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NEW BIRTH TECHNOLOGIES

**MALE
PREGNANCY**

**PRENATAL LEARNING
IDEAL SPERM DONOR
CHOICES IN CHILDBIRTH
MAN MADE WOMB**



OMNI®

VOL. 8 NO. 3

DECEMBER 1985

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An egg lover's dream! We have black resin of Ingo Swann's 45-by-50-inch colossal Salt Flats Vision. The eggshell is carefully torn away to reveal the colorful Swann's visionary surrealism as a leader in the New Age art movement.

OMNI (ISSN 0149-2110) is published monthly in the United States and Canada by Omni Publications International Ltd., 1865 Broadway, New York, NY 10019-6889. Second class postage paid at New York, NY, and at additional mailing offices. POSTMASTER: Send address changes to OMNI Magazine, Post Office Box 3089, Hightstown, NJ 08520. Volume 8, Number 3, Copyright © 1985 by Omni Publications International Ltd. All rights reserved. No. 2103, 598-599, Canada is a registered trademark of OMNI. Post not for one international unit. Printed in the U.S.A. by Meredith-North Corp. and distributed in the U.S.A. Canada: U.S. terms of publication, and the word "Canada" (the U.S.A.) by Curtis-Groves Company, 21 Henderson Drive, West Caldwell, NJ 07090. Distributed in the U.K. by COMAG, "Spadock Road," West Graydon, London, W6T 7GL, England. Other countries: Copyright 1985 by OMNI may be reproduced in whole or in part without written permission from the publisher. Any printing between places or persons mentioned, if the total of publication and sale prices to persons living or dead is not received. Subscriptions: U.S. \$10.00 per year; Canada and elsewhere—\$20.00 per year. Single copies \$2.00 in U.S. APO and Canada: Inquiries: 1-800-841-5410 in U.S. 1-604-633-1872. The publisher disclaims any responsibility for unauthorized reproduction of any contents published herein. The sole property of Omni Publications International Ltd. Letters sent to OMNI or its offices become the property of the magazine.



FIRST WORD

By Dr. Howard Jones

● *Archconservatives have voiced a blanket complaint against the "unnaturalness" of in vitro fertilization, but lack of government action may be the most unethical act of all.*

Medically, human reproduction is surprisingly efficient. With normal and regular sexual intercourse, the average woman can expect to become pregnant only one month of every three. Of all women who even become pregnant in any given year, only 50 percent will become pregnant after three months of trying.

If it is so difficult to have a baby, why are there now more than 4 billion of us? The answer is simple: A woman's reproductive system operates 13 times a year. As a result, the system can tolerate some inefficiency and indeed may be the better for it. To the reproductive scientist, however, the inefficiencies of the human reproductive process pose an intriguing conundrum. Reproductive problems are most severe in humans, yet animal models seem inadequate for study. The best scientific evidence indicates that many human germ cells, both male and female, are genetically defective and produce genetically defective embryos that fail to survive.

In fact, abnormal human embryos seem to be more common than normal ones. Fortunately, the body usually absorbs the most severely abnormal embryos spontaneously, so sometimes so early that a pregnancy is not even suspected. On other occasions, the woman's rejection mechanism fails, and a seriously abnormal fetus is carried to birth, becoming in life a severely handicapped child—a burden, albeit sometimes a loving burden, to the family and society as a whole. Adults with Down's syndrome are such a case.

These human misfires of individuals who are affected by hundreds of genetic abnormalities, such as diabetes, that are not ready as serious or disfiguring as Down's syndrome. Most of these people live healthy and gentle lives. It is very likely that all of us have many abnormal genes, since we have two copies of most genes—one from each parent—a defect may not be expressed if one copy is normal. Most humans are quite normal, and their genetic abnormalities do not remedy any imbalances that might otherwise be present.

It is perhaps not surprising that so fickle and imperfect a mechanism as human reproduction may sometimes not function at all. Infertility—the inability to have a child after one year of trying—affects about 15 percent of all couples who wish to reproduce. Since many patients do not respond to traditional therapies, newer methods are constantly being devised: in vitro fertilization (IVF), the use of donor sperm or eggs, the use of donor-fertilized eggs, and surrogacy—the temporary use of another's reproductive capacity to various forms. Freezing a method used to preserve the embryo for future implantation has also been introduced.

Most of these newer reproduction techniques have ruffled some ethical feathers, and each method has its own special issues. Archconservatives, however, have voiced a blanket complaint against the "unnaturalness" of the entire field and

have questioned the moral status of the fertilized egg. These blanket objections to IVF have largely been silenced by the birth of more than 1,000 babies who were conceived through this process.

Society has always been leery of innovation and change, especially at the scientific level. Remember the tribulations of Dolly, the first animal clone? Toward the newer methods of reproduction would be more easily clarified if there were a suitable ethical yardstick. For centuries, physicians have subscribed to the Hippocratic oath and when faced with medical dilemmas, have been guided by their desire to cure the ill of their patients. This has been considered highly ethical, provided the benefits of the treatment outweigh the risks and only for the patient but for others involved.

Biotech research can go forward in a meaningful way society must reach, if not a consensus, at least a majority view about these issues. Scientific endeavor does not flourish without popular support.

Because of a vocal minority, the secretary of the Department of Health, Education, and Welfare (HEW) in 1974 issued regulations that have effectively prevented the National Institutes of Health from supporting research in human IVF and, by extension, other reproductive research that has developed since that time. In 1979 an ethics commission formed by the secretary of HEW concluded that IVF research was not only ethical but worthy of funding. Nonetheless, the regulatory process, and government funding remains withdrawn. Any money that we are able to get for research has to come from individuals or private foundations, but many of the largest funding groups are taking their cue from the government and staying clear of any research involving human embryos.

Research on preembryonic development would enable us to determine which embryos are viable and which are not, thus helping increase the number of successful pregnancies through IVF. Although the kind of research has been sanctioned by the HEW ethics committee, there persists a feeling of uneasiness because fertilized eggs are involved. Unfortunately, embryo research gets confused with abortion because some of the fertilized eggs are ultimately discarded.

But if we were allowed to go ahead with research on the preembryo, we would be more able to understand the inefficiency rate of human reproduction, not only would these new insights benefit millions of infertile couples; they would also help us devise more effective methods of birth control. The lack of government action may in fact be the most unethical act of all—the lack of research law enforcement, while the potential benefits to the individual and society are great. □

Dr. Howard Jones, with his partner, Dr. George Arino, are a husband-and-wife IVF team in 1981. Their clinic in Norfolk, Virginia, is the largest IVF center in the United States.

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OMNIBUS



KESTON



COSMIC CREATION



THE DRAGON SEED



MULLINS



SANDERS



MALE PREGNANCY

Human life starts deep within the female ovum, where, shrouded in mystery, male sperm fertilizes the female ovum. The miraculous result: a single cell that divides and differentiates, yielding, nine months later, a fully developed fetus nestled in the shelter of the womb. But human reproduction has long been inefficient. Some women are simply unable to conceive. Others produce defective embryos or normal, premature infants that cannot survive. Today, however, with the advent of birth technologies, the historic nature of human birth is about to undergo radical change.

The area most revolutionized by advances in technology is conception itself. And in "Birthmade" (page 90), Kathy Keston, president of Ova, and Yvonne Baskin, describe embryo transfer, cryopreservation, and other alternatives to natural conception. "I believe birth technology is the most exciting and most important thing happening for women," says Keston, whose article is an excerpt from her recently published book, *Women of Tomorrow*. These breakthroughs may even enable women to have children later in life, much like the biblical character Sarah, who at age ninety conceived and delivered a healthy child.

Perhaps the most controversial future birth scenario is male pregnancy. At first, consulting editor Dick Tenn and contributing editor Kathleen McAuliffe were skeptical, but in "Male Pregnancy" (page 50) they report that male mothers are theoretic-

cally possible. Some of the most striking evidence comes from experiments indicating the placenta can support a fetus in the abdominal cavity, outside the womb.

But what man would want to experience childbirth? Not Dick Tenn. "Despite the fact that Kathleen McAuliffe and I worked together very closely," he protests, "there is no truth to the rumor that I am carrying her baby. We're just good friends. But there's a glint in McAuliffe's eyes. 'I don't think the idea of men carrying babies was very appealing to him initially,' she says, 'but it may be starting to grow on him.'"

It wouldn't be surprising if the first successful male pregnancy occurred in Australia, which boasts some of the greatest advances in birth technology. But such a procedure would not involve Alan Tounison, even though his research into in vitro fertilization and the freezing of human embryos has made him one of the world's top fertility pioneers. In this month's interview (page 82), features editor Robert Weil succeeds in getting the internationally acclaimed sheep embryologist to speak candidly about his work, something he has rarely done. "The most exciting part," Weil says, "was observing the in vitro fertilization process in action and learning that Tounison is about to perfect a technique that will freeze unfertilized human eggs."

But conception is only one arena in which new technologies are altering the notion of birth. The field of neonatology has made great strides in lowering the infant

mortality rate, with the greatest beneficiaries being the very premature. In "The New Art and Science of Naviety" (page 96) author Douglas Starr examines the state of knowledge that has revolutionized premature care. "Watching the parents of these infants was a heart-wrenching experience," Starr says. "Some are devastated. For others it's their only salvation. It's hard deciding how to feel about this kind of intensive care."

Complementing the theme of human birth in "Cosmic Creation" (page 74), this month's pictorial featuring artist Helmut Wimmer's work on the birth of the solar system. Wimmer's paintings highlight the process that began some 14 billion years ago with an explosion that spread the seeds of stars over the space of light-years.

But genesis isn't relegated only to the vastness of the cosmos, or the shadows of the world. "In the rain forest, where the plant life grows on and over itself, and even in the concrete jungle, where the grass pushes through the cracks," says science-fiction writer Kate Wilhelm, "there is an incredible compulsion to reproduce and grow." In "The Dragon Seed" (page 68) Wilhelm embodies the force in the character of the warmly reticent Cory, who possesses a mystical ability to create life.

In our second fiction entry "Travels in the Interior" (page 88), by Scott Russell Sanders, two men plunge into a dark jungle and head toward a mysterious mountain. Haunted by scavenger beasts, one man comes to terms with the darkness in himself. **DO**

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DIALOGUE FORUM

On our webpages, speculation, theories, commentary, dissent, and questions from readers in this open forum. We invite you to use this column to voice your hopes about the future and to contribute to the kind of informal dialogue that provokes thought and generates breakthroughs. Please note that we cannot return submissions and that the opinions expressed here are not necessarily those of the magazine.

Cloning Controversy

T. A. Haeppenheimer's *First Word* (July 1995) makes some interesting points in favor of human cloning, but I disagree with some of his suggestions.

Haeppenheimer describes delayed twinning, in which half of a divided female embryo is frozen and—years later—implanted in the womb of its sexually mature twin, who then gives birth to a child who is a clone of herself.

I suggest that anyone considering such a procedure should first be tested to see that she is free of psychological problems. If she weren't, she would not be a suitable candidate for cloning. Personality quirks are another problem. The cloned child would share the same quirks as its parent/twin, causing problems in their relationship. It is the unknown in our children that leaves room for hope that they will be better than we were.

Yet another problem for the clone would be privacy, which is necessary for any child's maturation. How would you feel if your parent were an exact duplicate of yourself, someone so similar to you that he or she probably knew exactly what you were thinking and feeling at all times?

Haeppenheimer also says that delayed twinning could offer parents insurance against the heartbreak of a child's early death. Each child could have a clone, waiting on ice. Haeppenheimer fails to realize, however, that every child is unique and cannot be replaced; what he suggests could lead to a throwaway mentality, such as we now have with material goods. Why take any special precautions with the original child? There's another one waiting.

Barbara Stancif
Houston

Haeppenheimer maintains that it would benefit the human race to let cloning become a common practice, but it seems to me that two-parent reproduction is infinitely superior from a genetic viewpoint.

It is also proposed that cloning would be a wonderful way to study the extent to which behavior is biologically determined. Despite his or her genes, a cloned person would still be a human being—not a laboratory rat. To create a human being purely for research is not so much unethical as it is inhumane.

Gary Heft
Seabrook, TX

I don't have anything against cloning humans, but I disagree with Haeppenheimer's thinking on the subject. His statement that your clone is not only like you but is you is false and absurd. Only I can be me. A clone may be an indistinguishable duplicate of me, but it is not me.

I also disagree with the conclusions Haeppenheimer draws from University of Minnesota psychologist David Lykken's research on identical twins reared apart. That work may have shown a strong sense that vastly more of human behavior is genetically determined or influenced than we ever supposed, but it doesn't take into account the considerable role played by one's environment.

Haeppenheimer's hypothetical Karen wouldn't be anything like her delayed-twin clone, because the two would have grown up in different decades. Such a time difference would see major changes in society and would translate into significant differences in behavior.

Gary S. Pies
Oklahoma City

I can't help but feel more apprehension than excitement in regard to the prospect of human cloning. True, cloning would provide the comfort of knowing that such people as Mahatma Gandhi and Martin Luther King could live again. But you could also clone such demonic forces as Adolf Hitler and Charles Manson.

Wouldn't we be better off by working with what we have here and now, nurturing

the best men and women and combating the worst? It may take a bit longer, but it seems a safer bet in the dream of an improved human race.

Laure Wandke
Roseville, MN

T. A. Haeppenheimer responds: *Mr. Stancif, why do you place such trust in psychologists? Do people need psychological screening before being allowed to have children? Clones will have quirks, but many relationships feature shared quirks.*

Clones are only as close as identical twins, so a room of the child's own should take care of any privacy problems. As for the throwaway mentality you speak of, a clone is still a human being, not a material possession. Delayed twinning would be a sort of baby insurance. We often carry life insurance, which offers monetary compensation for the loss of a loved one. Cloning is a method for replacing a lost loved one with a baby that will, in time, be that person's duplicate.

Mr. Heft, genetic adaptation would become a problem only if cloning were total and universal. Even a little sexual reproduction would maintain genetic diversity. What I originally said was that behavioral studies give insight into cloning, not that clones should be used in behavioral studies.

As for a clone that "actually is you," a clone would, in reality, be an identical twin. Mr. Pies's point is well taken.

Although Lykken's research on identical twins did indeed find expected influences that were caused by environment, what was surprising were the strong similarities he found in twins reared apart, even in widely differing environments.

Ms. Wandke, cloning is one more way to make babies, and every baby born is a potential Hitler or a potential Gandhi. We're not better off settling for what we have in the here and now any more than we would have been a century ago, before pasteurization, antibiotics, or vaccines. Cloning can be viewed as a tool, and the better our tools the more effectively we can solve our problems. Cloning may prove to be a most valuable tool in the dream of improving the human race. ☐

PERPETUAL MOTION EARTH

By T. A. Heppenheimer

A few years ago in Belton, Texas, an inventor named Arnold Burke built a perpetual-motion machine. He called it Jeremiah 33.3, after the biblical passage: "I will answer thee and show thee great and mighty things, which thou knowest not." His great and mighty thing was a 200-gallon water tank, 12 feet tall. Water spilling from the top turned an electricity-generating turbine. Then, to get the water back into the tank, Burke relied on "energy-free" siphonable pumps, the heart of his invention. With this, he attracted \$800,000 from investors.

After an investigation showed that a hidden wire led from the "energy-free" pumps to an electrical outlet, the state attorney general charged Burke with theft and perjury. But at his trial, Burke said he had replaced his special pumps with standard electrically driven ones only to protect his secret from prying eyes. He was acquitted.

"We had reasonable doubt of the defendant's guilt," the jury foreman declared. "The Lords will wait done," said Burke. More recently in Los Angeles, there was

the case of the inventor Karl Aegerter and his attorney Jackson Chandler. Aegerter built a 1,600-pound "aegeter" motor, which he and Chandler claimed generated more energy than it consumed. Essentially, the motor featured a long tube fed with compressed air from an outside source. The compressed air turned a propeller, and the energy produced by the propeller was siphoned off for use.

Aegerter and Chandler described their motor as "the power energy source of the world for all times." But to those in the know, proof of that claim rested in the machine's true perpetual-motion ability—the ability to run itself. The means seemed obvious: Why not forget about compressed air from an outside source and simply connect the two ends of the tube so that the same air could travel around and around? The air would run with energy produced by the machine itself.

Even when the duo said they couldn't figure out how to connect the two ends of the tube, investors, who put up \$850,000, remained convinced. Not so the district attorney who charged Aegerter and

Chandler with fraud, theft, and conspiracy.

"We've had experts analyze the machine, and in their opinion, it was worthless," said prosecutor James Green. But despite the evidence, the so-called inventors were acquitted. "The jury actually believed the machine delivered more power than went into it," complained Green. "I know because they told me so."

But the best and most successful of these inventors is Joseph Newman of Lucedale, Mississippi. Newman has developed what his patent application calls an "Energy Generation System Having Higher Energy Output Than Input." Proficient in neither math nor physics, he explains his machine with a unified field theory he recently developed on his own. "All matter is made up of one entity," says Newman. "This ingenious principle is so simple it beludges the mind."

Newman calls this entity, which allegedly runs his machine, the gyroscope particle. "There is no instrument made that can weigh or see it," he explains. "What is this particle's mass? I haven't concerned myself with that," he says. "I don't give a hoot about mathematics."

The essence of the Newman machine is an electric motor powered by batteries and featuring a 600-pound rotating magnet. The gyroscope particles slowly turn the magnet's mass into energy, says Newman. These particles, he adds, are also responsible for tornadoes, dowling, and ESP.

Why hasn't Newman run the machine on its own energy, proving beyond the shadow of a doubt that its perpetual-motion capability is real? That's an unthinking question, says the inventor, who insists the term perpetual motion does not apply to his generator. "The problem we have now is that the machine produces too much energy—if it ran on its own power it would be overloaded or destroyed."

Electrical engineer Kiri W. Carlson, of Mississippi State University, has a different point of view. Carlson, who tested the Newman motor in March 1993, found it to be between 55 and 75 percent efficient, most normal motors, he notes, are between 75 and 95 percent efficient.

But Newman has looked elsewhere for



J. Kelly records with century perpetual-motion machine inventor posing with his brainchild

ISLAND MADNESS

SPACE

By James E. Oberg

Amy speck in the vast Pacific Ocean, Easter Island has become the focus of a cosmic-scale dispute. One of the most isolated areas on Earth—2,200 miles from Chile, the nearest land—it is still partially shrouded in the mists of its past. The origins of its giant stone statues remain a mystery to this day. But the island has recently been thrust into the international spotlight.

In mid-1985, NASA announced that it was negotiating with Chile—which owns the 46-square-mile island it calls *Isla de Pascua*—for the right to establish an emergency space shuttle landing facility there. The ports function would be highly specific: to accommodate shuttles launched from Vandenberg Air Force Base. If a spaceship lost power during its ascent and the mission had to be aborted, the crew could make an emergency dive to the prepared landing strip.

Within a few months, both governments reached an agreement, and according to official announcements, the Chileans promised to upgrade Easter Island's Mataver Airport by extending its runway

and adding special shuttle guidance equipment. But the Soviet Union's reaction has caused both the United States and Chile some concern.

From the moment the NASA project became public, Moscow papers and radio stations fired a steady stream of accusations at NASA and the Chilean government. The Soviets contend that the project is actually an effort to establish a nuclear-armed military base on the island. On July 11, Moscow radio commentator Igor Chankov claimed that American experts have determined that from there [Easter Island] it will be very convenient to control the accuracy of guidance of nuclear missiles.

The Soviets have even gone so far as to say that the setting up of an Air Force base will turn the island into a U.S. colonial enclave. According to a report issued by the news agency Tass, "Washington's encroachment upon the island cannot be regarded otherwise than an encroachment upon the asset of the whole of mankind." Invaluable monuments in the natural open-air museum will be destroyed, and the island's ecology will be disrupted

during the construction of such a base. The Americanization of life on the island will inflict irreparable damage."

The Soviets have little—if any—basis for their arguments. The Chilean government insists that laws protecting archaeological areas will be strictly enforced. "None of those modifications will affect the historical treasures for which *Isla de Pascua* is famous," says a NASA spokesman.

Furthermore, the guidance equipment to be installed is hardly appropriate for navigating missiles—the system is currently used in civilian airliners. It will be installed in the existing Mataver Airport tower and operated by Chilean officials. U.S. officials will spend very little time on the island. Just prior to a launch from Vandenberg, a NASA team will arrive on *Isla de Pascua* to check out the equipment and communications link. As soon as the spaceship is safely in orbit, they will pack up and go.

The worry is that the Soviets' faulty assumptions may unduly alarm other countries that have consented to act as hosts for aborted shuttle missions. These include Argentina, Zaire, Turkey and Japan. Such emergency-landing agreements are fundamental to the survival of the space program. In the event of a critical mechanical failure, human lives could depend on such cooperation.

Thus far, the Chileans are continuing to honor their agreement, although a group of Chileans protesting the treaty did hold a demonstration in July. The first launch from Vandenberg is slated for spring 1986. Airport modifications will still be under way at that point, but there will be navigation aids and lights to guide the shuttle should the launch be aborted. By the time the second polar mission is made, next fall, the runway extension should be completed.

Although it's highly unlikely that astronauts will ever have to make an emergency landing on Easter Island, such preparations are easy to justify. And there's a rather simple way for the Soviets to finally assuage their fears of a U.S. military presence on the *Isla de Pascua*: They could send an inspection team to see whether the landing strip would be useful to cosmonauts as well as to astronauts. **DC**



Astronauts on Easter Island? It could happen if the United States and Chile can calm the Soviets.

LISTENING IN THE WOMB

LIFE

By Martha Nelson

Parents have known for a long time that kids find Dr. Seuss's classic tale *The Cat in the Hat* irresistible. Now the cat has found his way into science. Using the verse to test babies' recall of prenatal experience, psychologists Anthony DeCasper and Melanie Spence made some intriguing discoveries that may help doctors learn how to better care for premature infants. Their research also has some interesting implications for the development of the artificial womb.

DeCasper, a professor at the University of North Carolina at Greensboro, began to work with infants in the Seventies, exploring the auditory functioning of newborns who he points out, "have a highly developed sense of hearing at birth." He and psychologist Earl Buttenfield designed an ingenious communication system for asking babies about their preferences. An infant wears tiny headphones, which are attached to two different tape recorders, and is given a pressure-sensitive nipple, also attached to the recorder. By changing its pattern of sucking, the newborn child—not yet capable of speech, nodding, pointing, or any more complex means of indicating preference—can choose which tape it wants to hear. DeCasper and Buttenfield discovered that the babies they tested showed strong preferences, preferring instrumental music to white noise (a nondescript static noise) and singing voices to instrumental music.

In another study, DeCasper, with colleague Willem Flier, began to test babies' responses to their mothers' voices. He offered the newborns two choices: the mother reading *To Think That I Saw it on Mulberry Street* by Dr. Seuss, and another woman reading the same verse. In eight-out-of-ten cases, the infants preferred the sound of their own mothers' voices. In variations on the study, Flier looked for differences between infants who were breastfed or bottle-fed, between those who were separated from the mother after birth and those who were with her continuously. Despite the differences, the child's preference for the mother's voice was consistent. It seemed, says DeCasper, "as if the preference for the mother's voice was not a

result of experiences after birth. It looked as if whatever caused this preference was prenatal."

To explore this possibility, DeCasper and Spence asked pregnant volunteers to read *The Cat in the Hat* aloud twice a day during the last six weeks of their pregnancies. A few days after birth, the babies were offered a choice of two tapes: the mother reading *The Cat in the Hat* or another rhyme with a different rhythm. Ten out of the 12 infants tested chose the story their mothers had read to them in the womb. It appeared as if the babies had learned the story, or more precisely says DeCasper, "something registered before birth. But he cautions, "This doesn't mean that the baby understood. It doesn't mean that the baby can learn ABCs or that it learned to understand what the cat did." In fact, he points out, researchers have yet to discover just what aspect of the poetry the child recalled. It may be, he explains, "it was simply the repetition of the word cat, or it may be the pattern of different words or the rhythm, the tempo, or some particular

vowel and consonant sound." In work now under way DeCasper hopes to pinpoint which part of the auditory experience babies are remembering.

For the moment, though, the most promising use of the new "fetal psychology" lies in the care of premature infants. Dr. Norman Krasnegor, chief of the Human Learning and Behavior Branch at the National Institutes of Health, sees ways in which DeCasper's research may aid neonatologists. More sophisticated medical technology has allowed these specialists to save babies who weigh as little as 2.2 pounds, infants who earlier could not have survived. But, explains Krasnegor, "we know only that babies who are born prematurely frequently have problems later in life with perception, learning, or growth. What we don't know yet is which babies will survive with minimal insult and which ones will have lifelong deficits. If we can begin to understand that, we will begin to know what kind of care and attention to give premature infants."

