a country has no worthwhile rock bands, movie stars, or twelve-year-old fashion models—they can’t afford the hammer throw or the lug.) The country in question has been censured in the past for doctoring its teams with forbidden drugs and for entering athletes of dubious gender in the women’s events. But that’s Bronze Age cheating compared to what’s online. For the Los Angeles games in ’84, the judges will have to determine which entrants are human and which are not. To put it another way, get ready for the four-second mile, the fifty-ton bench press, and the L.A. to Paris pole vault.

- George Steinbrenner will replace the entire New York Yankee infield with android athletes. For a man who experiences such profound pride of ownership feelings, it’s a dream come true. No longer need he pretend to treat his players like human beings. If his new robot pitcher fails to perform, Steinbrenner can do something more dramatic than trading the bum to Texas. He can have him broken up and sold for scrap. The only people who are likely to fight the shift to automation are the players’ union and the chewing-tobacco lobby.

- Robots engage in bizarre sex acts. They like to keep appliances as pets and do kinky things to them. (That’s why I couldn’t discuss the Olympics in front of my toaster. It could be having an affair with some robot, and anything could be blurred out in a moment of digital ecstasy.) The appliance departments of certain stores, it has been learned, function as after-hours clubs for robot romés, catering to every sort of grotesque, automated lechery. Jaded human jet-setters have even been frequenting these robot bordelloës seeking high-tech thrills.

- Lassie? The dog never did its own stunts, everyone knows that. Mr Ed? His real name is Mr Edelstein. He changed it when he went into show business becoming the first Jewish horse to have his own prime time sitcom. Similar is the case in the celebrity robot rumors, as stars buy robot stand-ins to handle their public appearances. This will add zest to The Merv Griffin Show as viewers try to figure which if any of Merv’s nightly guests are actually human beings. Liza Minnelli? Zsa Zsa Gabor? Chardy?

- Certain powerful congressmen are secretly serving robot interests. They must they’ve accepted enormous campaign contributions from Robot PACs. Robot influence even extends beyond Congress to the Oval Office. When you are a machine, you don’t care if they call catsup a vegetable for that matter you don’t care if they call iron ore fruit. It’s all the same to you as long as you can get your batteries recharged when you please.

- It was not actually Howard Hughes hiding out in that Las Vegas hotel suite all those years. The truth is that Hughes had a robot recluse built to his specifications. All that time, the real Howard Hughes was hiding out in a hotel suite in Reno.

- There are Iranian robot hit squads roaming the country, gunning for Nancy Reagan’s clothing designers. That’s why she buys so many clothes—to throw the killers off the scent. That way they won’t know who to shoot first.

- There are Soviet robot disinformation teams disguised as computers at major American newspapers. Their mission is to discredit Jerzy Kosinski.

- Finally the coming robot rumors will exploit our fear that the machines are among us. Scientists are now working on building a robot that can mimic the complex behavior of a human being, or even the clumsy actions of someone like my Uncle Milt. But the truth is they aren’t even trying. Rather than developing simplified versions of people, government researchers are creating sophisticated versions of furniture, exploiting the insights made by Maple Fingers and the Barkatsunger. All they have to do is add some input/output devices, install an on-board computer, and devise a mobility system. And there it is the digital bed, the intelligent walking coffee table. In fact, perhaps they’ve already replaced your modular sofa with five sofa-robots. I’d be careful where I sat if I were you. They are among us.

- It’s like that famous SF movie Invasion of the Sofa Snatchers. At least that’s the rumor. 

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By Randy Cohen

"Perhaps they’ve already replaced your modular sofa with five sofa-robots. I’d be careful where I sat if I were you. They are among us."

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LAST WORD