DeCasper realizes that right-to-life groups may use his work to support their political stance against abortion. But says DeCasper, "my research doesn't bear on the question of abortion in any direct way. From a biological point of view there is no doubt that the conceptus [embryo] is a human one. That is not a moral position. It's a fact. The political, social and moral concerns have to do with something less factual. When does the biological being develop a status such that we are willing to call it a person?"

DeCasper's work, however, may have direct implications for the creation of an artificial womb. "Imagine the typical day for the fetus inside the mother," explains DeCasper. "She's lying down, she gets up, she takes a bath, she talks, she sings, she eats, she drinks. If all of this stimulation produced by the mother's activity—gustatory, auditory, visual, olfactory—plays a role in development, then substituting an artificial womb may be inadequate." I can't speak about the year 2000 or 2050, he continues, "but I do see to me that the best gestation vessel for a human being will continue to be a human being." □



Some babies may recall sounds from the womb.

LIFE SIGNS

MIND

By Paul Bagnie

The centerpiece of a controversial abortion film, *The Silent Scream*, is a ghostly image of a fetus as it is being aborted. In the ultrasound movie an aborted cadaver draws close to the twelve-week-old fetus and, bit by bit, sucks out pieces of its tiny two-rich body. The narrator, obstetrician Bernard Nathanson, says the fetus "does sense aggression" and makes a "pathetic attempt" to escape.

"Nonsense," challenges Clifford Grobstein, a developmental biologist at the University of California, San Diego. Grobstein questions the film's suggestion that the electrical activity of the fetal brain can be interpreted to mean the fetus thinks and feels. At that stage of life the brain isn't developed enough to allow the embryo to anticipate anything," he believes. The fetus withdraws from the catheter in a reflexive action.

"Nonetheless," he continues, "the embryo-fetus reacts. There may be primitive forms of sensitivity we don't know anything about." Grobstein is one of a small but growing group of scientists and ethicists who think it's time to study the developing brain more intensively. Information like this could help answer one of the most basic questions in science: When does a fertilized egg become more than just live tissue? When is it considered human?

"It's not a religious question," asserts Paul Ramsey, professor emeritus of religion at Princeton University. "It is a scientific decision." And each advance in fetal and reproductive medicine creates a greater need for an answer. One fetus may be aborted while another the same age is delivered as a premature baby; some researchers want to operate on a fetus in the womb, while others want to experiment on embryos or to freeze them for storage in fertility clinics.

We need a definition of life as consistent as the one we now have for death, according to Ilanusch Brody, director of the Baylor University Center for Ethics. His suggestion is modeled after the brain-death guidelines established by the Harvard Medical School in 1968. According to these criteria, a person is considered medically dead if, for example, he does not respond to the

surrounding environment or to pain; if doctors detect no spontaneous movement and if the brain shows no electrical activity.

The machine that helps determine the moment of death is the electroencephalograph. With input from electrodes pasted to a person's scalp, the instrument amplifies the brain's electricity and records it as an electroencephalogram (EEG), a squiggly readout on graph paper. Depending on the individual and his age, the EEG may detect anywhere from 20 to 100 microwatts.

When a person dies, the brain's synapses stop working, and electrical activity drops below two microwatts. On paper, the squiggly pattern flattens out. Medically, a flat EEG indicates brain death and signals doctors to unplug a patient's life-support systems or to remove any organs the patient had listed for donation.

Brody suggests that science use the same criteria as brain-life guidelines. If the patient is still responsive, in his brain waves or any of the life signs, he is considered to be neurologically alive.

Some have suggested that the presence of brain waves should be the most impor-

tant determinant in deciding when life begins. "The brain is the seat of human consciousness and the controller of all other organs," argues Dr. John Goldenring, a professor of adolescent medicine at New York Medical College. "If the brain is functioning, you are alive."

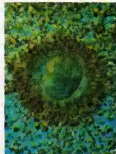
Goldenring proposed a brain-wave guideline in an article for the *International Journal of Medical Ethics*. He argues that science should decide once and for all on a consistent standard for when life ends and when it begins.

"I'm talking about a medical definition that can be used at any time," Goldenring says. "At some point in utero, a live and active brain is present."

Because distinct electrical activity only begins after cell structures for all parts of the nervous system are in place, he says the key to arriving at some definition of life is determining when brain waves appear.

In the growing fetus, the brain appears to stir and to generate signals of activity as early as eight weeks after conception. But coherent, recognizable wave patterns do not seem to appear until seven or eight months after conception. By then researchers can tell from EEGs when the unborn child is awake or asleep. They can even decipher REM, or rapid-eye-movement, sleep, which indicates dreaming. (This also suggests that late in fetal life the nervous system is advanced enough to construct and retain memories.)

But brain waves alone cannot be used to decide when life begins, according to Grobstein. "They are gross characteristics we do not fully understand," he says. "One also has to look at when synapses, neurons, and neurotransmitters appear." Before researchers can offer the equivalent of a brain-life standard, they have to learn more about fetal brain development. Some information—when brain cells and nerve structures first appear, for example—can be gleaned from studying dead embryos. But researchers also must determine when these cells begin to function. "There is a bit of a problem here," says Brody. "We can do that kind of research only on a living fetus, and in the course of doing those tests, we might find out that what we have



Fertilized egg. When is it a human being?

NO MORE MEN

THE BODY

By Dr. Jeremy Cherfas

Within a population of male and female animals happily reproducing by means of sex, a mutant female arises: one who can oöstepe males and still have young. Her offspring are all females who can reproduce without sex—by a process called parthenogenesis (wegin birth). Because she produces no sons, the female gives birth to twice as many daughters as the other females do. A very few generations later, every female in the group is reproducing asexually. Males have become a memory.

The males I'm referring to in this population are not men, but one day this tale may betell the males of our species. Already artificial insemination by donor gives women who want it the freedom to avoid men entirely. In vitro fertilization offers the same freedom to women whose reproductive equipment is not fully functional. But both processes require men as sources of sperm. What I am talking about is cloning—women reproducing without any contribution from men whatsoever.

There are three basic cloning techniques that women might use to dispense with

men. The first is the most widely discussed. Remove the nucleus, with its genetic blueprint, from an adult woman's cell and place it into an egg to develop again into a complete person. A second technique involves fusing two separate eggs, each with its half ration of genes, into a single viable whole. The third one requires the genes of an unfertilized egg to double up before proceeding to normal embryonic development. Each of these methods has been the subject of experimentation.

Already the research has uncovered at least one major roadblock to cloning in humans. According to a team at the Institute of Animal Physiology in Cambridge, England, both maternal and paternal contributions are apparently vital to the development of the fetus. Eggs with two sets of maternal genes do develop, but they fail to grow an adequate support system. The tissues that make the placenta, which nourishes the growing embryo, do not form properly. Eggs with two sets of paternal genes, by contrast, grow a functioning placenta, but the embryo itself does not develop well. The conclusion: The father

provides genes essential for developing the placenta, which, strictly speaking, is not part of the embryo, while the mother provides genes needed by the embryo itself.

That might seem like the end of the line for asexual reproduction in humans; but I doubt it. One technique being used for domestic animals, for instance, might overcome the problem by providing the egg with a surrogate placenta. The placenta develops from the outer layer of the fertilized egg. This external wall of the embryo is called the trophoblast. The embryo itself develops from the inner-cell mass, contained within the trophoblast.

Normally, of course, the trophoblast and the inner cell mass both grow from the same fertilized egg. But scientists have transferred the inner cell mass from a sheep zygote into the emptied trophoblast of a goat, implanted the concoction into a goat, and ended up with a perfectly normal lamb. Ordinarily a sheep trophoblast would not form a placenta in a goat's uterus. But by hiding the sheep's inner cell mass in a goat trophoblast, the researchers created a hybrid in which the goat placenta, attached to a goat uterus, nourished a sheep embryo.

What has this to do with cloning? I believe that a similar process could enable a woman to clone herself. We know that a purely maternal zygote would fail because it would not develop a proper placenta. It, however, one could slip the cloned zygote into the empty trophoblast of a normal fertilized egg; the result would be a cloned female embryo, supported by a normal placenta. In other words, the successful cloning of a woman.

This would not be a natural process. It would require costly high-tech medical engineering. But it could be done. Of course to get the trophoblasts, the women would need fertilized eggs; and that means a supply of sperm would still be needed, but not much of one. We men may not be entirely dispensable (yet), but it is surely only a matter of time. **DC**

Dr. Jeremy Cherfas, along with Dr. John Gröden is the coauthor of *The Redundant Male*, published by Pantheon Books.



Do human males go the way of the dinosaur and dodo bird: where will babies come from?

MENDING MYOPIA

BREAKTHROUGHS

By Scott Kanya

When Robert Mucci decided to become a New York City fire fighter, he knew one thing could stop him: City regulations required firemen to have uncorrected vision of at least 20/40. Mucci's was 20/400. In desperation, he appealed for help from his optometrist, Joseph Trachman, a vision-training specialist. After considering the problem, Trachman put Mucci through a series of tests with a machine he had invented while writing his doctoral thesis on reducing myopia, or nearsightedness. Twenty sessions later, Mucci passed the vision test for fire fighters with a measured score of 20/40.

Today three years later, Trachman has patented the device, called the Accommodic Vision Trainer, and has already sold 20 units—at \$18,000 each—to specially trained optometrists and ophthalmologists. Sales are expected to double this year.

Built on biofeedback techniques, the Accommodic consists of a harmless infrared light system that measures the focus of the eye, and a tone generator that provides instant, audible feedback. During

15 sessions spaced over a period of several months, patients look into the device and "train" their eyes to focus for longer distances simply by listening to the change in tones.

Although Trachman's technique does not eliminate the need for corrective lenses for all patients, clinical measurements of more than 100 subjects confirm reduction of myopia in almost all cases. Many patients with tested vision of 20/200 ended their sessions at 20/40, good enough to pass driver's license vision tests in many states. The system has already won over many respected experts, including Paul Berman, an eye consultant to the U.S. Olympic Committee and the New Jersey Nets.

The second most common human affliction next to tooth decay, nearsightedness often results from such structural defects as an elongation of the eyeball. This condition can be corrected only by surgery, if at all. But nearsightedness can also be caused by environmental influences that can be reversed. Extended close work, such as reading, causes the ciliary muscle in the eye to contract, thereby allowing the lens to focus on nearby objects. To see distant

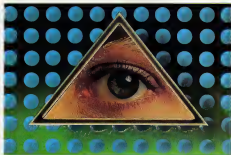
objects, the ciliary muscle relaxes and the lens adjusts accordingly. Research indicates that prolonged contraction may trigger a muscle to spasm. The muscle is unable to relax, and the person becomes myopic. This explains why students, professors, proofreaders, and other people who read frequently and for extended periods often report sudden deterioration in their visual acuity.

The Accommodic provides audible feedback whenever the ciliary muscle relaxes. During the sessions, patients learn how to control the relaxation of the ciliary muscle, thereby gaining long-distance vision. Although prevailing medical opinion holds that myopia is most often the result of structural malformation, the overwhelming success of the Accommodic suggests that the muscle control learned may even compensate for physiological conditions.

According to Trachman, the skill of controlling the muscle is never lost, though a refresher course may be needed two or three years after the sessions are completed. Accommodic success stories should be able to see their way clearly to such a repeat performance, especially if it means being able to see clearly without the aid of corrective lenses.

NEW PRODUCTS

For storing both moving and still images, optical videodisks are the wave of the future. A single disk can hold an astonishing 24,000 pictures. And any image can be retrieved instantly—in less than one second—at the touch of a key. Now Hitachi is selling the first in a new generation of videodisk machines that not only play back but also record. A standard video camera is used to take the picture. The recorder encodes the image—in either black and white or color—onto a blank eight-inch optical disk. The recordings have a 15-minute, 20-second maximum length. Two things, however, may keep the system out of the average home: First, this cutting-edge technology is not cheap: \$30,000 and second, you can't record over a used disk. (Available from Hitachi Ltd., Hitachi Atago Building, Nishi-Shinbashi 2-chome, Minato-ku, Tokyo 106, Japan) JOD



New hope for the nearsighted? A biofeedback device that relaxes eye muscles

DEMYSTIFIED DATA

ARTIFICIAL INTELLIGENCE

By Owen Davies

The trouble with computers is that using most of them is sometimes as complicated as it is helpful. Lately though, companies have begun to demystify one of the most confusing corners of computeland—the world of online databases. If you've ever had an important question you couldn't answer, it's a development worth checking.

Online databases are computerized reference libraries that you can summon with a telephone call. All it takes is your computer, an inexpensive modem to link it with the phone lines, and a communications program to operate the modem. Once online, you'll discover information on an astonishing variety of topics. If you want to know about stocks and bonds, medicine, thoroughbred horses, or the best restaurants in Dallas, you can find it in an online database. The selection is growing rapidly. There are more than 3,000 databases just a few keystrokes away, triple the number only three years ago.

The trouble is, they're all different. Computers being the nono-too-bright

things they are, they require users to follow exact procedures, to phrase their questions in precisely the right way, before they'll yield up their secrets. These procedures and query languages can be enormously complex, and there are almost as many of them as there are databases.

Furthermore, to use a database, you must sign up for it with an online vendor, a firm that specializes in marketing databases over the telephone. There are hundreds of them, and even the largest offer access to only a small fraction of the databases being published.

And they are seldom cheap. Database prices start at around \$10 per hour of use and soar into the hundreds of dollars per hour. Suddenly, though, databases are becoming cheaper, easier to access, and easier to use. The credit goes to two new online services: EasyNet, from Telebase Systems, of Norberth, Pennsylvania, and Business Computer Network (BCN) of San Antonio. Each manages to cut the cost and complexity of information searching.

At last count, EasyNet offers about

600 databases. It charges for answers to your questions, not for time spent online. And it spares you the need to learn dozens of search procedures—or even one.


Just call the database's toll-free number (1-800-EasyNet). You can tell EasyNet which database to search. Or you can call for help from an expert system that can study your question, decide which database is most likely to hold the answer, and guide you to it through a series of well-planned menus. EasyNet's computer automatically translates your questions into the language the database expects to hear.

EasyNet charges a fixed fee of eight dollars per search. For this, you receive up to ten bibliographic citations or 500 lines of full-text newspaper or magazine articles. If there is more, you pay another eight dollars for each ten citations or 500 lines of published material. But if the search comes up empty, there is no charge.

BCN charges only ten dollars per month as a minimum fee, but subscribers must learn the native languages of the databases they use and pay their standard fees for time in use. The emphasis is on the convenience of having a single source for hundreds of bases and on the chance to avoid costly sign-up fees. BCN estimates that signing up for all the databases they offer would cost more than \$3,500, most waive the fee for BCN subscribers.

It is clear that both these systems are only forerunners of wonders to come. "Because we have all these databases available in one place we can do enormously exciting things," says EasyNet's Marvin I. Weinberger. "We can build hundreds of little information boutiques."

"For example, if you are an engineer who needs patent information, you would have had to go to Dialog, STC, Pergamon, Quasitel, and other vendors, each offering more or less unique pieces of the puzzle. Now you can find them all with one call."

"We can tailor an information boutique to individual needs," he concludes. "You've heard the saying, 'Don't worry about a little luxury, it'll become a necessity by and by.' That's the way it will be with online information services: in just a few years, 



Hard facts: Some early databases required complex retrieval rituals and superhuman skills.

THE ARTS

By Mitch Tuchman

In *The Defiant Ones* it was a black convict (Sidney Poitier) and a white convict (Tony Curtis) chained together, hating each other, compelled to cooperate in order to survive. For its year, 1958, it was a bold allegory of racism: written pseudonymously by Nedrick Young, a blacklisted screenwriter, and Harold J. Smith, in *Hall in the Pacific* (1966) the tale about racism became a tale about war. Leo Minn was the American G.I. and Tachio Minn, the Japanese soldier stranded on a Pacific island at the end of World War II. Enemies, they must cooperate in order to survive. The plots vary slightly, but the allegory remains the same.

And now there is *Enemy Mine*. Willis Dawgde (Donnie Quaid) is the pilot from planet Earth. Jerbis Shagan (Louis Gossett, Jr.) is the pilot from planet Gorn. Having destroyed each other's aircraft, they land simultaneously on the uninhabited planet Fyre IV, and, though enemies, they are forced to cooperate to survive.

Remade motion pictures are by no means unusual. Literary classics are especially apt to be remade. There have been half a dozen versions of *Ozma* and *Punchinello*, a dozen of *Camille* and *Hamlets* without number. Transpositions from one genre to another are almost as common. *Gladiator* became comedies, and comedies become musicals. Pictures change period and gender (*Orlando*). The early *Seventies* were rife with remade melodramas in which black actors were substituted for white.

Crossovers to science fiction are not quite so common, but neither are they rare. *High Noon* became *Outland*. *Battle Beyond the Stars* is recognizable as *The Seven Samurai*. The only aspect of *Star Wars* not widely publicized was its basis in Akira Kurosawa's *The Hidden Fortress*. Undoubtedly best known to film buffs, however, is *Forbidden Planet*, a 1956 adaptation of Shakespeare's *The Tempest*.

What kinds of stories are most amenable to translation to SF? In a word, the simplest: the journey, the quest, the battle royal. *Moby Dick* is a natural. So is *Ambro*.

The second great category, of which *Enemy Mine* is an example, is the allegory, with its schematic, universalized view of

human relations and the eternal verities. The hidden assumption here is that although culture, period, or planet may change, the substance of morality does not. (The substance itself is culture bound, if not earthbound, but then we are probably not yet producing films for other planets.) Brotherhood is an obvious theme. So is any story in which the members of one culture observe or come into conflict with members of another. *Gulliver's Travels*, for instance, indeed, almost any picture directed by John Boorman—like *Hall in the Pacific*, *Deliverance*, *Leo the Last*, or *The Emerald Forest*—falls into this category. What does not work are stories that lack these films' sociological conflict. Purely psychological dramas, in which the broader assumptions of society are shared by all characters—soap operas, backstage musicals, and pornography, among others—would be pointless remade as science fiction.

The immediate source material for *Enemy Mine* is an 85-page novella by Barry Longyear, published in 1962 in a collection called *Manifest Destiny*. One hundred years from now, according to that tale,



Dear Boole's Peterson: Aliens can be friends

humankind travels effortlessly through space, colonizing galaxies, mining their minerals in competition with the Dracs, the only other known race of intelligent beings. The result of this competition is war. In a one-on-one aerial dogfight, Dawgde and Shagan plummet to inhospitable Fyre IV, where their war continues. Ultimately, however, they must make a truce, and that truce becomes understanding; that understanding, friendship.

After certain production difficulties, director Richard Loncraine left the picture, and Wolfgang Peterson, director of *Das Boot*, was hired in his place. Peterson gave an interview in which he said quite plainly that *Enemy Mine* was the best screenplay he'd ever read in his life, says screenwriter Ed Khoury. "I choose to believe that. I don't want to imply that this is a message picture," Khoury continues, "and I don't want to imply that it's a preachy story because it isn't, but this story ultimately is concerned with the fact that to have enemies, we must dehumanize human beings. We must put them into a different mold before we can kill, maim, and hijack them. There have been a lot of stories about that, but this takes a creature that is not human and shows that under the skin, the scales, the strange body he is very human after all."

Khoury was aware of the similarities between his story and *Hall in the Pacific* when he began, and he has since been asked to write SF glosses of other classics among them *Treasure Island* and *The Treasure of Sierra Madre*. "It's an old idea. You can do *Hamlet* as a Western. The king becomes a cattle baron, the dithers come to town to visit his mother. It's easy to do that, but it doesn't necessarily add anything. What's important is that science fiction enables us to look at things in a new way. If we did this story about an American and an Iranian terrorist, it would be called exploitation, but science fiction objectifies those things. We were able to do what you could never do in *The Defiant Ones* or *Hall in the Pacific*. We could go in new directions because we didn't have to obey the rules of physics or anything else except dramatic continuity." □

MOON MYSTERY

STARS

By Terence Dickinson

After the Apollo astronauts brought nearly a ton of lunar material back to Earth, many astronomers thought the long-sought answer to the riddle of the moon's origin was at hand. But today, 34 years after the last moonwalk, the same three theories that were in vogue prior to Apollo are still being debated. Is the moon: (a) Earth's sister, born simultaneously from the solar nebula in a process called coaccretion; (b) Earth's daughter, a by-product, fissioned from a rapidly rotating primordial Earth; or (c) our planet's adopted cousin, a stray object gravitationally captured by Earth?

By taking a different approach to the problem, a major study offers a fourth explanation: that the moon is the final remnant of a collision between Earth and a smaller planet. "Posing the problem [of the moon's origin] in terms of coaccretion, fission, or capture is not the right way to address the question," says George Wetherill, who conducted the study. "The formation of the moon should be addressed in the framework of the formation of the terrestrial planet, if not the whole solar

system. If you understand how these were formed, then the origin of the moon is something that is going to flow from them."

Wetherill, director of the department of terrestrial magnetism at the Carnegie Institution of Washington, in Washington DC, arrived at his conclusion after performing the most detailed computer simulation yet of the formation of the planets Mercury, Venus, Mars, and Earth.

He began by simulating conditions that existed some 4.6 billion years ago. Then the sun was a much younger, hotter star having just recently contracted from a massive cloud of dust and gas. The young sun's radiant energy had pushed the lighter gases from the inner solar system outward, while heavier particles, less affected by solar energies, settled into an orbit around the sun.

Wetherill's computer simulations, ten in all, suggested that the heavier particles coalesced gradually into increasingly larger chunks of matter as they bumped into one another in their orbits around the sun. After about 100,000 years a huge asteroid belt encircled the sun. After 10 million

years, the thousands of asteroids had become concentrated into a swarm of some 500 mountain-size bodies called planetesimals. Through repeated collisions, the planetesimals continued to build into increasingly larger bodies, protoplanets, about the size of Mercury or Mars.

Some of these objects might have been gaseptuous, having as much as three times the mass of Mars. Any object that collided with the object that was to be Earth became part of the planet.

The heat generated by impacts would have melted substantial portions of whatever hit the nascent planet. Debris from both the earth and the impacting body would have vaporized and splashed into nearby space. That could have lingered in Earth's orbit, says Wetherill, and eventually coalesced into the moon.

There is some evidence to support the theory. The Apollo moon rocks reveal that while some of the lunar material is from an unearthly source, some does resemble the earth's crust. The unearthly elements, says Wetherill, could have come from the projectile that hit our planet.

So far his study has received generally good reviews from planetary scientists ("I've gotten a lot of requests for reprints and no one has argued with me so far.") But no one, including Wetherill, thinks the matter has been solved once and for all. "It's possible that ten years from now, planetary scientists will be arguing over four theories, but I hope not."

HALLEY'S HOT LINE

Science writer and amateur astronomer Fred Schaaf is trying to get momentum behind a grass-roots movement called Dark Skies for Comet Halley or DSCH. Schaaf's aims: to get municipalities to turn down outdoor lights so that city dwellers can glimpse the famous visitor during March and April; and to increase awareness of how light pollution from outdoor lighting is crippling astronomy. Those interested can subscribe to the newsletter DSCH Journal (four dollars per year). For more information, write to the Astronomical League, Department DSCH, Box 12621, Tucson, AZ 85732. **DD**



Our moon: Where did it come from? Theory number four posits a head-on collision.



CONTINUUM

THE ULTIMATE BRAIN TRIP

Eack in the Seventies, Hollywood special-effects expert Douglas Trumbull set out on a mission to enhance the motion-picture experience. This master of special visuals—who over the years has contributed his expertise to such movies as *2001*, *Close Encounters of the Third Kind*, and *Star Trek: The Motion Picture*—created a powerful new image system called Showscan.

While tinkering with the film speed standard of 24 frames per second (fps), Trumbull discovered that motion pictures photographed and projected at faster speeds created some surprising special effects on viewers. Subjects in lab tests reported that 60-fps images were more vivid and real than those offered by standard movies. Recalling those early experiments, Trumbull explains that "by substantially increasing the frame rate up to about sixty fps, you can create tremendously increased physiological stimulation of human beings." The evidence pointed to an important revelation: The 60-fps rate approximated the speed at which the eye receives information and transmits it to the brain. This helps explain why the space between the Showscan viewer and the screen seems to disappear, making audience members feel as if they have become part of the image.

Trumbull's discovery has been refined over the years, and today Showscan offers vivid, highly realistic images in 70-millimeter widescreen accompanied by a superb sound system. The primary goal of Trumbull and his financial backers is to move the system into the commercial motion-picture mainstream.

Movies that Trumbull would like to see shot in Showscan are "experiential adventure films that will either have a lot of special effects or race-car driving or something that tends to exploit the medium." It's interesting to note that Trumbull had originally planned to shoot the brain-bopping sequences in his movie *Brainstorm* in Showscan, but the plan was eventually scrapped. More important, the powerful effect of Showscan leads to speculation as to how viewers may react to other types of films that could exploit the medium in other ways.

What kind of effect would a Showscan horror movie, for example, have on audiences? A *Poly* the 13th, Part 10 produced in Showscan would probably be too overpowering. So would other films with an overabundance of violence. Showscan may not be for the fainthearted and impressionable. Judging from the recent

public reaction to a movie like *Indiana Jones and the Temple of Doom*, if Showscan were used one day for gory or violent films, there could be a clamor from parents for a new kind of rating system. Today some theme-park thrill rides carry warnings to people with heart problems. Will doctors suggest that some patients avoid Showscan's visual roller-coaster effect?

Showscan also creates a feeling of voyeurism in its audiences. Voyeurism, along with stimulation—another Showscan effect—is the very responses that most "adult" moviemakers are trying to achieve. So it would appear that Showscan and pornography would make very likely bedfellows. But this is not likely to happen considering Trumbull's reputation and the company's desire to limit the system to mainstream entertainment. But if such a movie were ever produced, the battle over pornography would no doubt heat up even further, raising new issues relating to censorship—this time of a technology.

Showscan also has a growing list of applications outside the world of entertainment. It's not surprising that Trumbull has been approached by the defense establishment, which is interested in using Showscan for its own purposes. So far Trumbull has declined to work on battlefield simulations but acknowledges that Showscan "could be used as a very manipulative medium."

Trumbull is, however, encouraging the use of Showscan for education. He is reaching out into the academic community to establish nonprofit organizations that will test and later use his 60-fps system as a teaching tool. Showscan's creator even predicts that tests "will prove that if you put educational material on Showscan on a big screen with powerful sound, students will retain substantially more information than they would from any other way of teaching." An enthusiastic supporter of Showscan in the academic community is Kenneth Brecher, professor of astronomy and physics at Boston University. Brecher would like to see Showscan used to produce high-impact science-and-technology movies to draw students into the currently depleted ranks of university science majors. This BU professor is especially interested in examining the psychological effects associated with Showscan and how "they can be used to excite kids" about a range of subjects.

But Showscan as an entertainment medium is here. It will be interesting to see how the public reacts to its first close encounter with a movie of the hypereal kind.—MARJORIE COSTELLO



CONTINUUM



How can you check on the unborn child? Now there's a new prenatal test for genetic defects that's safer than amniocentesis.

PRENATAL TEST

At present, a pregnant woman who wants to have her fetus checked for possible birth defects has little choice but to submit to amniocentesis—a technique in which amniotic fluid is withdrawn by inserting a needle directly into the uterus. Although usually safe, the method does carry some risks, including infection and spontaneous abortion when the needle inadvertently nicks the fetus itself.

Soon, however, there may be a noninvasive alternative to amniocentesis. Developed by Michigan State University microbiologists Harold Miller and Harold Sadtoff, the new technique—called early prenatal assessment, or EPA—involves nothing more dangerous than taking a normal blood sample.

Knowing that a few fetal cells are always found in the mother's bloodstream ("They digest their way out of the

placenta," Miller explains, "and into the mother's capillaries"), the researchers developed a method for sorting the fetal cells from the mother's blood sample. A chromosome map of the cells is then prepared, and that map can be compared to known chromosomal profiles of infants with such genetic defects as Down's syndrome or spina bifida.

The advantages over amniocentesis are obvious. "If we gook up," says Miller, "we've lost only a blood sample, not a fetus or a pregnant woman." Miller hopes to see FDA approval within a year. "It all depends," he says, "on how fast the government wants to move."

—Bill Lawren

"The best guesser is the best prophet."

—Greek proverb

"Don't be so humble. You're not that great."

—Gilda Meir

GOLD BUGS

Prospectors, take note: Your picks and shovels, your ancient maps, and even your electronic sensing devices may soon be replaced by the simplest metal detector of all—a lowly bacterium by the name of *Bacillus cereus*, which, according to U.S. Geological Survey geomicrobiologists John Watkinson and Nancy Parduhn, shows up in overabundant numbers in the topsoil above large mineral deposits. It started in 1979, when Watkinson read reports of bacteria in New York Harbor that were tolerant of heavy metal pollutants in the water. Could it be that similar bacteria might show up in association with mineral deposits on dry land? To test the notion, he spent more than two years counting microorganisms above a copper deposit in Montana,

while Parduhn conducted a *Bacillus cereus* around gold deposits in California, Nevada, and Colorado.

Both researchers found that counts of *B. cereus* were up to 100,000 times higher in the area over mineral deposits than they were in surrounding topsoil. Even the depth of the ore seemed to make little difference. In one case, high *B. cereus* concentrations occurred over a molybdenum deposit that was 3,000 feet underground.

The assay, says Parduhn, costs only "a couple of bucks" and requires nothing more sophisticated than test tubes, petri dishes, and a small centrifuge. Will the scientists toss the laboratory to become active gold diggers? "Right now I'm enjoying just doing the research," says Parduhn. "But," she admits, "my mind changes every couple of months."

—Bill Lawren



What lives gold better than a prospector's pick and shovel? *Bacillus cereus*, a bacterium that thrives above mineral deposits.



Deuterium oxide may turn out to be the perfect mixer

SCOTCH AND HEAVY WATER

The latest spinoff of the space program may be a hangover-free drink.

Dr. Kenneth Money, one of Canada's first astronaut-inneers, was studying space sickness, a malady that afflicts astronauts during the first few days after blast-off, when he had a flash of insight.

Space sickness causes dizziness, vomiting, and disorientation. Sounds like a heavy drunk, no? That's just what Money thought, and his research shows that space sickness and the ill effects of too much alcohol may be related.

Both disorders are apparently caused by an unusual motion in the fluids of the semicircular canals, the balance organs in the inner ear. In space, zero gravity lets the fluids slosh against the walls of the canals. Similarly, when a person

drinks too much, the alcohol in his bloodstream finds its way into the ear.

Alcohol, which is a comparatively light liquid, mixes with the heavier canal fluids, causing a tiny eddy. Both the astronaut and the drunk feel as though they are moving, even though their eyes tell them they are not. The conflicting signals eventually make them sick.

That tiny eddy, Money reasoned, could explain why the room seems to spin after you've had one too many. And if your inner ear can sense the intrusion of a lighter liquid, then it could also sense a heavier liquid, which would create an eddy in the opposite direction, making the room spin the other way.

And, in fact, it does. At a recent seminar Money showed a movie of an anesthetized cat, its head held motionless in a brace. The cat's eyes tracked left to right, left to right as it watched the room spin. In the next cut, the cat, now sobered up, was injected with deuterium oxide—a heavy water—a liquid heavier than the fluids in the ear. The camera panned in, and the cat's eyes began tracking right to left, right to left.

The point? In theory, if you combine alcohol and a heavier liquid in just the right proportions, their effects on the inner ear may cancel each other out. You can reach a happy state of intoxication without the hangover. "The point," concludes Money, "is that you should always mix your scotch with heavy water." —Nick Engler

PERFUMED SEWAGE: THREE GREAT SCENTS

Sanitation officials in Duluth, Minnesota, are using cinnamon, bubble gum and pine-scented perfumes to cloak the foul odor emanating from that city's modern sewage-treatment plant.

Because the plant is situated right on the shoreline, sanitation-department spokesman Kurt Soderberg says, winds blowing off Lake Superior have been carrying noxious sewage fumes into nearby residential neighborhoods and onto the city's commuter-clogged freeway.

"We're talking about a very, very strong sewage odor," he says. "I've heard every description of it imaginable, from 'foul hog barn to the unprintable.'"

Naturally, the awful smell has had the local citizenry virtually up in arms. So

concerned sanitation officials, rather than spending a couple of million dollars on a high-tech odor-reduction system, hit upon the novel idea of pumping various perfumes, or masking agents, in with the sewage fumes before they are vented to the outside world.

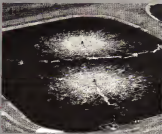
After the line points (such as figuring out which scents work best on hot days and which ones work best on cold days) are all resolved, sanitation officials think 80 percent of the odor can be concealed.

There is already an improvement, claims Soderberg, who says he personally "wouldn't have any problem" living downwind of the sewage plant "once all the bugs are worked out."

—Eric Mahara

"What is now proved was once only imagin'd."

—William Blake



Aerial view of a waste-treatment plant. Now you can get your sewage in a variety of delicious flavors: cinnamon, bubble gum, or pine.



CONTINUUM

NASA WALDO

In the parlance of robotics, it's called a waldo: an automaton capable of carrying out the remote commands of a human operator. NASA now has one in the planning stages, namely the orbiting maneuvering vehicle (OMV), a free-flying spacecraft designed to service satellites in orbits too high for the space shuttle to reach.

Once released from the shuttle's payload bay, the OMV could carry a satellite into a higher orbit, wait until the satellite proved it was functioning properly and depending on the outcome return with or without its mechanical passenger. All docking and rendezvous maneuvers would be controlled by an operator on the ground watching TV pictures transmitted from the OMV's camera eye—something

like a video game, except with millions of dollars of space hardware at stake.

Rocketing between orbits to a maximum altitude of 14,000 nautical miles, the OMV would burn hydrazine fuel. But around the shuttle, the planned space station, or contamination-sensitive payloads, the OMV would switch to a much cleaner cold-nitrogen propulsion system. According to project manager William Huber, the vehicle's basic docking attachments could be replaced in the future with dexterous arms or other complex tools for remote servicing of satellites.

If all goes according to schedule, one of the three aerospace companies now competing for the NASA contract will deliver the finished \$350 million OMV for its first flight in early 1990. —Randall Black



Artist's conception of NASA's shuttle-launched OMV maneuvering to make contact with a malfunctioning satellite in orbit.

NICOTINE-FREE TOBACCO

To Jean Nicot, the sixteenth-century French ambassador to Lisbon, belongs the dubious distinction of having introduced tobacco to France when he came home from Portugal in 1560 with several pounds of the plant's leaves stuffed into his luggage.

For that accomplishment, European scientists of the day named the highly addictive alkaloid called nicotine after him.

The substance has fascinated physicians, agronomists, plant geneticists, phytochemists, and the modern American tobacco industry ever since. So intrigued have they all been with this particular form of plant life that technical monographs with such baffling titles as "Quenching of Singlet Oxygen by Alkaloids and Related Heterocycles" are commonplace today in the scientific literature of tobacco research.

What particularly interests scientists like Edward Leele, a University of Minnesota chemist, is that perfectly healthy, nicotine-free tobacco leaves can be grown by grafting the tops of tobacco plants to the roots of tomatoes, which makes sense since the two plants are distant cousins.

But why he wonders, would the tobacco plant, if left to its own devices, go to so much trouble to produce an alkaloid it doesn't really need? He thinks the answer is that nicotine could be a natural insecticide intended



Cigarettes without nicotine would taste like corn silk.

to keep harmful insects off its leaves.

Richard Larson and Karen Marley at the University of Illinois believe that nicotine may perform an oxygen-cleansing function. But it is James Chapin, of the Tobacco Research Laboratory, in Oxford, North Carolina, and a student of the weed for years, who occasionally addresses himself to the key consumer question: Can you smoke this odd mixture of tobacco and tomato?

Says the plant geneticist: "Why would you want to do that? Why would anyone go to the trouble? If you wanted to smoke tobacco without nicotine, you wouldn't get the flavor or the aroma. Without nicotine, it would be like smoking any other substance—corn silk, for instance."

Says Reggie Lester of the Tobacco Growers Information Committee, in Raleigh, North Carolina: "There's not a whole lot of demand for that." —George Nottbe

PRICER PALSY

Latter-day Luddites have been waiting for years that video display terminals can run your eyes and playing Space Invaders can run your mind. Now you can add "pricer palsy" to the growing list of diseases wrought on us poor sissies by the high-tech age.

It started when a super-market cashier checked in with Milwaukee rehabilitation physician Jacqueline Wertsch. Seems the checker had developed a worrisome numbness in her left hand, accompanied by an occasional dull ache. The problem, she noted, got worse every time she passed a can or package over the store's electronic holographic pricer.

On investigation, Dr. Wertsch found that the woman was suffering from a pinched nerve brought on,

the doctor said, by "very fast pronation and flexion" of the left wrist—in other words, precisely the combined turning-and-bending motion the cashier was using to get the laser pricer to read the bar codes. A minor operation solved the problem, and the cashier was back at work in a few days.

Wertsch is not sure whether this case represents the tip of an enormous iceberg. The standard doctor's test, she notes, is not sensitive enough to catch the kind of pinched nerve brought on by pricer palsy. At the moment, she is hoping to get support to run a more delicate test on a large sample of cashiers. In the meantime, she recommends that checkers develop a two-step motion, first turning over each item so the price code faces down, then passing it over the scanner.—Bill Lawren

I'LL CPU IN MY DREAMS

You wake up in the night and your dreams've been a fright, who ya gonna call? The Dream Net Project, a computer database that aspires to be a benevolent Big Brother to the collective unconscious.

If you're online, you're in luck. Instruct your modem to dial 1 (303) 722-6210 and you will enter the digitized portals of Dream Net, dream child of Henry Reed, of Virginia Beach, Virginia. There you may choose from Menu 1 (which includes a premonitions registry, an open forum, and psi computer games), Menu 2 (dream news, lucid dreams, psi anecdotes, the near-death column, and the dream interpreter), or Menu 3 (parapsychological information, bibliographies, a dream newsletter, and statistical evaluations).

Sound otherworldly? This is nothing compared with the collective dreams of Reed and his on-line associates who wish to confound your computer's CPU (central processing unit) with even more nocturnal data. They foresee the day when your computer can interview you (as you relate your latest reviews), remind you of previous similar themes, help you create an animated cartoon of your dream, and display text and pictures from previous intrapersonal adventures. That's not all: Your computer would generate at your command a survey of dream themes and symbols collected over the past 24 hours from around the world, helping you to your



Scared? Why not tell your nightmares to your modem?

private reality into a universal context. (Was that earth-quake nightmare telling me to leave L.A. or to settle a personal affair?) If you wished, your silicon servant could help you contact others with similar dreams.

Though imaginary now, everything in the previous paragraph is possible, claims Reed, either now or with computer systems of the not-so-distant future. Reed likens his inner-space project to the initiation of the space program, "requiring the coordination of many different projects under development by many different people."

—Florence Morosan

"A corporation cannot blush."
—Howell Walsh

"Children are aliens, and we treat them as such."
—Ralph Waldo Emerson

"To study the abnormal is the best way of understanding the normal."
—William James



One doctor recommends cashiers adopt a two-step motion: Turn over each item, then pass the product over the holographic scanner.



For some, there is very little reason to stifle their yawns

YAWNS AND ORGASM

To the dismay of executives at CIBA-GEIGY, the international drug company based in Switzerland, three Canadian psychiatrists from St. John's, New Brunswick, claim that four of their patients who took the antidepressant drug Anafanil constantly experienced orgasm whenever they yawned—whether they wanted to or not.

No one seems to know why, and what's all the more puzzling is that the more common side effect of taking antidepressants is a decreased sexual capacity, not an increased one.

Nonetheless, the four case studies were reported in the Canadian Journal of Psychiatry by Drs. I. A. Kaplan and J. D. McEwen, of Regional Hospital, and R. G. Forsythe, senior psychiatrist at Centricare, Inc. They stress that their paper merely presents some clinical findings and is not to be taken as a full-scale study of Anafanil, a tricyclic more formally known as clomipramine.

Two men and two women being treated for depression all said yawning induced orgasm, a side effect that vanished shortly after they were taken off the drug. One of the women claimed she could induce orgasm at will by deliberately yawning. The other said she experienced sexual urges she simply could not resist.

Of one of the two men, the Canadian doctors write, "The awkwardness and embarrassment [of orgasm and ejaculation] was overcome by continuously wearing a condom." The other male subject taking Anafanil reported that he experienced "such an intense sense of exhaustion that he had to lie down for ten to 15-minute minutes after each yawn."

Odd side effects from tricyclics are not unusual, but the three New Brunswick doctors, who no longer talk to reporters, have yet to say whether they have treated any other cases involving the antidepressant, yawning, and the phenomenon of orgasm.

CIBA-GEIGY spokespeople point out that while their antidepressant is widely used in Canada and Europe, it is not available in the United States, adding, in a prepared statement, "We cannot comment on the validity of reports associating the use of Anafanil with a rare side effect of sexual stimulation." They said the company was currently attempting to determine if any of the Canadian claims about the prescription drugs were valid.

—George Nobbe

TOP TAILGATERS

Subcompact cars tend to tailgate more than any other class of vehicle on the road, according to a Purdue University study. "The image of the big-car bully or the tailgating truck may be a gross exaggeration," concludes traffic-safety researcher Michael Doherty.

Doherty set up roadside cameras on busy Indiana roads in the Purdue vicinity and videotaped the traffic flow. More than 10,000 cars and trucks were recorded by the cameras, then the videotape was studied so that the incidents of tailgating could be tallied.

"Subcompacts make up just twenty-seven percent of all the vehicles on the road," Doherty explains, "yet in our study they were responsible for almost thirty-nine percent of the tailgating." Other vehicle types tallied in much more moderate numbers.

Tailgating causes accidents, so Doherty advises that drivers stay back at least

one foot of following distance for each mile per hour of driving speed. One major reason many subcompacts tailgate, Doherty theorizes, is that the smaller cars have exceptionally short hoods, which causes their drivers to overestimate the distance to the car in front of them and thus inadvertently tailgate.

Then again, perhaps small-car drivers are just trying to get back at the world. According to Doherty, the vehicles most often tailgated in his study were subcompacts. —Eric Mathews

"Imagination is more important than knowledge."
—Albert Einstein

"We do not know what to do with this short life, yet we yearn for another that will be eternal."
—Anatole France

"Except during the nine months before he draws his first breath, no man manages his affairs as well as a free does."
—George Bernard Shaw



Bad distance judgment or just looking for revenge? In any case, the worst tailgating offenders are the owners of subcompact cars



Even fruit smugglers have a new adversary to contend with.

FRUIT GUN

People who try to smuggle fruit and plants into the United States illegally soon may have a gun pointed at their luggage. The gun is actually a sensing device that can detect contraband plant material by sniffing out carbon dioxide inside a suitcase.

Intact live plants and fruit produce carbon dioxide which builds up over time. The carbon dioxide can be measured by placing the "sniffer" end of the detector against the seam of sealed luggage, thus drawing out a sample of the air inside.

The device was developed by chemist Paul Magidman and engineer Wolfgang Helfand, of the U.S. Department of Agriculture's Research Service, to give customs agents and animal and plant health inspectors a new tool in reducing the amount of undeclared plant material smuggled into the United States. The device also is expected to speed up baggage checks at airports

and inspection stations at international border crossing points.

Many fruits and plants may not be brought into the United States because of the exotic insects or diseases they may be harboring. These may pose a threat to American agriculture similar to the Mediterranean fruit fly infestation of California citrus in 1980. Officials believe the infestation may have been triggered by Medflies invading the country on smuggled fruit. That outbreak cost nearly \$100 million to combat.

The prototype of the carbon dioxide sniffer has been field-tested during the past year at airports in Los Angeles, New York, Philadelphia, and San Juan, Puerto Rico. It proved to be 60 to 85 percent accurate in the various field trials.

Robert Duryea, of the Animal and Plant Health Inspection Service in Hoboken, New Jersey, says the main drawback is its lack of portability. The prototype weighs approximately 75 pounds and must currently be plugged into an electrical outlet. Duryea says the service is also working with private companies to improve the detector by reducing its weight and having it powered by rechargeable batteries.

—Joel Schwarz

"This science is much closer to myth than a scientific philosophy is prepared to admit. It is one of the many forms of thought that have been developed by man and not necessarily the best."

—Paul Feynabend

COLORFUL SMELLS

Color has a powerful influence on our sense of smell, suggests a fascinating Ohio State University study.

"The purpose of this study was to determine if there is a perceived difference in odor when hue is varied," explains Christine Malcolm, who conducted the study for her undergraduate psychology thesis. "The result was that darker hues of color generally caused people to perceive a given odor as smelling stronger but that lighter hues make it seem weaker."

In the study, 27 college students were instructed to smell various liquids that ranged in color from neutral through progressively darker shades of green. Even though all of the liquids had an identical lime scent, most of the students insisted that the odor became stronger as the shade of the liquids darkened. And the results were the same when equal doses of banana scent were substituted for lime in each of the

various colored liquids.

The interplay of color and smell, Malcolm observes, alters everyday human perceptions. For instance, when a woman wears darker-colored clothing, her perfume seems that much stronger. And darker-colored prepared foods are perceived as having a more pungent aroma and spicier taste than they actually do.

The tendency to associate stronger odor with darker color could be a learned response to the many things in our environment that are really connected in just that way, theorizes psychologist Lawrence Marks, of Yale University, a sensory-perception expert. As an example, the darker in color you make coffee, the stronger its aroma and taste.

"Or it is possible," Marks says, "that we are actually born with some kind of cross-sensory connection?"

—Eric Mishars

"Suffering isn't ennobling, recovery is."

—Christiaan Barnard



To the average nose, darker means stronger. Is it possible that humans are born with some kind of cross-sensory connection?



CONTINUUM



What if our tan squirrel be the star of Japan's next horror movie? Probably not. Even the Delmarva has only three pounds.

GIANT SQUIRRELS

It was 50 years ago that the canny Delmarva fox squirrel began to understand what was happening to his dwindling habitat and decided to move out of Delaware altogether. His departure caused wildlife biologists to fear that the state might have seen the last of the big (up to three pounds), silvery grey squirrels.

No one could have honestly blamed them for leaving. The government had begun harvesting the mature woodlands in which they lived, the types of cover they relied were rapidly vanishing, and the corn of which they were so fond was virtually gone. So the Delmarva,

quite sensibly, moved out to Maryland, Virginia, and the other suburbs.

This distressed wildlife biologists like Kenneth Reynolds, of Delaware's Fish and Wildlife Service. So last fall he snipped seven of the endangered creatures—three males and four females—and gave them a relaxing chemical that enabled him to slip tiny radio-transmitter collars on them. In an attempt to find out whether the chubby tree squirrels were reproducing, Reynolds began to track their movements. He'll find out how successful the project was come fall, when the second litter of the year are due.

The wind-up squirrels who cover a 900- to 1,000-

yard range, apparently don't mind being tracked. Only one Delmarva has bothered to slip his collar.

Reynolds's zeal about preserving the Delmarva is not always equaled by the Delmarva peninsula homeowners, whose concerns lean more toward keeping squirrels out of chimneys and attics. "There are so few of them," says Reynolds of the threatened species, "that they're not expected to be any problem."

In case the whole project fails, Delaware wildlife people plan to import some new Delmarvas from spots on the Eastern Shore, southern New Jersey and eastern Pennsylvania (just to make sure—George Nobbie

America has been discovered says "it's not there before been hushed up."

—Oscar Wilde

"The brain is only one condition out of many on which intellectual manifestations depend."

—Thomas Henry Huxley

SCIENCE-FICTION QUIZ NO. 7

Some science-fiction movies, such as *Cocoon* and *Star Wars*, are original stories created specifically for the films. Others, like *Planet of the Apes* and *2001: A Space Odyssey*, are based on previously written short stories or novels. Here are the titles (and years of release) of five well-known science-fiction films. Each was based on a previously published work of fiction. Can you

name the title and author of the original story and the year in which the story was published?

1. *The Day the Earth Stood Still* (1951)
2. *Rede Runner* (1982)
3. *Forbidden Planet* (1956)
4. *The Thing* (1981, remade 1982)
5. *Soylent Green* (1973)

—Ben Bova

ANSWERS

1. *Forwards to the Master*, by Harry Harrison, 1940
2. *Do Androids Dream of Electric Sheep?* by Philip K. Dick, 1968
3. *The Rampart*, by William Shakespeare, circa 1610
4. *Who Goes There?* by John W. Campbell Jr. (under the name Don A. Stuart), 1938
5. *Make Room! Make Room!* by Harry Harrison, 1966

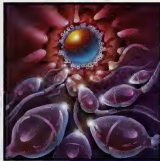


A diving scene from *The Day the Earth Stood Still*.



Can men have babies?
Research indicates they can, and volunteers
are already lining up for

MALE PREGNANCY



BY DICK TERESI AND KATHLEEN McAUUFFE

There it was. After all the fruit-
less affairs, the callous re-
buffs in singles bars and the
disbelieving looks of his
friends, Jake found himself
staring at his dream woman.
She appeared in the form of a
blind advertisement in the
personal columns of *The New
York Review of Books*:

SINGLE WHITE FEMALE, 38,
successful, businesswoman,
seeks warm, nurturing, ma-
ternal SWM, 35-42. Let's have
a baby. I'll pay the bills, you
carry the child. Looks not im-
portant but ample abdominal
cavity a plus. Send recent
photograph and resume to
fertility clinic to Box 20035.

PAINTINGS BY ELLEN GORING JACOBS

At least, Jake thought to himself as he composed a heartfelt letter to the anonymous adviser at Box 20035: I just hope she doesn't exist on natural childbirth.

Okay, so maybe it won't happen quite like that. But it will happen. Someday a man will have a baby.

Already, a male baboon has proved that males can get pregnant. Male mice have also carried babies. And the medical literature is filled with two dozen case histories of women who became pregnant after receiving hysterectomies—proving that you don't need a womb to carry a baby.

Our fictitious hero need not worry about natural childbirth, though. It will be anything but natural. What we're talking about is implanting an embryo into a man's abdominal cavity, where the fetus would take nourishment, grow to term, and be delivered by an operation similar to a cesarean section.

But we're getting ahead of our story. Public awareness of male pregnancy developed six years ago thanks to a remarkable birth in New Zealand. In May 1979 Margaret Martin, a twenty-nine-year-old Auckland woman who just eight months earlier had undergone a hysterectomy, gave birth to a

healthy live-pound baby girl. An errant fertilized egg had lodged in her abdomen, on her bowel, where it received enough nutrients to grow to term without the aid of a uterus. Dr. Peter Jackson, Martin's gynecologist, reportedly told journalists that the birth proved it was possible for a man to be made pregnant by placing a fertilized egg on his bowel.

Taboo! The world over announced that the era of pregnant men had arrived. The story struck a nerve in many men. Scientists doing work on the cutting edge of human reproduction were besieged with letters from men who wanted to be mothers. Some were transsexuals. But others were conventional men who simply wanted to experience the joys of pregnancy.

With this background, Orrin decided to check out the scientific possibilities for male pregnancy. What he found may surprise you.

The New Zealand case was not the first evidence for male pregnancy. Back in the mid-Sixties, Dr. Cecil Jacobsen of George Washington University Medical School performed an unusual experiment that commanded little attention at the time. He and Dr. Roy Hertz transplanted the fertilized egg of a female baboon to the abdominal cavity of a male baboon. The embryo attached itself to the omentum, a fatty tissue loaded

with blood vessels that hangs down in front of the intestines like a protective apron. It got adequate blood supply and nourishment. Jacobsen reports, "So with very moderate chemical support, the male baboon was able to carry the pregnancy to ward term—that is, well past four months."

The experiment was testimony to the hardy independence of the embryo. One key to the embryo's integrity is its ability to produce a placenta, the vascular organ that normally attaches to the uterus and draws nutrients from the mother. Or in this case, the father—as studies by Jacobsen and others show that the fetal placenta is a versatile, opportunistic, and perhaps even an indiscriminate organ. As UCLA neuroendocrinologist Roger Gorski puts it, the placenta is an "eroding tissue." It seeks out and opens blood vessels. Because of this, it appears that the fetus may be able to attach itself to any site rich in blood and nutrients. Jacobsen's team experimented with implanting fertilized eggs on the kidney and the spleen as well but had bad results on the omentum.

The experiment did not result in the birth of a fully developed baboon baby. When Jacobsen says the male baboon carried the pregnancy "toward term," he means that the fetus had reached a point at which it had "survived embryonic development." The

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FIERSTEIN



GROUCHO



FLOWERS

One of the few men to truly understand the challenges of childbirth was remarkably enough, Groucho Marx. "Men always complain that they can never know what it's like to give birth," he said. "I tell them it's easy. Just take hold of your lips—now feel them back over your head." Frequent *Groucho* contributor Barbara Flowers asked seven male celebrities for their feelings on the medical possibility of men having babies. Here's what they said.

"I'll deal with the morning sickness. I'll accept the lower backache. I'll breast-feed if necessary. But labor pains have got to go. I've got enough trouble with cramps."

Harvey Fierstein, playwright, author of *Torch Song Trilogy*

"The closest thing that I've experienced to childbirth has been kidney stones."



DEYOUNG

They say the pain from kidney stones approximates the pain of having a child, but I've never heard of anyone saying I'd have a kidney stone in nine months. I'm grateful to women for doing this job, and I'm a bit envious of that certain closeness that men have not been able to experience with their children. But then, I've got a bad back to begin with."

Dennis DeYoung, former lead singer for the rock group Styx

"I'm speechless."
Harry "The Fonz" Winkler

"It's interesting that you asked me this because several years ago, in the play *Marco Polo Singer a Solo*, I actually played the son of a man who gave birth to me. Needless to say, at the time it seemed like a total fantasy. But here we are in 1985 talking about it in the realm of pos-



DE GRAY

sibility. It's an event. I think that anything that would help further that bridge of understanding between the sexes would be good. Nurturing is clearly not an exclusively feminine characteristic."

Joel Grey, now starring in "Off Broadway's *The Normal Heart*."

"God forbid! Men have different strengths. Motherhood is not one of them."

Alexander Godunov, ballet dancer, and one of the stars of *Steven Spielberg's Money Pit*

"Men giving birth to babies in the twenty-first century? I'm immune to it."

Stuart Berger, best-selling author of *Dr. Berger's Vagina*

"It's about time!"

Dustin Hoffman

normal gestation period for a baboon is seven months. At four months, Jacobson and Hertz "delivered" the fetus. "Had we wanted to," Jacobson says, "we could easily have taken the pregnancy to term, because embryonic development was normal, and the fetus was alive when we surgically removed it from the male's abdomen. But we didn't bring it to full maturity because that was not the purpose of our study."

So what was Jacobson trying to do? He and female-cancer expert Hertz, who is now deceased, were by no means interested in allowing males to have babies. They were concerned with pregnant women who develop ovarian cancer. The ovaries produce various female hormones. At what stage they wanted to know is it safe to remove the ovaries without causing a miscarriage? "The question wasn't whether a male could bear a pregnancy," Jacobson explains, "but at what stage does the embryo make all the hormones needed to maintain a pregnancy? You can answer the question in two ways: You can go ahead and take the ovaries out of different females and see how many babies you lose. Or you can transfer a fertilized egg to the male genital and see if the fetus can survive in different stages."

The experiment has striking, though controversial, implications both for men who want to have babies and for the fields of obstetrics and fetal development in general. Contrary to what many researchers at the time thought—and still think—female hormones may not be required for normal embryonic development. The baboon operation implies that the fertilized egg may be autonomous, producing all the hormones it needs for its own development. "That was the marvel of our discovery," says Jacobson.

Not everyone is similarly impressed. Two decades later, the study remains largely obscure even to specialists in gynecology and obstetrics because Jacobson never published the results. It was one small part of a much broader project, he says. Not unjustifiably, this has raised doubts in the minds of some of his peers. Says one critic, who asked not to be identified, "I'm dubious of the validity of that claim because it never appeared in a bona fide scientific journal." Still, Jacobson has some heavy credentials. Now director of the Reproductive Genetics Center in Vienna, Virginia, he is credited with developing and testing using amniocentesis, a prenatal test that involves extracting amniotic fluid from the womb to detect chromosomal abnormalities in an unborn child. That was in 1967. Today physicians use amniocentesis almost routinely on older women and others at risk for giving birth to babies with genetic defects.

Jacobson is the only scientist on record who has experimented with male pregnancy in primates. But he says that similar work has been done with low rodents, salt alligators, and other amphibians.

In a series of experiments in the early Sixties, for example, Dr. David Kirby, of England's Oxford University, transplanted mouse embryos into the testes, spleens, and kid-

neys of adult male mice. Kirby got the best results in the testes, where one embryo developed in "perfect condition" for 12 days—about half the normal gestation period for a mouse. Kirby now deceased, theorized that the testicle capsule was simply not elastic enough to allow the embryo to mature fully. The experiment did show, however, that testosterone and other male hormones, found in high concentrations in the testes do not thwart normal embryonic development—a positive sign for those males who want to have babies.

But perhaps the best hope for these men comes not from animal studies but from strange pregnancies in women. According to the medical literature, there have been some 24 cases worldwide in which women became pregnant despite having had hysterectomies. While 23 of these ectopic pregnancies (ectopic in this case means outside the uterus) didn't result in live births, they offer considerable evidence for the possibility of wombless childbirth. Inconceiv-

*Women without
uten have given birth. In
these rare cases,
the fertilized egg works
its way into
the abdominal cavity,
which expands
to accommodate the fetus.*

ble proof, of course, comes from the twenty-fourth case: New Zealand's Margaret Martin and her five-pound daughter.

Then there are those women who despite having intact uteri have given birth without using these organs. Ectopic pregnancies are fairly common, but in most cases this condition refers to embryos that have implanted themselves in the fallopian tubes. Such pregnancies are doomed as well as life threatening to the mother. The expanding embryo can rupture the tube, and the patient can hemorrhage.

In rare cases, however—about 1,000 have been reported to date—the fertilized egg works its way into the abdominal cavity which can expand to accommodate the growing fetus. This is an ectopic pregnancy of a different color. Approximately 9 percent of those women with abdominal pregnancies have actually given birth to healthy babies.

It is a difficult condition to diagnose. In July 1961 doctors prepared to deliver a New Jersey woman's baby by cesarean section, because ultrasound studies indicated there was a large tumor on top of her womb. The womb, as it turned out, was empty. The tumor was actually a seven-pound, ten-ounce baby

growing inside the abdominal cavity. In August 1979, Dr. George Porcetta attempted to perform an appendectomy on a Michigan woman suffering from stomach cramps. "I opened her up expecting to find an appendix," Dr. Porcetta told the Associated Press, "and there was this tiny foot." Prematurely delivered, the appendix weighed three pounds, five ounces and was named Joseph Thomas Oak.

An abdominal pregnancy is precisely the kind of pregnancy the best man/mother will have to endure. It is dangerous. Estimates vary, but the maternal mortality rate is about 8 to 7 percent. Part of the danger stems from the fact that such pregnancies are often not diagnosed until the woman is on the operating table. John Money, a pioneer of transsexual operations and professor of medical psychology and pediatrics at Johns Hopkins Medical School, points out that the "extraordinary thing about the New Zealand case [Margaret Martin] was that the medical person in charge made the correct diagnosis. I mean, it really was an A-plus to be able to recognize what was going on with this lady and to realize that it was a healthy pregnancy." Even so, Martin's pregnancy wasn't diagnosed until 23 weeks after her hysterectomy. She had briefly considered that she was pregnant—her breasts were tender and she had felt the baby move—but refrained from mentioning the symptoms, according to her doctor, for fear of being ridiculed. In the case of men who purposely undergo abdominal pregnancy, however, the danger of misdiagnosis will obviously be eliminated.

Still, risks remain. In vitro fertilization pioneer Dr. Landrum Shettles has personally delivered two healthy babies that developed in their mothers' abdomens. Such babies, Shettles warns, cannot be delivered normally. He cites the case of a colleague who attempted to remove a baby that was attached to its mother's intestine. "He tried to separate the afterbirth and the placenta from the bowel," recalls Shettles, "and the blood gushed to the ceiling. The mother died instantly." UCLA's Orlowski reminds us that the womb is not without purpose. "When delivery occurs, the uterus, which is just a muscular organ, contracts and shuts off the blood vessels created by the placenta. Blood vessels supplying the placenta in an abdominal pregnancy, however, do not contract, and massive hemorrhage can occur if the placenta is separated from the mother. As one obstetrics textbook puts it: 'bleeding may be "torrential".'

Which is not to say you absolutely need the womb. The point is," Shettles says, "if you have an abdominal pregnancy, you're the cord of light near the placenta and leave the placenta in place. Don't touch it, and the body will absorb it."

There are some of the dangers. But let's say a man wanted to have a baby so badly he was willing to take the chance. How would it be done? What experience awaits the first man to carry a baby? After talking to Shettles, Jacobson, and other experts both in the United States and Australia, it appears the

procedure would go something like this.

Doctors first perform standard in vitro fertilization to produce an embryo. Eggs would be surgically extracted from the wife's ovary and fertilized with the husband's sperm in a petri dish. (In vitro fertilization is often referred to as "test-tube baby" technology.) In 30 to 50 hours, when the egg has matured to the two- to eight-cell stage and is about the size of the tip of a needle, it would be placed in a flexible catheter for implantation. At this point, however, the in vitro process would take an abrupt left turn. Instead of snaking the catheter through the wife's vagina into her uterus, the doctor would perform a laparoscopy on the husband. A small incision would be made in the abdominal cavity, and the gynecologist would place the embryo into the lower abdominal cavity against the omentum, the fatty, blood-rich tissue in front of the intestines. With luck, the fertilized egg would implant in the omentum, the placenta would develop from the embryo and begin drawing nutrients, and the pregnancy would be under way. At this point, or possibly even earlier, an endocrinologist might be called in to administer hormones to the male mother so that his hormonal status would mimic that of a pregnant woman. Finally, nine months and several thousand dollars' worth of custom-made maternity clothes later, the baby would be delivered from the man's abdomen in an operation called a laparotomy, which would be similar to a cesarean section.

There are two alternatives to this scenario. First, conception could take place in the woman's body, most likely through artificial insemination. The fertilized egg would then be flushed out of the womb and implanted in the man. This is the method used in the process called embryo transfer, when a fertilized egg is moved from one woman's womb to another's. Shettles, for one, prefers the in vitro method, however, because it allows more control.

Second, it is debatable whether hormonal treatment is needed. In January 1984, before an assemblage of sex researchers at a Kinsey Institute symposium, John Money raised the possibility of male pregnancy. He was encouraged in the discussion period afterward to hear Gorski say that the hormonal technology was sufficiently in place to carry off such a pregnancy. Today Gorski still maintains that on a hormonal level, male pregnancy is possible. But Jacobsen's bebop study indicates that priming the male with female hormones may not be necessary. "Maybe that's right," Shettles says. "It might well be that when the male gets a new inhabitant, his body adjusts."

Or perhaps the embryo/fetus is a self-sufficient alien within us. Richard Harding, a fetal physiologist at Monash University in Australia, supports that hypothesis. "You know on an androine basis, on a hormonal level the fetus appears to be totally autonomous," Harding says. "It generates its own signals after a certain period of time. The placenta

produces a lot of the steroids that are necessary for fetal survival."

In vitro fertilization or embryo transfer hormones or no hormones, male pregnancy is not a popular idea today in the medical establishment. "It's an outlandish proposal," says Gary Hodgen, who is the scientific director of the Eastern Virginia Medical School's Jones Institute for Reproductive Medicine, in Norfolk, the leading in vitro fertilization clinic in the United States. Hodgen's main objection to male pregnancy (he used the word outlandish at least five times when interviewed) is that it's tantamount to ectopic pregnancy, a life-threatening condition. "As a male, I obviously don't have a uterus, right? A male who would request the transfer of an embryo to his abdomen would be asking the medical personnel involved to advocate him taking on a life-threatening condition that wouldn't even be to the benefit of another extent person," Hodgen emphasizes. "That's an anachronism."

Dr. Jack Hallatt, an expert in abdominal pregnancy at Kaiser Permanente Medical Center in Los Angeles, says, "There's no way doctors could avoid the dangers of hemorrhage [during the pregnancy]. And it would be catastrophic. There's no way it would willingly be attempted." Hodgen agrees that you can't eliminate the danger of male abdominal pregnancy. "Think a minute why," he says. "It's apparent. The placental sac and the baby, at term, are going to weigh on the order of twenty-five pounds. And all of the months this is growing, this bag may be twisting and turning."

Cecil Jacobsen feels that the risk posed by an abdominal pregnancy has been greatly exaggerated. The condition, he says, tends to be lumped together with the much more common ectopic pregnancy in which the fertilized egg becomes lodged in the Fallopian tubes.

"Any type of ectopic pregnancy in the tube is dangerous," Jacobsen says, "because it is a closed cavity that can't expand. But the abdominal cavity can expand. It is a risky condition, but if the pregnancy is watched carefully, the risk of death is low." Even so, Jacobsen is not anxious to be the first physician with a man in labor for a patient. "Sure it's feasible," Jacobsen insists. "But why in heck would you do it? In my opinion it would be an abuse for males to use the technology in that way. I think the proper use of the technology would be for women who have no uterus but want to have a baby. That's where I think medicine will first do it."

Perhaps it would be an abuse of the technology to use it on men. Still, there will be men who want it. Who are they? What kind of men would have a baby? Johns Hopkins's John Money originally envisioned only one kind of person—the transsexual. "If male pregnancy ever became possible," Money says, "the first applicants would be male-to-female transsexuals, because it's so terribly important to them to experience everything a woman can experience."

They're already lining up. In July 1984 a group of at least six male-to-female trans-



"And what appears to be a pretty girl is actually a high energy X-ray holograph."

FICTION

*It's always the same
dream, of flames as red as the
mysterious flower*

THE DRAGON SEED

BY KATE WILHELM

Bruce Enfield has a seat on the aisle and nowhere to put his elbows or his feet. Next to him is a woman with squatter's rights to the armrest and in the aisle the stewardesses are hurrying back and forth, pushing their heavy carts, delivering drinks and peanuts. He huddles into himself, hating it all, hating the rest of the day that will be just as bad with a two-hour wait in O'Hare, another cattle car in the sky to Portland, another two-hour delay, and finally the last twenty minutes to Eugene.

He is troubled because he is not certain why he is going back. Not to see her, he tells himself again, and he wishes he had taken the slim Lucita piece from his pocket before he put his coat in the overhead bin. He will vet his parents and an old friend or two, sleep and relax, and on Sunday afternoon make the rest of the trip to San Francisco.

His actual destination. He will not see Cory. There is no reason to look her up; he is married, settled, rising in his world.

He twists and struggles to extract his wallet from his pocket, gets a glare from his neighbor and accepts his drink gratefully when the stewardess puts it before him. In his mind he is seeing Cory side by side with Beatrice, and that is embarrassing to him.

Cory in her jeans and heavy boots caked with mud; a man's flannel shirt over a sweater; an untailored, olive rain jacket over it all; her pale hair pulled back carelessly with a string or a rubber band. And Beatrice, elegant in a navy blue dressmaker's suit, high heels, her nails and lips exactly the same shade of red, hair as soft and sweet as a baby's, kept in a style that flatters her face and draws

attention to her wonderfully made-up eyes. Beatrice has the loveliest eyes in the world, he thinks, and he finds he cannot summon an image of Cory's eyes. Pale lashes and brows, pale gray or blue eyes. The comparison of the two women is cruel, and again he feels embarrassed that he is making it. He gulps his scotch and thinks of the Lucita in his coat pocket, wishes he had it in his hand. He wants a cigarette although he has not smoked for almost a year. He thinks almost desperately that he has to have a cigarette, because in his head the comparison is continuing, and he cannot sleep it. Beatrice with her quick intelligence, her humor, her easy grasp of everything, silver roads or heels, and Cory cowlike, retarded or so near that it makes little difference.

Whitman had put his ad in

PAINTING BY PIERRE LACOMBE



the paper on Sunday and on Monday morning, when he opened his door before dawn to start work, she was there on the back doorstep. Whitman was a large, muscular man in his late thirties, a widower for the last six years. To him Cory appeared an empty-faced child that bright morning.

"I've come for the job," she said.

"Worked in a nursery before?"

"She shook her head. She was tall, strong enough, and the fact that she was there that early meant that she wanted to work. Whitman thought, studying her. "Where you live?" She told him, one of the subdivisions ten miles or more away. "How'd you get here?"

"She pointed to a bicycle leaning against a tree, and he heard her.

He would have to teach her everything, but then he always did, and come fall, they always left to go back to school, and next year he had to do it over again.

He showed her how to take chrysanthemum cuttings and how to space and plant the pieces and mark them for a top crop of blooming plants. She watched him silently and then took over as if she had been doing it for years. He supervised for a short while before he went off to get his other tasks started, he came back from time to time to glance at her work. Neither of them spoke. At ten thirty he told her she could have a break when she wanted it, that he didn't expect anyone to work straight through, he wasn't a slave driver. She listened as attentively as she had listened to his instructions about the cuttings, and he realized that she could not distinguish between kidding and the straight goods. The tone he invariably took with his employees was either a brusque directive or a banter that was meaningless. He knew no other way to address them. He stood looking at the girl kneeling in the bark mulch along the row of chrysanthemums, and he did not know how to speak to her. It was a mistake to hire her, he thought, and tell a stir of self-contempt as he realized he was shifting his own problem of noncommunicativeness to her shoulders.

"When you get tired," he said, trying to soften his voice, because she looked frightened, "go on over to the shop and get a drink. Rest a few minutes. Okay?"

She nodded and turned again to the chrysanthemums, began to cut seed.

"Cory, take it easy girl. You're doing a fine job, the best of anyone I've hired starting as green as you. I don't expect you to finish all this in one day."

She looked at him again as if trying to measure his words, to test his truthfulness. And then she smiled, and he knew he had done right in hiring her. He walked away thinking about her smile, not that it made her pretty or anything, but it changed her. At first her face was immobile, guarded; then it began to soften, and very slowly like the opening of a light, hard bud, the softening, relaxing continued until her whole face was transformed and was not protected at all.

During her lunch hour he saw her wandering over the nursery grounds, and he remembered that he had meant to show her

around when he had time. There was always too much to do, not enough good people to get a grow. Don, his brother and partner in the business, kept telling him to hire a full-time manager, but he resisted. He had tried that. No one else did anything his way and his way was not the back way. He did things when they needed doing, not when the books said it was time. Only one man, Hank Walchek, might have worked out, but he had quit after a few years and opened his own nursery on the other side of Eugene. And meanwhile Whitman's Nursery was growing business was expanding, and his, William Whitman, was a tired, overworked man. But at least the paperwork was Don's department. Payroll taxes, ordering inventory, advertising, all that he cheerfully left to his brother, who in turn never set foot in one of the greenhouses or the long rows of seedling trees and bushes and shrubs.

It was Don, filing in the employment records who discovered that Cory had left home to go to school that day and instead

● He was
as cold, as rigid as stone,
without will
as he listened to Frank's
voice, like a
snare drawing tighter before
the victim
could suspect its presence. ●

had come to the nursery. She had dropped out, he said, and only in the tenth grade.

Whitman tried to see Cory sitting quietly at a desk, immersed in history lessons or math problems, and nothing came. He shrugged. "Her business," he said. But Don Whitman was concerned about it. He had three grown children, and he knew teenagers sometimes did things their parents were ignorant of until too late. He called Cory's mother that night and learned that Cory had a history of failing and that the school counselor had advised a training school for her. The brothers dropped the subject and never referred to it again.

Cory's mother liked to go to her daughter's room on her day off from the bakery and just sit quietly awhile. The room was not messy, the bed always neatly made, there was no scattering of books or records or clothes to offend the most fastidious housekeeper, but there were plants everywhere in pots, coffee cans, milk cartons, rusty vegetable cans, Styrofoam cups. In here the light was soft and green, filtered through leaves at just windows.

A heavy rain was driving leaves from the

trees, mashing them in muddy heaps. Mrs. Davenport had come in wet and cold from the weekly shopping and now sat drinking coffee, thinking nothing, content to smell the green smells of growing plants instead of cinnamon and vanilla and yeast. When the kitchen buzzer sounded, she got up to make supper. One day Raymond had come home to find her sitting in there and had stared all night at her, and of course at Cory. Sometimes when Mrs. Davenport came out of Cory's room she found that she had been weeping with no memory of the tears or the cause. Now that Cory had a good job and was doing well at it, there was no longer any reason to worry of dry over her, but still there were times when she wept.

It only Raymond could accept her, she thought at those times, that would make the difference, but he could not look at Cory without a shadow passing over his face without his eyes narrowing and a slight ridge forming along his cheek. Most times he avoided looking at her, and most times she stayed out of his way, out of his sight. Now that she was working, they never even ate at the same time. He got home at four thirty and had his supper, and Cory got in at six thirty after he had settled in front of the television for the rest of the evening.

Raymond was a good man, she thought as she peeled carrots. He was a good man in all ways except with Cory. From the start there had been something in her that drew out the devil in him. Mrs. Davenport knew that one of those long, slow smiles from Cory was more important than hours of giggles from other girls, but Raymond had never learned that.

Tonight they would fight over their daughter, she knew, during the meal and vegetables. Cory needed things, a new sweater, new wooden socks, and he would act as if it were his money. Each week Cory's check went to him, to be deposited in the checking account, where he guarded it jealously.

"How many years did we provide everything, ask nothing in return?" he would yell. "It's her turn to help. If she wants to keep her money, let her move out! Once she's gone, I don't give a damn what she does!"

Sometimes Mrs. Davenport fantasized about moving out with Cory, just the two of them sharing a small house with a garden for Cory to work in. It was a pleasant reverie, but it was frightening also, because she cared for Raymond. It was only where Cory was concerned that he became a cruel stranger. Sometimes Mrs. Davenport felt that someone had planted a sharp knife in her skull on the day of Cory's birth that day by dry through the years had sliced downward a little at a time, ready dividing her into halves. She imagined that the knife was eased with her heart by now and that it she had to make the decision about leaving with Cory or driving Cory away to be able to live with Raymond, the knife would make the rest of the cut very fast.

Bruce Enfield has gone to the phone booth twice and each time has left it without pick-

ing the call to his friends in Chicago. He sits in a clattering coffee shop and stares out the window at fitful snow that looks dirty even before it hits the ground.

His friends would ask about Beatrice, and he does not want to talk about her. He sips his coffee, wishing he had gone to the bar, he hates coffee shops. The snow is stopping again, it is like the ash-fall they sometimes have in Savannah. He remembers standing at the glass wall of his house close to Beatrice but not touching her as they watch the powdery ashes settle on the lawn, on the surface of the pool.

"Lovely," she says. "Your company?"

"No."

"Have you made an appointment with a doctor yet?" Still looking out the glass, pretending indifference, or actually lying (—he no longer can tell which—she asks the question as if she were asking for the time "No.")

A 747 rolls past the window, and he watches until it is at home in its own bay and the caterpillar mouth has attached itself to the giant body.

He imagines the scene with the doctor. "You say you have nightmares, Mr. Enfield. About what?"

"Dragons. They are chasing me, breathing flames, and I can feel the heat touching me, spreading, consuming me."

"Dragons? Very interesting," Mr. Enfield.

He lights a cigarette and watches the tip, the smoke curling slightly at first, then so-

anding in a column and a draft hits it. He stubs out the cigarette and is mistily surprised to see four others already in the ash-tray, all three quarters intact.

Yesterday he changed his reservation, added this side trip to Eugene. Beatrice did not ask why. He wishes she would pretend to be interested but understands that she won't play that game with him. From the start she refused games, then it did not matter because there was no game to play. But now...

He fears again her indifference when she asked how long he would be gone. He can't remember if she acknowledged his answer or even if he answered. It mattered as little, they both seemed to say.

"Tell me about your mother," the doctor says, trying to hide a smile.

"Not my mother. Not my father. It's Cory. And I can't tell you." Abruptly he stands up and snatches his check and hurries from the coffee shop. He can feel the hot breath on his back, and he does not dare turn to look for fear he will see the dragon in daylight. He knows when that happens he will be lost.

One morning Whitman woke up before daylight, listening to sloot hit the roof. Drowsily he turned over, finding comfort in the steady patterning of icy feet while his own feet were warm. Then he sat up. Sleat. He switched on the radio before he reached for the light. They were already talking about the weather conditions, freezing rain throughout the valley, roads closed, schools closed.

He dressed, made coffee and eggs, and planned. He had to prune the two-year-old trees. He had scheduled for early-January, but they would break under a load of ice. And cover the evergreens. And the balled and burrapped trees, and if he had time, get to the year-old, dwarfed fruit trees. The radio was giving no comfort at all, not even trying to predict when the ice storm would pass, turn into ordinary rain, wash away the gruel the ice always brought with it.

It was as dark as night when he was ready to go out and start what seemed to be a day of hellish effort. The ice was already a quarter inch thick. For a moment he squinted in disbelief as he stared at the foiblishly brightly lighted. He hurried toward it, the gravel drive was already treacherous as ice smoothed out the irregularities.

"Cory! What the hell are you doing here?"

She ducked her head and murmured, and he drove closer to her.

"How did you get here?"

Her mother had brought her, she said, on her way to work. She had heard the rain and knew it would turn to ice. He stared at Cory for another moment, and then they went to work. Together they pruned the trees and covered the evergreens and got to the graded trees.

By late afternoon they had it all done, everything they could do to protect the nursery stock. In exhaustion Whitman made his way to the house, motioning her to follow. He eyed her young, strong body, her stamina, but even she was tired by then and hungry and fell asleep. Their outer coats were covered with ice, ice was a half inch on everything in sight. It had stopped falling an hour earlier, but the temperature had dropped throughout the day, there would be no thaw until the wind changed. At the door of the house Cory stopped and looked at the magic world, and she smiled her rare smile. Whitman nodded. It was truly beautiful, but he was too cold and tired to smile.

He made coffee and got steaks from the deep freeze and made a trip in the fireplace. They both sat very close to it, driven back gradually as the flames went from orange-yellow to blue. Neither talked. When Whitman felt himself drifting off in a daze, he roused and went out to make their dinner. The telephone lines were down, and the radio was nothing but chatter about the ice storm and its consequences. Nothing was moving. Whitman sighed. She would have to spend the night; he thought gloomily and then might be talk. No one else had been able to get to the nursery that day and he had not talked to his brother, who probably was dead. Who would ever know? He pushed the thought aside and went about making dinner methodically, the way he did everything. And he wondered about Cory. She always knew about the weather, no matter what it did, she was dressed for it or had clothes to change into. Today she had brought rain pants and heavy enough clothes to get by on an Arctic expedition. When they had come in, she had gone into the bathroom and stripped off a layer or two



"For tomorrow a weather the clouds partly roiled with scattered meteor showers by late afternoon."

and had come out dry and clean. She never lost plants to a drought or knew there isn't a week of steady rain. She knew.

She could not handle money or take an order or talk to a customer. She seldom talked to the other employees; she managed to take her lunch break after the others were back at work. Sometimes in good weather, she took her sack lunch out under one of the walnut trees and ate there alone. She had not missed a day in a year and a half; never had a cold, an ache, a complaint. In fact, he had had to tell her she could not work seven days a week; it was the only thing he ever had to tell her more than once. And when he had tried to pin her down about her vacation, she had said sullenly that she had nowhere else to go, nothing else to do, and if she couldn't work, she would just sit under the trees and watch.

A few days later, when everything was back to normal, he told his brother he was raising Cory's salary.

Why? You know her father gets her money.

You been telling me for years I should hire myself another Hank Valchek, another manager. I been reaking make and more that she's it. She does more than Hank ever did. And we set up a trust and don't tell her daddy. When this goes," he said, "looking vaguely toward the grounds, the greenhouses, everything," "what's going to become of a girl like her? Set it up, Don."

Don Whitman was sixty-three and had begun to talk about training his own replacement. William Whitman would be sixty in the fall of this year. Sobriety they nodded at each other and it was done; the trust fund was established. Cory became the highest-paid employee of the enterprise.

Bruce finished tries to remember if he ordered chicken or the seafood casserole. He cannot tell by tasting. He is on a DC to this time, seated by a window in the smoking section. The plane is two thirds filled, service is prompt and efficient, already he has had two drinks, and after he finishes his meal there will be plenty of time for several more.

Beatrice travels more often than he does; she is an assistant buyer for a department store and her trips are to New York, Paris, London, even Hong Kong.

The food is taken away and presently a mellow voice suggests that the window seat passengers pull down their blinds in order to view the movie. He pulls down his blind and closes his eyes and remembers when he went to work for Whitman.

His master's degree was assured by the spring break, and in the fall he would report to MIT for the eighteen-month grand toward his Ph.D. That was already assured also; his project had been accepted; the execution would be a matter of putting in the time it took to do the designing, the drawings, the mock-ups. He was a chemical engineer specializing in plant design; there was a great need for him and the too few others like him.

What he wanted for that summer was an

outdoor job that required muscles and no mind. He found it at Whitman's. The old man asked few questions, put him and Frank Frodinckson to work the day they applied.

"Cory show these two fellows how to bell up the roses," Whitman called. Across the drive, near a shed, a girl nodded and motioned to them to follow her. She was tall and could have passed for a young man, bundled up as she was in jacket and boots and gloves. It was a cold March day, misty, with more rain threatening any minute.

Bruce and Frank exchanged a glance and followed her. She went inside the shed and waited for them. Her directions were terse, almost mumbled, and she did not look at them directly.

Within a few minutes they all walked toward the rows of roses, pulling long weapons. On one there was a box with labels, a stack of wooden flats, clipping shears, scissors. Bruce had a stack of burlap squares, a large box of wet sawdust, a spool of wire and wire cutters, and Frank's had the spare

●He went
closer and looked curiously
at it—just a
red flower, pretty, unusual,
but nothing
more—and started to say it
was just a flower
but decided to say nothing ●

and fork. The work was mindless enough. Bruce decided quickly. Cory moved on ahead of them, pruning the roses that they then dug out and balled up in little bundles with the roots packed in dirt and sawdust. The roses came out easily. Bruce learned later that they had been root pruned twice to force them to make a compact root system, easy to dig, easy to transplant, almost guaranteed to suffer no shock when moved. He found himself watching the girl as she left them behind. Her hands were so quick it was hard to follow exactly what she was doing. First she seemed to feel the rosebush and then she clipped it so fast that he could not tell what she looked for, how she determined what needed cutting, what needed saving. Some of the cuttings fell around the plants, to be cleaned up later by one of the younger boys, some of them she kept until she had a bundle that she tied together and labeled.

Her cuttings always grew, he learned that spring and summer. The more she cut, the more plant stock they seemed to have.

After a while she came back to Bruce and Frank to inspect their work. She shook her head over several of the burlapped roses and pointed to one she had done. It was a

plump little package, neatly tied off with a wire. The ones she singled out were then scenery. She told them to do theirs over and returned to her own task.

Frank watched her walk away. "And how do you spend your day? Bailing roses?" He laughed. "I'm going to be in her pants within two weeks, wanna bet?"

"Her? But she's a

"A dummy? Sure, she is. They make the best jobs. They're grateful, you know? And they don't kill. They do what you want them to do. Two weeks. I'll let you know how she is. A side bet. She's a virgin. Am I or?"

Bruce was revolted by the idea of taking a girl like her, revolted by Frank's easy appraisal, her experienced air. That winter Bruce had met Beatrice Langley and although he looked at other girls, she was the one he always saw. The thought of gazing a tall, frozen-faced, slow-witted girl like Cory was sickening.

Somehow Cory kept eluding Frank all spring. She was not where he expected to find her, or a third person related, when he thought he had her alone, or something else happened. He told Bruce that he had the place picked out, back behind the last greenhouse, the one they called Cory's trial greenhouse. A grove of holly trees had the spot Frank had in mind, and no one ever bothered Cory when she went back to her own greenhouse. That was where she got strange gifts to take, where she hand-pollinated flowers to get new colors, new varieties. No one knew what she did there because no one ever asked.

Leave her alone, Bruce said sharply. "She doesn't bother anyone."

But he knew she did bother Frank. A frown from her was enough to make anyone have to do a day's work over again, and her a dummy second in charge of a million-dollar operation. Frank resented her more, he learned her, because if a retard could go up like that in a couple of years, where did it leave someone like him? It wasn't right, he said, Whitman treated her like some kind of special royalty, excusing her from anything she didn't want to do, things she couldn't do that any normal eight-year-old could handle.

One day Frank grinned at Bruce and motioned for him to look at something. It was an envelope. Frank opened it carefully and showed Bruce.

"Seeds," he said triumphantly. "She can't talk about movies, or books, or television, or anything. All she knows is plants. I have the ultimate weapon, my friend."

"What are they?"

"Damned if I know. My old man brought them back from Africa ten, fifteen years ago. They've been around the house ever since. Last night I remembered them and knew I had 'em."

Bruce thought so, too. He had an impulse to knock the envelope out of Frank's hand and grind the seeds into the earth, to yell out to Cory to hide, to run away. It was none of his business, he reminded himself, and went back to work.

It was late afternoon when Frank wan-

dered over to Cory's greenhouse. Bruce watched him helplessly and slowly followed knowing he would not interfere. He wished a storm would come up, lightning hit the greenhouse, set fire to the holy grove. At the screened door he stopped and listened.

"I know you'd be the only one to plant them." Frank was saying. "See that black one? It's almost like a stone, isn't it? And those little ones in the glassine envelope, they're more like grains of dust than seeds. And that red one. That must be the dragon seed."

Her voice did not carry enough for Bruce to make out her words.

Frank laughed. "Sure they did. Where do you think dragons came from? Two ways: seeds like that and their own teeth. When you grow one, you save the teeth and plant them, too. They'll grow. You want to borrow my book about dragons?"

Bruce could no longer choose to move or not to move. He was as cold, as rigid as stone, without will as he listened to Frank's voice, then the wordless murmur that was her voice. Frank's voice again, like a snare drawing tighter and tighter before the victim ever had a chance to suspect its presence. He was moving her toward the back door, saying what a wonderful surprise she would have for Mr. Whitman when the seeds sprouted. Then he was talking about how much the seeds cost, how he had been willing to pay so much because he liked her. Bruce could imagine his hands on her now, her bewilderment.

"When a man likes a girl and she likes him, it's the most natural thing in the world to show each other."

Bruce never saw her coming, but suddenly Whitman was there, entering the greenhouse. "Cory, you run along home now." His voice was low and easy, the way he always spoke to her. She ran from the greenhouse clutching the envelope, ran to her bicycle and sped away. "You, you piece of shit! Get your gear and clear out and don't come back!"

"You've got no right, Mr. Whitman. I want to go to the h—" "You're going to hurt her."

"You say another word and I'm going to whip you. Get out!"

Frank came out blinking in the bright sunlight. He called over his shoulder, "She's got free will, doesn't she? I was going to give her a good time, a little fun, that's all."

Bruce hurried back to the new greenhouse where he was supposed to be caulking windows.

The next day when he met Whitman, he saw contempt on the old man's face.

Bruce opened his eyes in order to stop seeing that look. It is all there.

August heat lay over the land like someone opened the door to hell. Whitman thought, pulling up in the driveway of the Davenport house. He was not sure what he would say to Mrs. Davenport, but he had to say something, let her know Cory was vulnerable. All summer he had worried about this, pondered what he should do, what he could do, and finally he had got in his truck

CONTINUED ON PAGE 109



Introducing **BILL BLASS FOR HANES**

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One tone warns that the baby has stopped breathing. Others sound when the heartbeat has dropped or when oxygen levels are too low.



Brigham and Women's Hospital, in Boston, weren't so sure. Kimble had lost two premature babies, and the chances for this one didn't look good. The child, weighing a mere one and a half pounds, was born about 25 weeks after conception. She was at the very edge of human viability, before which life cannot be sustained.

Predictably, things soon went awry. In a few days doctors found a small hemorrhage in the baby's brain. Then she became jaundiced, as broken red blood cells lingered in her skin. Her toes turned blue. She developed infections. She needed transfusions enough in her first week to replace all the blood in her body several times over. Her blood-sugar levels skyrocketed, sending her brain into seizures. Her heart stopped twice. Both times a doctor did cardiopulmonary resuscitation (CPR) by pressing his thumbs lightly against her chest.

"I called the hospital, and the doctor said he didn't think she would make it," says Kimble. "I just rushed right over there. But first I asked him to go over to her and say, 'God bless you.' I knew that God would know it was coming from me."

Once at the hospital, she continued to pray. The doctors, meanwhile, used every technique they could muster. They administered antibiotics, clotting agents, and seizure repressors. They used the latest technology to examine the baby's brain. They fought infections and wild changes in tem-



perature. They fought things they didn't even know how to explain, like the unusual swelling and blue color of her stomach.

Days passed, then weeks. And with the passage of time the child's underdeveloped organs began to mature. Finally after two and a half months, she was strong enough to be transferred out of intensive care. One month later she was ready to go home—three days before she would have been born had she been the product of a normal nine-month pregnancy.

"She's come a long way," said Kimble as she prepared to take her baby home. "From the very beginning she was not supposed to live." Indeed, from the outset the child seemed to merit her name—Victoria, an homage to the victory over death.

Victoria is one of the quarter million premature babies born each year who are benefiting from a revolution in neonatal care. That revolution is due, at least in part, to a simple but crucial concept: Premature babies have nothing special wrong with them. Their organs are simply underdeveloped and still adapted to the dark, cushioned environment of the womb, where oxygen, food, and waste disposal are all provided by the placenta. Thus, the task doctors face is to nurture these babies, fighting damage while the preemies' fragile organ systems mature.

Spurred by the notion of the preemie as a loose frame of human development, medical researchers have forged dramatic improvements in care for the premature. They've used ultrasound and the three-dimensional X-ray machine known as the CAT scan to understand the physiology of premature babies. They've developed sophisticated respirators that produce rapid, shallow puffs of oxygen for tiny, sensitive lungs. They've adapted computer technology to monitor and sustain the babies' vital functions. They've even begun to probe the minds of premature babies, learning how they respond to all this intensive care. And they have concentrated all these developments in special baby wards so modern that one expert says they look like "Hollywood portraits of intergalactic spaceships."

"It's absolutely a product of the Space Age and microprocessors," says Dr. Lu-Ann Pepile, director of neonatology at the University of New Mexico Medical Center. The progress in the last decade "has been absolutely incredible."

Dr. Elizabeth R. Brown, director of neonatology at Boston City Hospital, agrees. "The horizon of viability" she says, "has moved back. In the 1950s, it was unusual to save a thousand-gram (2.2-pound) preemie. Now they survive all the time."

Indeed, survival rates, which depend on size and age, have been rising in every category. Twenty years ago more than 85 percent of all preemies less than 1,500 grams died; now that same percentage survive. For larger preemies, the survival rate has jumped into the nine-fifths percentile. And the rate of severe handicaps—such as cerebral palsy and mental retardation—has either dropped or stayed the same, depending on whose studies you read. Increasingly smaller babies are remaining healthy. Though complications from prematurity still account for 8,200 infant deaths a year, the picture has changed.

For most of human history, of course, preemies were considered wailings and

The neonatal unit at Cedars of Sinai Hospital in Los Angeles is shown at top. Middle: Adult beggars cradle the only foot of a premature infant.

given up for dead. Then, in the late nineteenth century, a French doctor named Stephane Tarnier got an idea while visiting a Paris zoo. Noticing how baby chicks were kept warm and alive in incubators, he asked the zoo staff to make one big enough for a child. Voila—the world's first warm-air incubator was invented. And the Paris Maternity Hospital became a world center for care of the premature.

Years later a young doctor from the hospital displayed the incubators—babies and all—at the 1896 Berlin World's Fair. The so-called Child Hatchery was such a hit that Dr. Martin Couney took it to London and then to America for a tour lasting several years. He went to Chicago, Omaha, Buffalo and other cities, displaying the hatchery at carnivals, fairs and small. Finally he settled near New York's Coney Island amusement park, where in the summertime he charged 25-cent admissions to all who wanted to see his Premature Baby Exhibit. The show remained open until World War II.

Couney's approach may have seemed sensational, but he's credited with saving thousands of "hopeless" premies and advancing the cause of premature care. Couney's work influenced Dr. Julius Hiss, who established the country's first hospital preemie unit in Chicago.

It was Hiss who eventually pioneered the practice of giving oxygen to premies, dramatically improving their rates of survival. But with the boon came a problem. Doctors soon

realized their oxygen supplement was scarring the immature blood vessels of the eye, preventing the retina from attaching and rendering the infants blind. By diluting the oxygen, doctors finally curbed the epidemic—but not before thousands of preemies had been hurt.

Other dangers abounded in the Fifties. Then, as now, the leading killer of premies was respiratory distress syndrome. All that doctors knew about the syndrome was that infants afflicted with it spent two or three days gasping for breath, only to give up and die. Autopsies revealed that the lungs were collapsed, airless, and purple-red.

Then, in the late Fifties and early Sixties, Dr. Mary Ellen Avery, of Boston's Peter Bent Brigham Hospital, examined victims' lungs with an electron microscope. She found that they lacked a soapy coating, called surfactant, that kept lung tissue pliant, much as mark oil can soften a shoe. With surfactant the air sacs in the lungs can expand easily like smooth-working bellows. Without it they collapse like small, dried-out balloons.

Indeed, without surfactant most premies could not breathe on their own. The obvious solution: pumping air into the lungs at a relatively high pressure. Yet high pressure could destroy the fragile lung tissue.

"There were a lot of abortive attempts," according to neonatologist Michod Slahman, a pioneer in the field at Vanderbilt University. "You'd try to use high pressure, but it would blow out the lungs."

Eventually a former Air Force doctor designed a machine that kept babies' lungs inflated with continuous air pressure while pumping in small puffs of air. The machine also had an "air clutch" which allowed the baby to override the machine if he started breathing on his own. Thousands of the new respirators were installed, and by the early Seventies a majority of respiratory distress syndrome victims lived rather than died.

"It [the new technology] was like a band-aid sticking up," says Dr. Jerald Lucey, professor of pediatrics at the University of Vermont and editor of the journal *Pediatrics*. "You'd hear a lot when a wheeler and soon everything was in motion." The progress was so rapid that in 1975 the American Academy of Pediatrics formed an entirely new medical specialty called neonatology.

Since then work has continued unabated, giving insights into problems that scientists barely knew existed. In the late Seventies, for instance, Dr. Lu-Ann Papile, of the University of New Mexico, started the medical community with her studies of premies with brain hemorrhages. Doctors had long known that some premies died of bleeding in the brain but didn't think it was very common. But Papile—using CAT scan machines to examine the brains of 100 premies in her hospital—found this inkblotlike bleeding in about half of all premies who weighed less than 1,500 grams, about half of whom died. Her work helped identify hemorrhage as one of the leading causes of preemie mortality and the prime cause of cerebral palsy and mental retardation.

By the Seventies it had also become common knowledge that about a third of all premies suffer the effects of an immature circulatory system. In the fetus, a small tube near the heart directs blood away from the lungs. That's because the fetus gets its oxygen through the mother's placenta, so lungs don't need to be suffused with blood. After birth, the tube naturally closes, and circulation adjusts to life outside the womb. In many premies, however, the tube does not close. If severe enough, this condition, called patent ductus arteriosus (PDA), can cause heart failure.

The standard treatment for PDA in the Seventies was to stitch the tube closed. But then doctors at Stanford University, looking at the circulatory system of fetal lambs, found that a body chemical called prostaglandin keeps the tube open. If that's the case, they reasoned, why not use a drug to inhibit prostaglandin? And so for the next several years, various teams of scientists used a chemical relative of aspirin to inhibit the production of prostaglandin in premature lambs and then in human premature babies.

Finally, in 1983 the National Institutes of Health reported that in a nationwide study involving 421 premies, the recovery rate of the treated group was nearly three times as high as for the untreated group. So positive were the results that this year the Food and Drug Administration approved the drug for intravenous use, eliminating thousands of surgical procedures per year.



"Relax. It's my publisher."

These advances, moreover, have spurred the advent of perhaps the most crucial factor in preemie survival: the modern neonatal intensive care unit (NICU). These high-tech facilities, the latest word in the treatment of premature babies, represent medicine's latest attempt to simulate some of the functions of the womb.

"We're not here to create something super or to intervene in nature," says Dr. Michael Epstein, of the NICU at Brigham and Women's Hospital, in Boston. "We're just trying to help with the functions until the baby comes to full term. At each stage we try to pick the minimum intervention."

At first glance, the technology in the room seems to contradict him. A baby girl sleeps in one plastic incubator. Nearly four months premature, she has no fewer than half a dozen tubes and wires connected to her. A clear plastic tube carries nutrients to a vein in her left ankle; another drips medication to a vein in her left hand. Two tubes lead from the respirator behind her into her nostrils; past her vocal chords, and down her trachea. Nurses explain that some babies "fight" the respirator and breathe against it. They may be completely paralyzed with pancuronium, a synthetic form of curare, so that the respirator can take control, forcing them to breathe.

Three wires lead from computer-driven monitors to small plastic bands on each arm and one leg. The monitors display her breathing and heart rate in an ever-changing series of green numbers and graphs. Other wires lead to a neck-size disc on the baby's stomach. This translucent oxygen monitor heats a small patch of skin and then measures the oxygen that diffuses from the capillaries. Because the disc heats the skin slightly, nurses often shift it to avoid causing a burn. A few mosquito-size red spots show where the monitor has been.

"The whole body is warmed from a small overhead heater and bathed in an unearthly blue light. Doctors have found that the light breaks down the old red blood cells that the liver does not remove. To avoid eye damage, nurses tie the baby with a blindfold."

"Here we go," says nurse Gretchen Lawton as she reaches through two portholes in the side of the incubator. Avoiding the tangle of wires, she removes a tube from the needle in an ankle and tucks a capillary tube to the base of the needle to withdraw a blood sample. In a few minutes she'll have a lab report showing oxygen and carbon dioxide content and the pH of the infant's blood. She takes less than a tenth of a teaspoon. This preemie blood contains a bit more than a shot glass of blood to draw more would necessitate a transfusion.

Lawton explains that the vast majority of babies she sees are moderately premature—31 to 38 weeks gestational age and usually weighing from 1,500 to 2,500 grams (3 1/3 to 5.5 pounds). A small percentage—about 1 percent of all births—are very premature babies. Their gestational ages range from 24 to 31 weeks, their weight, from 500 to 1,500 grams (1.1 to 3.3 pounds). It's these

tiny ones who require the most care.

"It's all bone—skin and bone," says Lawton as she repositions the baby, who at 24 weeks gestational age weighs a mere 600 grams. "It feels like you're touching a tiny Cornish hen."

As Lawton speaks, monitors in the back ground sound electronic alarms. One tone warns nurses if the baby stops breathing (The condition called apnea; arises because the preemie brain may not be developed enough to "renew" the lungs to breathe.) The treatment: Tickle the foot to make the baby alert again. In serious cases doctors administer a chemical related to caffeine. Other alarms warn that a baby's heartbeat has dropped or that his oxygen levels are too low. Some of these kids are so sensitive that just touching them will cause the alarm to go off," says Lawton. Nurses check the babies, then reset the monitors.

Every corner of the room is alive with drama. A nurse puts a needle into a baby's arm. The baby tries to scream, but no noise

● *The baby lay in a frog pose—legs splayed on either side of the head. A fine white fetal hair covered the body. Her skin hung in loose wrinkles around the joints.* ●

comes out. She explains that the breathing tubes passing between his vocal chords prevent them from vibrating and giving voice to the scream.

A mother who has just given birth is wheeled in on a stretcher to see her premature daughter. Still sedated, she is barely strong enough to turn her head and gaze "O-hi-hi-hi," she says weakly. "Is it okay to touch her?"

"Feel free," says a nurse. The mother tentatively strokes a leg, afraid she might break it. At the nurses urging she caresses the head. "She's so beautiful, so sweet," murmurs the mother. She stares dreamily at the baby while her husband stands behind her.

"I've been through that before," laughs Carol Cardoso, rocking her baby a few feet away. Her first preemie was "sucky" but with this one she seems almost nonchalant.

Dr. Epstein walks in and recognizes Cardoso from two and a half years ago, when he helped her keep her first preemie alive. "How's the first one?" he asks.

"Oh, fine. Of course we want to give him up for adoption."

"No return!" says Epstein, in mock protest. "We have a firm policy of no returns!"

At the other end of the room a nurse disconnects a baby from a respirator. "Cute!" he exclaims as he removes tubes and tape. The baby tries his liberated vocal chords with his first healthy scream: "Hi! I'm being substituted," says Lawton. "That's a big step, because now he can breathe on his own."

In a few weeks that baby may be sent across the hall to the mid-level care nursery. Quicker and less high tech than the first room, the mid-level room houses those babies who have come through the first critical few months. The babies—no longer connected to respirators or monitors—lie in incubators or in miniature cribs with clear plastic sides. The atmosphere is brightened by stuffed animals, pictures, and brightly colored signs in the cribs.

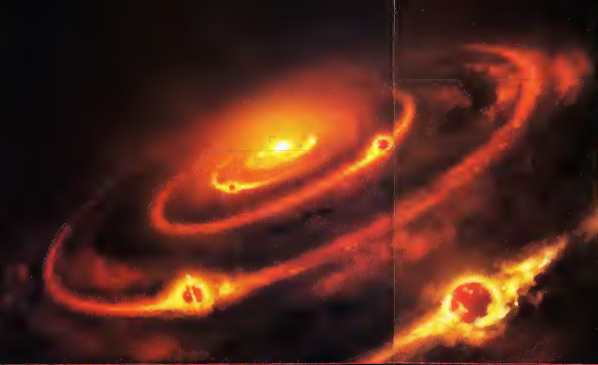
But if the NICU and mid-level care nursery represent the state of the art, scientists around the country are pushing the technology further still. Even though doctors in the late Seventies recognized the danger of hemorrhage, all they could do then was watch the bleeding with CAT scan and ultrasound, draining the fluids and hoping the leakage would stop.

Last summer, however, a Washington University team announced a new treatment. Using an ultrasound probe, they measured the flow in blood vessels around preemie brains. The vessels they found lack an important feature of more mature capillaries. Blood vessels in the adult brain maintain a constant blood pressure. Those of preemies are "pressure passive," according to Dr. Jeffrey M. Perlman, and exert no control over the blood pressure within them. As a result they swell or collapse—sometimes enough to rupture.

Perlman and his colleagues found that the blood pressure changes occur in the first 48 to 72 hours of life—exactly when respiratory distress syndrome is most severe. They suggested that the two are linked: as babies struggle to breathe, their blood pressure sometimes changes enough to cause hemorrhages. As treatment, Perlman used the standard procedure for infants who fight respirators: giving synthetic curare until the infant is 72 hours old. The result: 5 of the 14 test infants remained free of hemorrhages, while none of the 10 control infants did. In fact, Perlman says that using pancuronium and other drugs has reduced the deaths due to brain hemorrhage among preemies to about a third of the national average.

He acknowledges that pancuronium is harsh, causing complete paralysis while it is applied. "The next step is to find a less noxious agent."

Of course, there might be fewer hemorrhages if preemies did not have to struggle to breathe. And so scientists have recently developed a new kind of respirator that seems to take the struggle away. At first glance it's not apparent why the device works. Conventional preemie respirators deliver about 50 teaspoon-size puffs of air per minute; this one puffs about 20 times faster using far smaller volumes of air. It sets up thousands of tiny air swirls in the lungs—



The Big Bang (near right) created heavy elements that grew as the first stars (middle) and condensed to form our solar system (above). Then heat and light cooked organic compounds into the molecules of life (far right).



In Pagan mythology, which formed the foundation for the Greek pantheon, the goddess Eurydome sprang forth from Chaos and sculpted the earth from the sky. According to the Judeo-Christian tradition, God created the universe in six days. He molded man from clay, and women from man's rib.

In the past we used these myths to help explain the primordial mysteries. Where did we come from? How did the universe come into being?

But as cosmology, the myths were flawed. Almost all the stories divided creation into separate events. First the universe appeared. Then man was born. Yet nothing arises from nothing. All of time and space are a continuum; creation is an ongoing process.

Science has learned more about that process in the last 15 years than it has in all the generations of human history. Radio telescopes and space probes have led us the new dawn on creation; computers have helped us to analyze them and to test new theories. As a result, we now understand the outlines of creation, from the first few microseconds of the universe to the appearance of life on Earth. It happened like this. Every-

COSMIC CREATION

BY OWEN DAWES

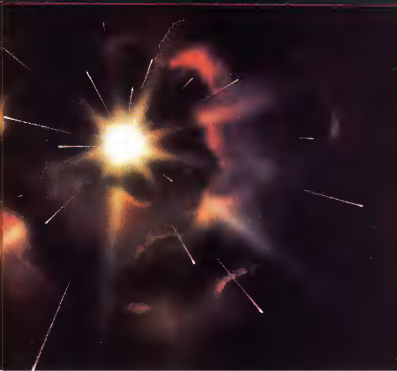
A burst of matter, a fireball of gas, and the infant universe was born. But what happened then?

PAINTINGS BY HELMUT WIMMER

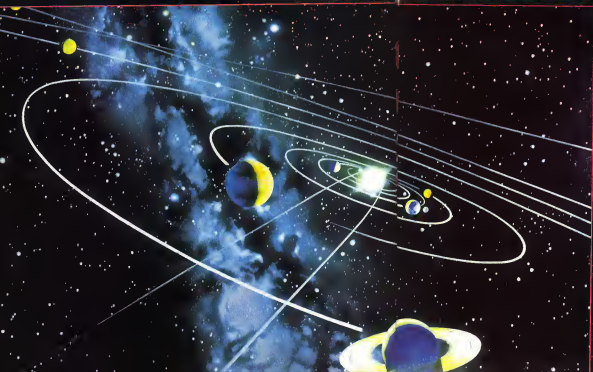
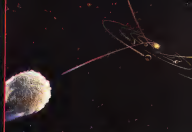
Our solar system was born of a supernova. (Below right), whose vast explosion seeded a cloud of dust and gas that was filled with heavy elements. (Below and at bottom), eventually, the cloud began to collapse into itself (right).



they began with the Big Bang, some 14 billion years ago. No one is sure what caused it or what cooled before. But suddenly matter burst out from a single point. Initially, the fireball was too hot, too dense for atoms to exist. Neutrinos (elusive particles with no mass or charge) condensed first, then the more familiar atomic particles. Later hydrogen and helium formed. Only minutes old, the infant universe was already billions of miles across. Perhaps as many as 5 billion years passed during which gravity lugged swirling clumps of matter back together. As it condensed, the first stars



The cloud gradually shrank and organized (lower right). Then gravity swept it clean of its dust (middle). Today, the only remaining primordial stuff in our solar system (below) is the dust of comets (far right).



were born. Acting as furnaces, they welded hydrogen and helium into heavier elements. Some stars died in violent supernova explosions, which ejected still heavier atoms and sowed them forth to seed other clouds of stars.

These clouds, too, condensed, forming a second generation of stars. Around them, matter clumped into similar bodies—the planets and moons, the meteoroids and comets—all revolving around the central stars. Solar systems were born.

At least one planet had an atmosphere rich in water, methane, and cyanide. Within 100, lightning raged, and the sun baked it to puddles and oceans, small molecules in period to form nucleic acids and proteins. Eventually, simple life forms began to appear on Earth.

But questions still remain. What caused the Big Bang? And what caused billions of the sun and planets condensed from a cloud of gas and dust, they should move in the same direction, in the same plane. So why do four of Jupiter's moons, one of Saturn's, and Neptune's Triton orbit backward? Why does Venus spin counterclockwise on its axis? Why is Neptune tilted so dramatically that its axis points almost directly into the sun? And why are the paths of Pluto and Halley's Comet tilted far away from the rest of the planets? We may one day discover the answers to these puzzles but only if we are willing to invest the necessary time and money in space exploration and the scientific study of the universe.

But even if the noddies stay with us forever, cosmic accident has already taught us most important lessons. From the sand at our feet to the farthest stars, we are all children of the same creation. □



*While sperm and egg
may meet in a glass dish, and frozen
embryos can survive
indefinitely, the first human birth on the
far side of the galaxy
will still come from a mother's womb*

INTERVIEW

ALAN TROUNSON

Epworth Hospital, run by the sisters of the United Church, lies in a residential section of Melbourne, Australia's second largest city. The hospital is across the street from a row of turn-of-the-century Victorian homes attractively doctored with blooming gardens and second-story latticework, and its quaint appearance hints little of its position as the leading in vitro fertilisation (IVF) clinic in the world. Despite Epworth's pioneering role in enabling hundreds of infertile couples to have babies through the practice

of glass-dish conceptions and embryo freezing, the high-tech accomplishments of the antiseptic procedures are nowhere to be found. Instead, a modest gift shop on the ground floor sells lilacs and roses, while relatives cluster in a central lobby for news of their loved ones' operations.

Like the hospital itself, the city of Melbourne is a puzzling paradox. The capital of the state of Victoria, Melbourne is a curious mixture of old-fashioned morality and repressed prurience: its divided social personality seems

PHOTOGRAPH BY LEE McELFRESH

entirely in keeping with traditions established during the reign of Queen Victoria and Melbourne is both the most and the least lively place for the world's top IVF center. On the one hand, this is Rupert Murdoch's new land, a country where islands scream of barmaids attacked in their pubs by aboriginals of sun-glass 'mums' refusing to give up another couple's baby of profligates needing AIDS tests, and of child molesters staking the tidy gardens of the city's western suburbs.

On the other hand, Melbourne has distinguished itself for decades as a world-class research center. The success of Australia's sheep and cattle industries has led many of the nation's scientists to specialize in animal husbandry and reproductive biology. Sparsely populated (15 million people) and geographically remote from the crises of Western science, Australia offers its researchers a laboratory environment less encumbered by rank and hierarchy and more conducive to achievement at an early age.

If by any nation's standards, the accomplishments of thirty-nine-year-old Alan Osborne Tournon are remarkable. Working since 1977 with his mentor Carl Wood, and about two dozen brilliant researchers at Monash University's Queen Victoria Medical Centre in Melbourne, Tournon has revolutionized the field of IVF. His contributions, ranging from the introduction of fertility drugs into the IVF process to the development of human-embryo freezing, have transformed test-tube-baby research from the risky crapshoot that it was in 1990 to a legitimate and increasingly accepted medical science. Next in Tournon's series of achievements will be an announcement that he has successfully frozen, thawed, fertilized, and implanted a human egg, a breakthrough that is anticipated in early 1996. The Queen Victoria unit alone is responsible for nearly 300 test-tube-baby births, more than all the IVF babies born in the United States.

Tournon's mellow rise has been nothing short of spectacular, yet he is distinctly uncomfortable with such laudatory descriptions. There is a modesty and a professional humility that more belies the sheep farmer Tournon thought he would be than the internationally acclaimed scientist he has become. He is reluctant to take sole credit for his breakthroughs and never fails to praise an associate or an assistant.

Given the ethical controversies and the basket of laws that now envelop IVF research in the state of Victoria, Tournon does not seem entirely comfortable with the spinning reels of a reporter's tape recorder, yet his playful banter is evident both to colleagues and patients. "You're pregnant, darling," he quips to a woman lying on an operating table after he and a colleague have just finished an embryo-transfer procedure, inserting three embryos into her uterus through a long catheter.

As with other pioneers in this field, Tournon's genius seems to be more intuitive than learned. He parlayed his childhood fascination with goats and other animals into a

master's thesis on the fecundity of sheep, then into the first baby born from a frozen embryo in 1984. Yet the road from sheep embryologist to preeminent scientist was paved with extraordinary obstacles. In 1979 his team found itself in a grueling race with England's Patrick Steptoe and Robert Edwards, who had delivered Louise Brown, the world's first test-tube baby, in 1978. For more than a year, Tournon's team labored relentlessly to duplicate the success of the British, and in finally doing so incurred the wrath of Edwards, who charged that Tournon's introduction of fertility drugs into the IVF process was highly unethical. The British, in the late Severmies, had applied their techniques to only one egg from a woman's natural cycle. Tournon believed that using drugs to induce superovulation—the release of as many as a dozen eggs during a single cycle—would greatly enhance the woman's chances of pregnancy through IVF if several embryos were implanted at once. Following Melbourne's first test-tube-baby birth in 1990

● Once you
get a lot of embryos and
tubes in those
incubators, it can look
like a forest.
We can't have more patients
because the
incubators get so crowded. ●

Tournon's methods became widely accepted, and the Australians took a decisive lead in IVF research.

Yet if any one event placed Wood and Tournon's group on the international map, it was his treatment of the American millionaire couple Elsa and Mario Rios. Arriving without fanfare in 1981, the Rioses hoped that Tournon's IVF team could "replace" Mrs. Rios's only child, a daughter from a previous marriage who had been tragically killed in a gun accident. Submitting to an "egg collection" or laparoscopy, Elsa Rios initially had five eggs removed from her ovaries. Since Mario Rios was infertile, sperm from an anonymous donor was used to fertilize Mrs. Rios's eggs in a laboratory. Three of the embryos were promptly inserted into Elsa Rios's uterus, but she miscarried after 14 days. The other two were frozen in liquid nitrogen to be thawed later and used in a subsequent embryo transfer.

While such a procedure today might seem routine, human embryo freezing was in 1981 almost unthinkable—a concept conjuring up frightening visions of Aldous Huxley's *Brave New World* in the extreme. In April 1983, the Rios couple died in a plane crash over the

Chilean Andes, leaving a legacy of two fertilized eggs, a substantial financial estate, and a scientific imbroglio with far-reaching international consequences. The case became a headline writer's dream. Right-to-life groups from several continents lobbied vociferously for the embryos' protection, and the Melbourne clinic was besieged with requests from hundreds of infertile women hoping to adopt the abandoned embryos. The legislature in Victoria became embroiled in an ethical controversy that still awaits resolution today.

There's where the Rios embryos are kept, Tournon says, as he points to a silver vat at his research lab. The gleaming container resembles a pasteurizing machine, yet its contents of roughly 250 labeled human embryos is quite a bit more precious than milk.

Almost two years after the initial Rios fiasco, the mood at Epworth Hospital is decidedly low-key. Some procedures have become so routine that husbands of IVF patients, for example, see given handout instructions on how to submit their semen samples. "HANG SOME TIE DOWN TO THEORETICALLY COMPLEX AT THE END OF CONCORD, THE INSTRUCTIONS SAY, 'HANG BUZZER IF UNHAPPY, LEAVE IT AT SISTER'S DESK IN THE MIDDLE OF THE WARD.' The doctors sound almost jocular as if they are shooting an updated segment of M*A*S*H on an IVF locale. They joke about a patient weary of undergoing the IVF process in the first place, who ended up pregnant with twins. "The sperm sample was pretty low," someone gaily says at the Sunday hormone meeting, in which the staff goes over the medical merits of each case. Any laparoscopies tomorrow? "No, just a frozen transfer of six."

After the morning laparoscopy most of the staff has gone home, but Tournon, dressed in jeans and a sports jersey, huddles over his equipment, examining the latest harvest of eggs to be mated with sperm about five or six hours later. While his affable manner often covers an intense personal drive, his embrace has taken its toll on his personal life. Despite so many successes in the IVF field, Tournon remains uncertain of his future and not fully reconciled with his scientific accomplishments. Like Cronin, the famous Roman senator, he harbors a wish to return to the land and the simple life of a farmer. Such an move would free him from the police hounding his research and bring him closer to the sheep that dominate the Australian countryside.

Omnis features editor Robert Weil traveled to Melbourne, where he observed IVF operations at Epworth Hospital and interviewed Tournon in his office at Queen Victoria Medical Center.

Omnis: In the year 2000, how will our attitude toward birth and reproductive technology be different from what it is today?

Tournon: People will have a much freer choice about the type of reproductive options that will suit them. For example, with a much better knowledge of birth defects, instead of choosing a male on the basis of love and affection, a person might select

someone who minimizes the chances of birth defects. I believe that the actual process of having children will be taken much more seriously than it now is. Reducing the number of children in each family will shift much more emphasis onto those few children and whether they will be normal.

Omni: How did you first become interested in the field of reproductive technology?

Townson: I grew up in the country towns of New South Wales. My grandfather, with whom I was very close, was a farmer before he moved to Sydney to become a fruit inspector. He had a tremendous interest in the land, which he passed on to me, my brothers, and my sister. We had chickens, ducks, cats, dogs, and birds. We looked after them and bred them.

Once my father turned up with two goats he'd brought to keep my mother company while he was away. They were really the last thing she wanted, but I was absolutely delighted. We bred those kids, too, when they grew up. So my interest in farm life and animals existed before I went to agricultural high school. At the University of New South Wales I did a master's degree studying the genetics of multiple births in sheep.

While finishing my master's I wanted to determine whether the egg or the uterus enabled some highly fecund sheep to produce triplets and quadruplets. Did the uterus allow those embryos to develop, or did these sheep produce more eggs on average than

other animals? Embryo-transfer technology was the only way I could sort out those two factors. So while still a student, I approached Neil Moore, then senior lecturer in animal husbandry [at the University of Sydney], suggesting we could solve the interesting problem relating to multiple births by using his embryo-transfer techniques in my sheep. Neil and I actually did the experiment together at a field station in Hay, about four hundred fifty miles west of Sydney, way up in the arid zone. We selected two types of sheep, one kind that produced only single lambs and another that produced mainly twins. We transferred eggs from the twin-bearing to the single-bearing sheep, and vice versa. Then we varied the number of eggs that were being transferred in either kind of sheep. We found out that the pregnancy rate was not determined by the type of eggs but influenced by the number of eggs that were put in the uterus. The sheep that received three eggs produced either triplets or twins, regardless of the origin of the eggs. In short, multiple births resulted from animals that produced multiple eggs. I was quickly enraptured by this technology, realizing it could solve many problems I had in my mind about the embryo and pregnancy. When I finished my Ph.D. I joined Moore's mentor, who had invited him at Cambridge. That's when my interest in cryobiology developed.

At Cambridge we were dealing with mil-

lions of egg maturation, fertilization, and embryo freezing. The work was very complicated—instead of evolving a technique like embryo freezing, we were trying to understand how this very large cell, the egg, was being controlled within the ovary.

Omni: When you joined Carl Wood's IVF group in 1977, did four goals shift?

Townson: We simply wanted to duplicate the success, not the work, of the Edwards and Steptoe experiment of 1978. Throughout 1979 I literally tried to repeat their work [inserting only one fertilized egg into a uterus], but it all seemed wrong to me. I'd been raised in the animal reproduction area and I knew that you could use fertility drugs effectively with animals and that you were always much better off if you could get more than one egg and more than one embryo. You'd really have a much better chance at success.

So in 1979 I started working independently on superovulation in women, using clomiphene citrate as a fertility drug. It was in the early Eighties that we put all these techniques together using superovulation, despite a lot of criticism from Bob Edwards and others, who said that this was the wrong direction to take.

Omni: Was the Melbourne group the first to achieve a high success rate with IVF?

Townson: Sure. With clomiphene I got more than two eggs per person, so I had more embryos to implant. I had a better chance than anyone else to obtain pregnancies. Un-



ing clomiphene was a breakthrough. Suddenly we had eight pregnancies that went to births. So other researchers switched to superovulation instead of using the women's natural cycle. I also altered the culture medium for egg maturation, again based on my knowledge of what works in sheep.

Once I'd gotten fertility drugs to work in 1980, there remained the problem of what to do with so many spare eggs. Sooner or later we'd be restricted on the number of embryos we could return to a patient—women would otherwise have quadruplets, quintuplets, sextuplets, and real serious complications for mother and child. I felt that we had an ethical obligation to develop a technique to freeze those extra embryos so that they weren't in the laboratory for people to experiment on indiscriminately or just dispose of. I argued that they could be thawed out and given back to the patients.

Ques: How did you pioneer the freezing technique?

Tourison: I started using techniques borrowed from sheep and cattle embryology in 1981 but soon found that I needed to freeze a human embryo at a much earlier stage. Toward the end of 1982 and after some experimentation, we were able to get our embryos to survive. The first pregnancy unfortunately lasted only twenty-four weeks. The patient ruptured a membrane and the infection went into the amniotic fluid. The baby actually caught pneumonia and a serious infection in its lungs. Heavy doses of antibiotics kept it alive for four or five days. Our first healthy birth from a frozen embryo in Melbourne was in January 1984. I'd done the freezing and thawing.

Ques: Is it true, as a newspaper once printed, that you tried to defrost a human embryo in your home freezer?

Tourison: No way because you can't freeze or thaw them in an ordinary freezer. They have to be stored in liquid nitrogen. I've never done any embryo work at home. Why would you, unless you wanted to do some cattle embryo work on the side? Were not permitted to have human embryos out of the hospital environment anyway.

Ques: How many human embryos lie in frozen storage at Queen Victoria Medical Center right now?

Tourison: We currently have about two hundred to two hundred sixty. The temperature of the storage vat being minus one hundred ninety-six degrees Celsius [-320°F].

Ques: At the embryo incubator at Epworth Hospital you once looked in and said, "A full house today."

Tourison: Sometimes you get so many embryos and tubes in those incubators that it looks a bit like a forest. Incubators get crowded, and that limits the number of patients in our program.

Ques: At what cellular stage is it best to freeze a human embryo?

Tourison: We don't know yet. If you freeze a two- or four- or even eight-cell embryo, you can still destroy some of the cells without damaging the viability of the embryo. It won't make a difference to the embryo, provided

there's still sufficient numbers of cells at the time of conception. But after the eight-cell stage (at about the sixteen- or thirty-two-cell stage [in humans]), the cells in the embryo bind or compact to one another. Some of these cells are internalized within a ball of cells, and it's these internalized cells that then go on to develop into the embryo proper.

Right now we're doing most of our freezing still at the two- and four- and eight-cell stages, because we have gotten an exceptionally high rate of success. But we can also freeze all the blastocyst stage.

Ques: A blastocyst is the last stage of the embryo before it attaches itself to the uterine wall. How old is it then? How many cells does it have?

Tourison: It's about five or six days, about sixty to one hundred cells. The cells are much smaller and easier to freeze at this stage. Embryos are normally frozen at this stage in animal reproduction. This requires that you grow them for five or six days in culture. This is a liability because conditions

Adoption, under such circumstances, takes place at the one-cell stage with the donated egg.

Ques: How does a woman whom you've accepted actually move through the program? What will her week be like?

Tourison: She calls the nursing staff at Epworth and informs them that her period has started. If there are no outstanding problems, she'll come to the hospital between the second and fourth day of her cycle and begin taking tablets of clomiphene, or she'll begin getting injections of human menopausal gonadotropin, a hormone derived from the urine of postmenopausal women, which will stimulate the ovaries to burst.

She'll return each morning after the seventh day to have blood samples taken because by measuring the circulating hormones we can determine how many eggs are growing in her ovaries. First we measure the estradiol level, which tells you how many eggs are growing. We will also use ultrasound to get a picture of the number of eggs developing. Later on we check for two other hormones, luteinizing hormone (LH—a gonadotropin, a pituitary regulator of sex steroids) and progesterone, which tell us ovulation is about to occur. Then, around the thirtieth or fortieth day of her cycle we'll send the woman to the hospital.

We'll then take blood samples three times a day. We want to draw these patients very close to their own ovulation pattern (to parallel the natural hormonal cycle) because they may then spontaneously release their own luteinizing hormone and initiate their own ovulation without requiring an injection. Most patients, though, will need an injection of human chorionic gonadotropin to produce the same biological activity as the patient's own natural LH. About thirty-six hours after the patients receive this injection, we go into the theater (operating room) for a laparoscopy. Once the laparoscopy is done and say nine or ten eggs have been collected, what's the next step?

Tourison: The husband and wife must decide how many eggs to let go and whether to donate. About six hours after the egg collection the husband provides the semen either with the assistance of his wife or by masturbating. We require that the semen be provided in the hospital since it must be fresh and must be the husband's.

Ques: Is there a possibility for intrigue?

Tourison: Yes, intriguing possibilities do exist, though we don't necessarily believe that they would happen. Most of the husbands don't have any problem, but some would prefer to provide their sample at home. If that's their real wish, then we'll accede. When we finally prepare the semen, the preparation system very much depends on the semen quality of the husband. When we first examine the semen, we look at everything that's in the sample—normal and abnormal cells, volume, and anything else that's pertinent. Once we've prepared the sperm sample for insemination, we also look at the sperm's quality to make certain that we've gotten rid of a lot of the abnormal cells. The

•When you'd get to
the other end of the universe
you'd need a
uterus for those embryos.
Perhaps at
that end of the universe there
are creatures
who have functional uteri •

in culture, that is, in vitro [in glass], are not as good as those in vivo [in the world].

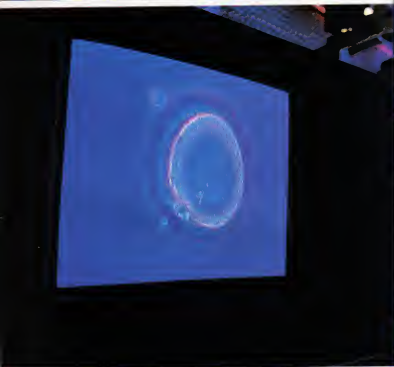
Ques: What basic steps does a patient go through in embryo freezing?

Tourison: Prior to coming into the IVF program, patients are counseled about their options. Somebody whose religious beliefs do not permit embryo freezing may find egg freezing more compatible. We also inform patients that we will not implant more than three embryos, as do many groups in the United States. The risk of premature deliveries and stillbirths is greatly increased with multiple births. If a patient chooses freezing, we'll freeze the remaining embryos, and she can have them thawed later on.

Ques: Basically, embryo freezing gives a woman the opportunity to have several iterations if the first one should fail?

Tourison: That's right. This procedure effectively minimizes her chances of pregnancy with only one egg collection or laparoscopy. This is what the majority of patients, some ninety percent, choose. Patients not opting for freezing can donate her eggs to others. We have about two hundred patients who either have no ovaries or no eggs or who have a familial genetic disease

Do the mothers of tomorrow want test-tube babies and surrogate dads?



BIRTHTECH

BY KATHY KEETON
WITH YVONNE BASKIN

In 1999 Louise Brown, the world's first test-tube baby, will turn twenty-one. Somehow it is fitting that the women of her generation—the women of the twenty-first century—will be the ones to reap the full benefits of a technology taking shape today. Over the past ten years science has revolutionized the process of human birth. It promises to put the very definition of mother, father, family lineage, and even human life in our hands. In the past two years alone there has been news of the first baby born from a frozen embryo, the first instance of a woman who carried to term an infant born from a donated egg, and the first birth of a child from an embryo transplanted from one woman to another. In fact, so much has happened since Louise Brown was born that the techniques used to engineer her birth are considered a little old-fashioned.

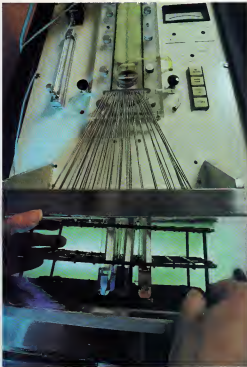
Because women bear the heaviest burden of deciding which birth technologies to use, their opinions will shape the development of reproductive sciences in the next century. To find out what those opinions are, *Crave* enlisted the prestigious research firm *Statistica*, *Brady*, and *White Inc.* and conducted an

Left: A technician examines a group of donor eggs. Above: Sperm meets egg in the glass world of a petri dish.

international poll querying women in the United States, England, Japan, and South Africa for their thoughts on the new birth technologies. (For Omni readers—women and men—who would like to register their opinions on the implications of this technology, we have included in this issue a new poll, designed by Dr. Judith Ann Densen-Garber, on page 106. This will give readers the chance to compare their attitudes with those of the women of the world. And because Dr. Densen-Garber hopes to use the poll results to influence birth-technology legislation in Michigan, this will also offer readers the opportunity to have a specific influence on how the technology is used.)

Would women consider freezing their embryos to save for later implantation? Given the choice, which would they accept: a child or an embryo? Under what conditions would they choose to have a test-tube baby? If they had the opportunity to handpick the characteristics of an anonymous sperm donor, what would they choose? When the results were in, the answers were often surprising and always enlightening.

These questions are more than academic



Already science has transformed the biological process of becoming a parent. In addition to old-fashioned conception, men and women today have a variety of novel alternatives for bringing sperm and egg together to produce a baby.

- A couple can have a baby by artificial insemination using sperm from the husband or an anonymous donor.
- They can choose to use a surrogate mother, a woman who agrees to carry her own or an implanted embryo to term for them.
- The couple's own egg and sperm, or donated egg and sperm, could be joined in a petri dish and later placed in a woman's womb, a process that is known as *in vitro*, or test-tube, fertilization (IVF).
- Finally, an embryo conceived in the body of a surrogate can be flushed from her womb and implanted in another's womb, a technique known as embryo transfer.

Depending on a couple's fertility problem, all sorts of combinations of these methods are possible. Donated sperm can be used either to inseminate the biological mother of the desired baby or a surrogate mother chosen to bear the child. Similarly, the eggs and



Opposite page (near left) sperm being screened for sex selection before fertilizing egg (far left). This page: tools of high-tech birthing include ultrasound scans of the womb (left), ultrasound-free storage tanks of liquid nitrogen (below), and the warm, nurturing womb of an incubator (top and above left).

the womb that are used could be those of either the woman who wants a child or her surrogate chosen to carry the embryo.

Various scenarios are possible. In the most complicated, a child conceived by IVF could actually have five parents: the woman who donated the egg, the man who donated the sperm, a surrogate mother who carries the fertilized egg, and the two nonbiological parents who finally adopt the child.

In the not too distant future we can expect to see these techniques made available not only to couples who have fertility problems or who are concerned about genetic diseases but also to women trying to coordinate family and career plans or to evade the tyranny of the biological clock.

For the past 15 years, more and more American women have been delaying the start of their families. Between 1970 and 1982, the number of those who put off having their first child until age twenty-five more than doubled. Among women thirty to thirty-four, first births have more than tripled in that same 12-year period. Demographers think the trend is here to stay, and our survey supports that prediction.

Half the women we polled felt that if the medical risks were the same at any age, the ideal time for starting a family would be be-

tween the ages of twenty-six and thirty. For women with higher incomes and those who work, the ideal age was even higher. They would opt for childbirth over thirty as the ideal. For women who had not yet begun their families, delayed motherhood was also considered desirable. Half of these childless women said becoming a mother over thirty was their preference. As one woman executive put it, "At ages thirty-five to forty you've got your life squared away and your values straightened out. And you're young enough not to be an old parent."

Postponing pregnancy has its drawbacks as well as its benefits. The later the pregnancy the riskier it is for both mother and child. Women in their late thirties or older have a greater risk of such complications as toxemia (pregnancy-induced high blood pressure), stillbirth, premature delivery, and lower-weight babies.

Getting pregnant may be another difficulty. Some women fail to ovulate, a condition that becomes more common as a woman gets older. Others may suffer from endometriosis, a pelvic inflammatory disorder sometimes called cancer woman's disease because it progresses with age. One effect is that the lining of the womb spreads outside and attaches itself to the ovary, the Fallopian tubes, or other organs.

But with standard hormone treatments or surgery, most women can get pregnant and carry a child to term. For example, such fertility drugs as Clomid and Pergonal help

women with ovulation problems get pregnant. Others can have their problem corrected surgically. One San Francisco surgeon transplanted an ovary and Fallopian tube from one sister to her infertile identical twin afflicted with endometriosis.

For some women, none of the more conventional solutions work. They would be the ones to take advantage of other new options. And IVF is becoming the most popular of the alternative birth technologies. Since the birth of the first test-tube baby in 1978, infertile couples around the world have been clamoring for the procedure. By the end of 1984 more than 1,000 babies conceived in lab dishes were born. As of 1985 there were 116 in vitro clinics operating in the United States; 8 in Canada; and at least 50 others around the world.

Here is how a basic IVF works today. A woman is given fertility drugs Clomid or Pergonal or hormones to stimulate her ovaries into releasing several eggs instead of the usual one. To detect when her eggs reach the peak of maturity the IVF team gives her ultrasound and hormone blood tests. Then, while the patient is under general anesthesia, a doctor inserts a laparoscope, a telescope device the diameter of a pencil, into her ovary through a small abdominal incision. Looking through the scope, a physician can identify the little blisterlike follicles that contain the eggs. He then inserts a long, hollow needle to suck them up.

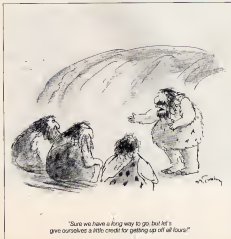
The tiny eggs are placed in a petri dish with a layer of liquid nutrients. A technician adds drops of sperm and the container is stored in a body temperature incubator. The eggs are left in the incubator until they have been fertilized and have divided to an eight-cell stage, usually after a day or so. The embryos are drawn up in a plastic catheter and deposited in the uterus.

Two weeks later, a pregnancy test will tell whether the embryo has taken. If one embryo is used, a couple stands a one-in-five chance of a pregnancy in the most successful clinics. If three embryos are used, the odds almost double. Yet even when a pregnancy takes, a third of women will miscarry during the first three months.

Now done in a hospital or clinic, out-of-body conception will eventually be performed in a doctor's office. Physicians have already taken the first steps in that direction at the University of California at Los Angeles Medical Center. Teams there no longer use a laparoscope but, guided by the refining needle to the egg with ultrasound. The UCLA team celebrated its first success with the method in 1984 when a baby girl was born to a thirty-five-year old California woman.

The women we polled were of two minds on IVF. Most said they would prefer to adopt a child if they could contribute neither their eggs nor their wombs to produce a child. Their preference for adoption faded, however, if doctors were able to use their eggs or their wombs to produce or bear a child. Given the latter conditions, an overwhelming 88 percent of women say they would consider in vitro fertilization.

Adapted from the book *Women of Tomorrow*, by Kathy Kestler with Ivonne Baskin. Published by St. Martin's Press/Mariner Books. Copyright © 1986 by Kathy Kestler and Ivonne Baskin.



to carry another woman's eggs fertilized with their husband's sperm. For them being pregnant was part of the appeal. "I'd want to give the baby my environment, to feel the baby stirring," said a mother of two.

When compared with adopting a child, however, tradition won out. A slightly greater number, 47 percent, said they would prefer adopting someone else's child to carrying someone else's embryo to term. Some offered medical explanations: "I wouldn't want to take the risk of receiving an anonymous embryo." Others were more pragmatic: "I'd much rather adopt than go through the trouble of being pregnant," one woman said.

Women were even less enthusiastic about a more established birth technology: artificial insemination by anonymous donor (AID). Conception through artificial insemination has been possible for 25 years. At least a quarter of a million children have been conceived by this method in the United States. Yet when given an either/or choice of adoption or artificial insemination, half the women said they would prefer to adopt.

And of those interested in AID, more than 80 percent wanted to know more about the donor than his age, race and general health. When asked what traits they would seek in a sperm donor, women polled chose the top three: emotional stability, high intelligence and pleasant personality. In declining order, these were followed by good looks, leadership qualities, athletic ability, artistic talent, scientific ability and financial success.

As for professions (or the father, the biggest vote by far [almost half the women] went to businessmen. Distant seconds were lawyers, scientists and scholars, each group garnering roughly 20 percent of the votes. Even more distant thirds were athletes, writers, and teachers, with 12 percent for each of those groups. These were followed by artists and musicians, religious leaders, politicians and statesmen, entertainers and, at the very bottom, actors.

Interestingly, priorities shifted once we put names to those general categories. Politicians and actors moved to the head of the line. John F. Kennedy and Walter Cronkite took the largest vote, with Robert Redford, Albert Einstein, and Chrysler steward Lee Iacocca close behind.

For all their divergent opinions on birth technologies, one attitude was unchanging. Women as a group do not fear the future consequences of these new methods. Only around a tenth of the women surveyed worried that future mother-child relationships would be less personal and that children will be ordered like consumer goods. "Nearly half were convinced that because of the new birth technologies, the relationship between women and their children will change for the better in the future and that children will be better planned, wanted more and loved more. Even as others talk about Brave New World scenarios, most women today do not see the future as ominous but as holding the promise of a new degree of freedom and choices in the way they will bring children into the world. ☐

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FICTION

*Under the snarled canopy
of ash-gray trees, the ring watchers and
shadow creepers feast on death*

TRAVELS IN THE INTERIOR

BY SCOTT RUSSELL SANDERS

Viewed now at twilight through the station's tripe-paned windows, the forest seemed to rise up like a call, solid and impassable. A million seasons of leaves might have fallen all at once, so thick were the shadows. Wire reinforcements in the window glass superimposed on the view a grid of lines, giving the illusion of order as if the labyrinth of limbs out there had been surveyed. But Garrett knew better. The forest had never been mapped, never photographed. The few explorers who had returned safely after penetrating its heart were reluctant to speak about how they had traveled or what they had seen.

When Garrett questioned those veterans about the white mountain he had glimpsed while riding the curve of gravity down from orbit, they fell silent. "Have you been to that glowering white peak," he asked them, "the one that looms up through the forest canopy like the snout of a whale? How far is it? What's it made of?" But the old-timers just stared at him with the bruised look of refugees. Their secretiveness about the white mountain only intensified his desire to go there. The few hints they let

fall made it sound both hideous and holy.

With a slap on the arm by way of warning, Kyle announced bossily, "Look out, old buddy—you're lost again."

Wrenching his thought away from the forest and its mountain, Garrett swung around to view the screen of the simulator on which the two brothers were playing a game of



Wild-Survive. It took him several moments to locate his player amid the glitter of luminous beasts and savage terrain, then he sped it, a bio of light safety in a swamp, flickering toward extinction. He waved at the screen dismissively. "Stupid, stupid, stupid."

"Some pathfinder you are!" said Kyle. "You get lost and die three times in twenty minutes. I hope you do better when we get outside."

Exasperated with the game, with his high-spirited brother, with the cramped sleep-chamber in which they looked off the slow hours waiting for their time of departure, Garrett declared, "Only a bear of very little brain could play at this make-believe with a real wilderness just beyond the wall."

Kyle tilted the chamber with his rowdy laughter. He was a big man and did not provoke easily, re-

PAINTING BY H. R. GIGER

seeing changes in mood as a boulder re-sets changes in temperature. Of the two brothers he was younger by half a dozen years and heavier by some two dozen kilos. Both men were tall, but while there was a good deal of meat on Kyle, there was very little on Garrett. The older brother had to find his way around obstacles, while the younger one bulldozed his way through, killing or intimidating whatever beasts stood in the way. And so in their wilderness tasks they had taken into complementary roles. Garrett leading them into the uncharted zones and back again, Kyle keeping them alive.

"Another round?" said Kyle.
"No. I've had enough," said Kyle ahead.
Kyle needed no encouragement. He seemed fully alive only when faced up against danger, and if he could not for the moment confront real danger, then imitation danger would do. Boost after beast attacked his player, shaggy forms bounding across the simulator's glass face, but he shot each one before it struck. Between onslaughts, he leaned away from the console and said, "Why don't you go up on the roof and see if you can spy that mountain of yours?"

"I already tried. It doesn't show above the horizon. It's west of here—I found out that much—and maybe twelve days of hiking."

"You could go out in the lounge and milk a little more wisdom from the old-timers."

"Why so anxious to keep me busy?"
"You just seem kind of all wound up."

"Well, I'm not," Garrett snapped.

"Not a bit, not one little bit tense," Kyle hummed a broken melody. Then he suggested amiably, "You could check the gear."

"All right."

There wasn't much gear to check, and what there was had already been minutely examined. Garrett went through the motions anyway to reassure his brother. Food to last a month, tools, clothes, tackle for climbing rocks and descending caves, stove and fuel, lights, journals, books, guns—an easy list, compared with what they carried on most expeditions. No cameras or recorders, for any device that could reduce the wilderness to images was forbidden. No signposts, since the brothers were ninth-degree explorers, the most austere and advanced, and would not consider calling for help. No breathing apparatus, because the atmosphere of Kentucky-2 was close enough to E-normal to permit travel without anxiety.

Having finished his ritual inspection, Garrett paced back and forth along the outer wall of their sleep-chamber, preparing his mind for the journey that would begin the next day. Each time he passed the fortified window, he glanced out at the encroaching forest. No movement, no glint of eyes. Abrupt and final as the flank of a continent or the brow of a glacier.

Big Thicket, the veterans called it, a dense snarl of trees and brush, coarsens and braids stretching inland for thousands of kilometers. Even the channels of rivers were rooted with vines. The only trails through the forest were those worn by animals: the more open the trail, the larger and more dangerous the

animals passing along it.

Suddenly Kyle let out a cry of triumph, turning away from the screen, flushed with a kill. "Bam! How's that for shooting?"

The look of rapture on his brother's face made Garrett uneasy. Yet he also felt a kind of rapture, thinking about tomorrow's journey into the intricate woods—the sweet dread a man feels on a cliff's edge in honor of these woods, the discovery of a new named planet, Kentucky-2. Perhaps he named more than anything else had saved the world from settlement, for the Federation had been so taken by the idea of a second Kentucky—one incomparably vaster and more tangled than the original—that they declared the entire planet a wilderness preserve. No one was permitted to draw maps or even to name the islands and continents and seas. Apart from a few nicknames—Big Thicket, Ogre Pass, Tooth Alley—Kentucky-2 was bare of words. This applied to Garrett—the land's muteness. Throughout the human system, everyone who made a

● In the
darkness the forest looked
more solid,
an impenetrable weave of
branches.
He must find a way through
the tangled mass
to the dazzling mountain ●

profession or a hobby of exploration dreamed of venturing here, but only ninth-degree explorers were granted entry.

On all that wild globe the single human marks were the station and the rocket pad, tiny scars on the margin of the chief continent. Together with two dozen other explorers who had earned the right to come here through success in survival competitions on larva worlds, the brothers awaited their turn to enter the forest. At twelve-hour intervals, in groups of twos and threes, the explorers slipped out through the air lock and disappeared into that unmapped immensity. Some of them would return to the station after only a few hours, baffled and numb, some would return after a few days or weeks, some never.

"Got you, big paw!" Kyle bellowed, as he undid another electronic phantom.

"Will you quit that so we can get some sleep?"

"Hay hay, I'm cooking, brother. Just one more round."

"I'm sick of it!" Garrett cried, slamming his fist on the control, blanking the screen. "All this brutal make-believe!"

Kyle swung around menacingly, eyes fixed with his murderous game. In a quiet voice,

force with self-restraint, he said, "It keeps me sharp."

"Sharp for what? The wilds aren't like that—one threat after another. You make exploring seem like warfare."

"That's exactly what it is—war!" Kyle stood up and stretched his brawny frame, releasing the tension from his muscles. "It's them against us, Garrett. One of these trips you're going to see that as plainly as I do. You're going to get it, imagining gardens outside and sea lochs. Togh and claws and pancons and poison. And this is the meanest son-of-a-bitching planet of them all. Why else do so many tough outposts like you and me," he added, forcing a smile, "never make it back out of the Big Thicket?"

Garrett knew the statistics—the number wounded by animals, the number shivered by hunger, the number lost or crazed, and besides, it was an old argument between them—so he held his tongue. Unless people could die from going there, no place was truly wild. On Earth death had retreated to the intensive-care wards. Here it still lurked abroad in the countryside and could meet you anywhere.

The hammocks were quickly slung from hooks in the walls of their compartment. Garrett taking the position next to the window. With an agility remarkable in so big a man, Kyle swung gracefully into his berth. "So get your sleep, ball sniffer," he muttered.

He soon slipped into snores, but for a long while Garrett lay gazing with wide-open eyes into the shadowy forest. In the darkness the woods looked more solid than even an impenetrable weave of branches. Somehow he must find a way through that tangled mass to the dazzling mountain.

The air lock closed behind them with a sucking noise—even on a planet with breathable air, the human system took no chances with aly nature. The brothers hesitated in the clearing just outside the station. Garrett scanning the forest wall for a point of entry. Kyle listening for the footpads of animals. Their silhouettes were opaque in the early light, clinging to them like brown pelts, and their heads bulked high above their shoulders like cargoes of darkness. It was shortly before dawn that ambiguous hour when nighttime predators are yielding to those of the day. Nothing stirred.

"You see any deer, big brother?" Even though Kyle whispered, his voice sounded huge in the stillness.

"Plenty. But I don't see ours yet." Garrett always savored this moment on the threshold of a wild zone, the moment of deciding where to enter. At length he chose a small opening where two trees had fallen close was against one another, their trunks forming an arch just high enough for crawling through, their barked roots splayed in the air like upturned arms. He dropped on all fours. "Here it is."

Oh mercy, starting out on hands and knees," Kyle grumbled, crawling after.

They soon wriggled through, and now they belonged to the forest. They had to read the

tilt of land with their feet, read the pattern of dense undergrowth and interwoven branches with their eyes, obeying the grain of the woods. Garrett in the lead, as always, his senses alert to every detail of the way. Kyle, as always, lumbering behind, attuned to danger, three of them moved swiftly and in tandem, almost like a single one-legged beast not taking, not needing to talk, putting as much distance as they could between themselves and the station below the next term of exploiters was scheduled to depart. The ground was spongy, yielding beneath their boots and then springing back to erase all marks of their passage. During the first few hours they paused only to allow Garrett to backslight along the way they had come, memorizing the textures of soil and twig and root so that a month from now he could lead them out again.

Then as the local sun climbed overhead and drove shafts of red light like hairy rats into the forest floor, both brothers halted, as if on signal. They shrugged free of the backpacks, took off their goggles and helmets, and sat back by side on an outcropping of rock. Garrett took a pinch of dirt and held it to his nostrils. Must, mallow, iron—the signature of this spot.

"It's a mean son of a bitch, all right," said Kyle. His face was slick from sweat and broken wide open at the mouth from paring. He kept one hand on the rifle, which lay across his lap.

To Garrett the tangled woods seemed not mean and not beautiful, but awesome. The leaves and vines and fernlike fronds were mostly in shades of red; the solid trunks nearly black, giving a combined effect of flames and ashes. Instead of growing up and up, as on Earth, the trees rose only about three times the height of a man before branching horizontally, and these branches twined through those of neighboring trees, the twigs seemingly fused together where they touched. Flowers bloomed everywhere in this lattice-work of branches, fierce yellows and serene blues, and creepers looped down from it in lassitudes. Dead here, some with their trunks rotting quite through, hung suspended in air. The canopy appeared so lightly woven. Garrett imagined a person could walk on it. The smaller animals probably tumbled up there—might be up there right now spying on these two legged intruders. "Have you seen any beasts yet?"

"A few," Kyle answered. "Nothing to sweat about, I don't think. We've scared all most of the little brutes with all our hurrying. And the big brutes—the ones that don't scare—I expect they never come this close to the station. They're back deep in the woods, so the old guys say."

This was about all that the old guys—the veterans who had penetrated the Big Thicket—would say. You won't meet the killer beasts until you've hiked for two days or so, you can drink the water, some of the plants are poisonous, offer to touch or eat the meat of animals will keep you alive, but what it does to your stomach is not much more preferable to starving.

"What kind did you see?" Garrett asked. "Haven't you noticed those silvery bags hanging on the trunks, brooks all over these snaky drilling holes through the bark?"

"I thought those things were some kind of epiphytes."

"No, I expect they're animals. Tree suckers." Holding the rifle in one fist to use as a pointer, Kyle gestured overhead. "And those snaky things that slither through the root I call branch weavers."

Garrett peered a long time before he could make out one of the scarlet creatures with long, serpentine and slow, through the lattice work of limbs. Once he discovered the first, he suddenly perceived them everywhere. The canopy was in fact crawling with these snake-like animals, which seemed to be lacing the branches together, coiling and knotting their scaly bodies, binding twig to twig. "How do you suppose they do it? Some kind of secretion?"

"Let's see."

Before Garrett could protest, Kyle had freed

Against
the darkening sky, they were
thickenings of
shadow, arrayed in a crude
circle, two crept
in, then two more, arriving
in pairs till they
formed an unbroken ring.

a quick burst up through the canopy. In an instant later three of the branch weavers fell clattering to the ground and lay still like hanks of rusty chain.

"Why'd it do that?"

Bending over one of the fallen creatures, Kyle said, "It won't hurt them. Half a minute and they'll be squaring again." Examining the scarlet body, turning it over and over with the butt of his gun, he added, "How about that armor? See how these plates mesh together? It looks like some kind of glue seeps out between the joints all along its torso. It must smear the bark with this stuff, so when it weaves the branches together everything sticks. And the whole canopy becomes one gigantic web."

"To catch what?"

"Anything that falls. Who knows what's crawling around up there?"

Garrett turned back to gaze at the solid mat of limbs. He would have to climb up through the canopy sooner or later to get a bearing on the white mountain—but he was in no hurry. He shouldered his pack and filled goggles and helmet, yet he did not want to leave until the branch weavers had re-wed from Kyle's shot. Seconds passed, and

the bodies failed to stir. "Maybe you gave them too high a charge."

"It was nothing. A tickle," Kyle prodded the bodies with the rifle. The barrel thumped against the scarlet plates. "I do believe the suckers are dead," he said in a tone of gruff amazement. "Funny—you wouldn't think anything this tough on the outside could be so weak on the inside. With plates from his tool belt he dragged the fleshy snipe onto the rock outcropping. "Might as well let something else eat them."

Garrett left the first nail marks of dread along his nerves. "Whatever they use for wiring must be awfully delicate, too delicate for you to go blazing away with that damn gun."

Kyle gave him a furious look. "I wasn't blazing away. What I shot them with wouldn't have killed a rat back home."

"Why shoot at all?" Garrett wanted to say. Instead he muttered, "Yeah, okay. Let's go."

The brothers had walked only a few paces when there came a sound of scratching and snoring from the rock where they had taken their rest. Turning around quickly they discovered a pack of cat-like animals toasting the bodies of the branch weavers into shades. Within seconds, every last scrap of meat and scaly hide and bone had been snatched up and stuffed into slots in their shaggy flanks.

Weighted down, the animals scurried back into hiding in the network of roots. Kyle whistled. "Hungry!"

"And quick," said Garrett, doubtful by the swift work of these scavengers. Did they eat even the fur and bone?

"Maybe they're the reason nobody ever comes across the bodies of the guys who get lost in here," said Kyle.

The word lost set Garrett in motion again. He poked his way among the arching roots and ash-dark trees, trying to put these first kills out of his mind. There would be others. On recent expeditions, Kyle had become more and more trigger-happy, firing at anything that was even vaguely menacing, as if he feared that their luck was running out. "Lead on, big brother," Kyle sang out. "Just don't forget to keep track of how we got here."

Warmed from body heat, their shimmer-suits took on a ruby sheen in the midday sun. They were panting easily now, a pace they could maintain all day, if need be, for days on end, for weeks, like caribou migrating. Now and again Kyle would lay his hand on Garrett's shoulder and point wordlessly at some new beast in the canopy overhead or in the undergrowth, and Garrett would stare and stare before seeing the creature watch. This was always the way of it. Garrett had an eye for pattern, for the still matrix of things, and Kyle had an eye for anything that moved against the flood background, and each brother was nearly blind to what the other could see. "If I can't run or jump or fly, I can't hunt you," Kyle would say. "If I move, you can't find your way by it." Garrett would counter.

Because the local day was only a little more than twenty E-hours long, the afternoon passed quickly the fiery shafts of sunlight burning in longer and longer slants

through the woods. They pitched camp beside a stone-thriller creek. Kyle tested the water, shaking a slug of it in a tin bowl to make certain it was pure. Satisfied, he lay down and plunged his face into the stream to drink. Garrett dipped his out with a cup.

"I'll set up," Kyle said, water dripping from his beard. "You remember?"

While the encampment took shape under Kyle's practiced hands—damped tent blos sewing, skid-pouches infusing, supper brewing on the cookskins, securely flare curving in a great circle around the perimeter—Garrett sat on the creek bank with his bare feet in the water and his eyes closed, reviewing the day's trail. He recollected backward through every step of the path until he reached the beginning point where the two broken lines formed a crowsley. Then he turned about and worked his way forward to the creek, returned again to the station, again to the creek, retracing his steps back and forth along the trail as if he were winding and unwinding a ball of string.

At length he opened his eyes, and Kyle was serving out the stew.

"Grub, old buddy."

It tasted vaguely of catfish and potatoes, but it was the same high-energy confection that would hide under the camouflage of other tastes on other nights. Garrett swallowed some, then spoke about what had been troubling him. "I can't figure out whether the old-limers have got a taboo on that white mountain or whether it's just something precious they're trying to keep secret."

Kyle was not listening. Some movement in the vault of limbs overhead had caught his attention, and he was gazing upward, hands tight on the rifle, body tensed for a leap. "Voices!" he said.

That time even Garrett could easily see the beasts. Silhouetted against the darkening sky, they appeared like thickenings of shadow in the branches. There were at least ten of them, arrayed in a crude circle directly above the camp. While he watched, two more crept into the circle, then two more and two more, and they kept arriving in pairs until their bodies formed an unbroken ring. The limbs creaked faintly under their weight. They were larger than the scavengers that had torn up the branch weavers, as large as wolves, but thick and slow moving.

"Ring watchers," whispered Kyle, who always named strange beasts immediately.

Reaching out to place a hand on his brother's thick forearm, Garrett said, "Don't shoot. Let them be."

"You want to sleep with that little party upstairs?"

"Maybe they're just curious."

"Maybe they're just looking for supper!"

A tremor passed around the circle of long-haired bodies, sending waves of harsh grating noises out through the network of limbs in a low voice, Garrett said. "See what the light does first."

"Lend me a hand," Kyle hissed. But he slipped a cartridge into the breach of the perimeter flare and twisted the fuse. There was an explosive release of gases, and instantly the

campsite was enclosed in a blazing dome of light. A chorus of guttural cries and whimpers drowned in the branches overhead, then a frantic scuffling of sluggish bodies. Kyle let out a notorious laugh. "Black out the night, you hairy bastards! Go eat somewhere else!"

Garrett watched uneasily as his brother shuffled in a heavy lumbering dance around the circumference of the light dome.

Twice in the night Kyle wriggled out of his sleep-pouch, muttered at Garrett, "It's nothing—go back to sleep," disappeared outside the tent, and in a few minutes returned, breathing heavily. Come daylight, the purpose of his trips became clear: for the bodies of two ring watchers lay sprawled near the entrance of the tent.

"They got too curious," Kyle explained. "Did they attack you?" Garrett said. "They kept nosing around the flare, and finally these two started creeping through. Garrett said his mouth grimly. Death—all

It swung into position, then suddenly dropped and spread open like a fan, its ribs unfurling a thick blanket of flesh, and an instant later the beastly weight buried him.

ways more death. Showing one of the carcasses with his boot, he rolled it over, revealing a cluster of many-jointed legs surrounding a bony hole that was lined with spikes. A man's head would have fit into that lethal opening. Was it a jaw? Wrecker? Lump? A thick and clumsy skeleton bulged underneath the pelt, which was covered with delicate silver hairs, like the pelt of an aped gorilla. Why did the beasts do so easily? The only way of finding out would be to carry one back and let the biologists take it apart. But if explorers were allowed to collect specimens, Kentucky 2 would soon become as tame, as fully known as any trapped world. Ignorance was the condition for wilderness.

"Pretty on?" said Kyle. "I figured you'd want a look."

"Did you mean to kill them?"

"I meant to stop them," he said gruffly. "I hit them with about the right dose for a dog. And then—down they came—and never gave another kick." He grasped one of the ponderous necks of bones with gloved hands. "Here, grab hold of this thing."

Together, they heaved the bodies out through the bamer of light, which still blazed with a fierce yellow glare against the same

early red. While the brothers ate breakfast inside the light-dome, scavengers outside devoured the two carcasses. The voracious beasts evidently could not see in through the flare, but Kyle and Garrett, with eyes shielded by goggles, were able to watch the snarling banquet. It was over in a few minutes. The scavengers withdrew back among the ash-dark rocks, gorged and yawning. A single bane was all that remained of the ring watchers on the stony bank of the creek.

"Hide and hair and giblets—they eat it all," said Kyle.

Putting on his gloves and stepping out through the light-bamer, Garrett said, "I'm going to have a look at what they left." He squatted down beside the bone. It was vaguely horseshoe shaped, the color of very reddened wax with sockets as if it were the meeting place for many joints. As he reached down and cautiously lifted it, testing its weight and hardness, there was a frantic scuffling beneath the rocks, and dozens of the scavengers came rushing at him, a wave of hard bodies tumbled him over, limbs swarming weight, Kyle shouting, claws groping, the bone turning in his grasp and jerking violently away. A moment later he was sitting dazed on the creek bank. Kyle was crouching over him with gun at the ready, and there was not a beast in sight.

"You hurt?" Kyle asked. Garrett shook himself. He felt as if twenty fists had landed on him, but gently as if tapping a message. "No, I don't think so."

"Did they cut you? Bite you?"

"Not that I can feel." The brothers scanned Garrett's shimmer-suit, but could find none of the translucent smears that would have marked even the slightest wound.

"They were all over you before I even saw them," said Kyle. "I thought they'd rip you to pieces."

Rubbing his neck, remembering the grip of the claws on his body, the furious twisting of the bone torn his grasp, Garrett said, "I think they could have if they'd wanted to. But all they seemed to want was that bone."

"What in hell for?"

"God only knows." Garrett could hear his own voice shaking. "Maybe they didn't want me messing with their booty."

"Could be they're pure scavengers and don't like anything on their own."

A last shiver coursed through Garrett's body. "Let's hope so."

They broke camp in silence. Pathfinding came hard for Garrett that morning. The more he thought about the attack, the more his initial fear gave way to astonishment. Why hadn't the beasts ripped him apart? What impulse of mind or instinct had restrained them? Puzzling over this, he kept losing the trail. He paused more often than usual to backslight along the path they had walked. Again and again he found himself uncertain whether to go left or right when he came up against a phalanx of trees or a river or a swamp. He wet his cheek with a soaked finger to detect the faint motions of the wind but this gave him no clear guidance.

CONTINUED ON PAGE 130

How do you feel about the new technology of conception? Your answers can help shape upcoming legislation

BIRTH POLL

BY JUDIANNE DENSEN-GERBER

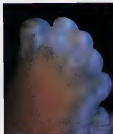
One of the most challenging and provocative issues in science is how to deal with the many sparkling reproductive aids coming into use. Artificial insemination has been available for some 20 years, and we still haven't solved all the ethical and legal dilemmas it raises. In vitro fertilization—so-called test-tube babies—and the use of host mothers—women who carry someone else's baby to term—are bringing further puzzles, both for prospective parents and for lawmakers.

Take just one case that could happen today. Both members of a married couple are sterile, so they obtain a donated egg and donor sperm. These are used to create an embryo in the laboratory. The prospective mother also cannot carry a child, and the couple pays a third woman to do so. When the baby is born, the host mother, who carried the child, the genetic mother who donated the egg, and the woman who co-ordinated the creation of the baby sue to obtain custody of the child. Who gets the child? If the host or genetic mother keeps the child, should she return her fee? Do the others have any parental rights or responsibilities?

So far, there are no state or federal laws to govern such cases, but the need for them has not been overlooked. Last summer the Michigan legislature asked Oolyssey Institute Corporation of Connecticut, the research institute I founded and operate, to gather information to help them devise policies to regulate the new reproductive technologies. Our birth-technologies poll is one of the first steps in this project.

Please give the following questions and statements some serious thought; then mark down your answers and send them to Birth Poll, Department O, Oolyssey Institute Corporation, 817 Fairfield Avenue, Bridgeport, CT 06604.

Remember, this poll is a rare chance for private citizens to guide the course of legislation on one of the most sensitive issues in science and society. Your views are important! Feel free to add whatever details you'd like to on a separate piece of



paper. By September 1989 legislation will be introduced in at least ten states, and the lawmakers are listening. Thank you for your help.

PERSONAL DATA

Please tell us about yourself.

1. Are you male or female?

Female _____ Male _____

2. What is your sexual preference?

Bisexual _____ Colicase _____
Heterosexual _____ Homosexual _____

3. How old are you?

Under 20 _____ 20-29 _____ 30-39 _____
40-49 _____ 50-59 _____ 60 or over _____

4. What is your marital status?

Married _____ Single _____
Separated/Divorced/Widowed _____

5. How many natural and/or adopted

children do you have?
None _____ 1 _____ 2-4 _____ 5 or more _____

6. What is the highest level of education you have attained?

Did not graduate from high school
High school graduate
College graduate
Advanced degree

7. Please check the total income earned by you and other members of your household in the last year.
Less than \$10,000 _____
\$10,000-\$19,000 _____
\$20,000-\$29,000 _____
\$30,000-\$39,000 _____
\$40,000-\$49,000 _____
\$50,000-\$59,000 _____
\$60,000-\$69,000 _____
\$70,000 or more _____

8. What is your religious preference?

Agnostic _____ Atheist _____ Catholic _____ Jewish _____
Moslem _____ Protestant _____ Other _____

CONCEPTION UNDER GLASS

Cited below are several high-tech methods to give a couple the child they want and various circumstances in which these techniques might be used. Assume for now that the parents to be are legally married. Please indicate your views on the following statements.



9. In vitro (test-tube) fertilization, using the couple's own sperm and egg, should be used to overcome infertility.

Strongly agree	Somewhat agree
Neutral	Somewhat disagree
Strongly disagree	

10. Artificial insemination with donor sperm should be used when the husband is infertile.

Strongly agree	Somewhat agree
Neutral	Somewhat disagree
Strongly disagree	

11. Artificial insemination with donor sperm should be used when the husband carries a genetic disease.

Strongly agree	Somewhat agree
Neutral	Somewhat disagree
Strongly disagree	

12. Artificial insemination using sperm chosen for the donor's high IQ or another desirable trait may be performed even when the husband is fertile and free of genetic disease.

Strongly agree	Somewhat agree
Neutral	Somewhat disagree
Strongly disagree	

13. If a woman is infertile, she may be implanted with a donated egg fertilized by her husband's sperm.

Strongly agree	Somewhat agree
Neutral	Somewhat disagree
Strongly disagree	

14. If both the husband and the wife are infertile, the woman may be implanted with a donor egg that has been fertilized by a donor sperm.

Strongly agree	Somewhat agree
Neutral	Somewhat disagree
Strongly disagree	

15. A host mother should be allowed to carry a couple's child when the natural mother cannot.

Strongly agree	Somewhat agree
Neutral	Somewhat disagree
Strongly disagree	

16. A host mother should be allowed to carry a couple's child for the convenience—not the medical necessity—of the natural mother.

Strongly agree	Somewhat agree
Neutral	Somewhat disagree
Strongly disagree	

17. If a wife is infertile, a host mother may be fertilized with the husband's sperm.

Strongly agree	Somewhat agree
Neutral	Somewhat disagree
Strongly disagree	

PARENTAL RIGHTS

Some of the most important questions about artificial insemination, host motherhood, and other forms of high-tech maternity are concerned with the legal rights of the donors, the host mothers, and couples seeking a child.

18. The donation of egg and sperm cells should be regulated by the government.

Strongly agree	Somewhat agree
Neutral	Somewhat disagree
Strongly disagree	

19. A sperm or egg donor should have such parental rights as visiting the child.

Strongly agree	Somewhat agree
Neutral	Somewhat disagree
Strongly disagree	

20. The recipient of a donated egg should be considered the child's legal mother.

Strongly agree	Somewhat agree
Neutral	Somewhat disagree
Strongly disagree	

21. A host mother carrying a fetus to term for an infertile couple should have the right to visit the child.

Strongly agree	Somewhat agree
Neutral	Somewhat disagree
Strongly disagree	

22. A donor's name should be kept on record.

Strongly agree	Somewhat agree
Neutral	Somewhat disagree
Strongly disagree	

23. The child, once grown, should be told the donor's identity.

Strongly agree	Somewhat agree
Neutral	Somewhat disagree
Strongly disagree	

Neutral
Strongly disagree

Somewhat disagree

40. A would-be host mother should be allowed to alter her services on the open market.
Strongly agree
Neutral
Strongly disagree

Somewhat agree
Somewhat disagree

41. A host mother should be able to abort the fetus independently or to participate in deciding whether to abort the fetus.
Strongly agree
Neutral
Strongly disagree

Somewhat agree
Somewhat disagree

42. If it becomes possible for the husband to carry the fetus to term, this should be encouraged in a certain percentage of marriages, including cases in which the wife is career oriented or is infirm.

Strongly agree
Neutral
Strongly disagree

Somewhat agree
Somewhat disagree

43. If male pregnancy becomes viable, a male should be permitted to be a host mother even if he is not the donor father.
Strongly agree
Neutral
Strongly disagree

Somewhat agree
Somewhat disagree

44. If it becomes possible to carry a child from the four-month mark to term in a womb

machine, should it be allowed?
Strongly agree
Neutral
Strongly disagree

Somewhat agree
Somewhat disagree

45. A fetus should be transferred to a womb machine shortly after conception if the parents wish to do so.
Strongly agree
Neutral
Strongly disagree

Somewhat agree
Somewhat disagree

46. If an embryo is not implanted into a mother's womb, there should be a limit to the amount of time that the embryo is allowed to develop in a uterus-like environment outside the body.

Strongly agree
Neutral
Strongly disagree

Somewhat agree
Somewhat disagree

EMBRYO'S RIGHTS

What rights does an embryo have?

47. All embryos produced in the laboratory should be implanted immediately into a woman.
Strongly agree
Neutral
Strongly disagree

Somewhat agree
Somewhat disagree

48. It is right to freeze embryos for such medical purposes as improving a woman's chances of conceiving at a later date.
Strongly agree
Somewhat agree

Neutral
Strongly disagree

Somewhat disagree

49. Embryos should be tested for genetic defects before implantation occurs.
Strongly agree
Neutral
Strongly disagree

Somewhat agree
Somewhat disagree

50. Embryos should be used for scientific research.
Strongly agree
Neutral
Strongly disagree

Somewhat agree
Somewhat disagree

51. Embryos should be used to test drugs for such harmful side effects as toxicity or carcinomas.
Strongly agree
Neutral
Strongly disagree

Somewhat agree
Somewhat disagree

52. Parkinson's disease and various other illnesses might someday be cured by transplanting tissue taken from a fetus into the patient. Fetuses should be donated so these operations can be performed.

Strongly agree
Neutral
Strongly disagree

Somewhat agree
Somewhat disagree

SEX SELECTION

It may soon be possible to predict or manipulate the sex of an embryo before implantation.

53. These techniques should be used when there is a known risk of sex-linked genetic disease.
Strongly agree
Neutral
Strongly disagree

Somewhat agree
Somewhat disagree

54. They may be used simply because parents have a preference as to the sex of their child.
Strongly agree
Neutral
Strongly disagree

Somewhat agree
Somewhat disagree

TRANS-SPECIES HYBRIDS

Techniques are being used to fertilize cow eggs with human sperm. Scientists wielding such technology have created what they call "trans-species gametes." How far should we pursue trans-species experiments?

55. Scientists should be allowed to continue to create and experiment with trans-species gametes in the lab.
Strongly agree
Neutral
Strongly disagree

Somewhat agree
Somewhat disagree

56. The U.S. government should determine how far trans-species gametes may develop (the British have set the limit at the two cell stage) and how such gametes should be destroyed.
Strongly agree
Neutral
Strongly disagree

Somewhat agree
Somewhat disagree



• When the
earth shifts on its axis at the turn
of the century,
only one in seven will survive •

ANTI-MATTER

Ruth Montgomery for those not familiar with her 14 books, was once a syndicated columnist covering Washington politics. Today as one of the world's best-known psychics, she is dispensing information. Most of it will be in a penultimate cataclysm, Montgomery contends, and he end is coming soon.

Montgomery claims to learn such things from her Guides, souls like ourselves who have had many previous lifetimes but are currently in the spirit plane as we will be after we pass through the mysterious door of death.

For 25 years, Montgomery and her Guides offered only familiar occultisms, on reincarnation and the so-called spirit plane. We are all sparks from God, was one message. We live many lives, which only a few can recall, was another.

Recently, though, the Guides have reportedly chided Montgomery to write about UFOs. The result is *Aliens Among Us* (G. P. Putnam & Sons, 1985), a description of the "spiritually advanced" aliens who have come to Earth. According to the Guides, these "spacefliers" travel by breaking down their bodies and equipment into a form of energy that moves faster than light. They resemble what they need upon arrival and use flying saucers only to lug hardware around once here on Earth.

In *Aliens Among Us*, Montgomery claims to have found two dozen people who either have encountered UFOs or lived as aliens themselves. Joseph Cotton, for instance, was vacationing in Crete in 1978 when he dreamed of meeting an extremely tall, thin man who took him to a flying saucer



UFO UPDATE

and lectured him about the sorry state of the world. Within months he had closed down a successful advertising agency in Tucson and moved to Fort Collins, Colorado. For the next four years, he says, he has spent much of his time building what he calls a chromogenic healing device, from instructions received by automatic writing—in which spirits move his hands across the typewriter and page thereby sending messages from beyond.

And, in Manhattan, there is an entire section of mystics who claim to remember past lives on a planet in the star system Arcturus.

The system's leader, the fabulously wealthy thirty-nine-year-old heir Frederick Von Meiers. Eight years ago, Von Meiers says in Montgomery's book, he was lying in a California hospital with a severe infection when "three beings materialized in my room and revealed secrets, including the need to help Earth prepare for the cataclysm to come."

That is a mandate with which Montgomery agrees. At the turn of the century, the earth will shift on its axis, she says. Six out of seven will be sped toward reincarnation by being objects "freezing" or flooding. And the rest will rebuild civilization with the help of Montgomery and her Guides.

Of course, there is no way to prove any of this before the world comes to an end—for most of us, anyway. But Montgomery does offer one test of her power. President Reagan, her Guides say, will leave office in poor health before the end of his term. Given Montgomery's other forecasts, even liberal Democrats are likely to wish the President a healthy stay in the White House.—OWEN DAINES



THE DEAD MUMMY HEAD

When Memphis State University recently announced plans to host the Ramses II exhibition coming to the United States in 1987, Clara Austin began thinking about the strange thing tucked away in her attic: Brought back from Egypt as a souvenir by her husband's great-uncle, amateur explorer Archibald Marvin, the curious object appeared to be the decapitated head of an ancient Egyptian.

Austin decided to take the head to Memphis State's Egyptian Institute of Art and Archaeology to see whether there was any interest in exhibiting it there. Not only did the university's Egyptologists accept her offer, they were amazed at their good fortune. Says Memphis State Egyptologist Rita Freed, "It is one of the best preserved mummy heads in existence."

After examining the head with CAT scans, dental X-rays, and mass spectrometry, a team of experts from

Memphis State and the University of Tennessee announced its findings. Apparently broken off from the rest of the body at the shoulders, the head once belonged to a woman between thirty and forty years of age. Her naturally dark hair had been dyed red during the embalming process, and an electron microscope revealed that it had been cut to a two-inch length by a dull razor—probably to facilitate the wearing of elaborate wigs.

Unfortunately, the brain had been removed through the left nostril, which was a common Egyptian practice, notes Hugh Berryman, a forensic anthropologist from the University of Tennessee Center for Health Sciences. "We still have a lot of clues about the woman, however, and we suspect her death may have been related to infection from her teeth."

Because of the gold coating on the mummy's face, researchers have concluded that she was well-to-do and may even have been a member of royalty. A scarab on her left cheek provided a way to place where and when she lived. "Right now it just looks like a wart," but thousands of years ago the scarab was an attractive decoration, Berryman explains. And it was used only during a thirty-year period in Akhmin in Middle Egypt. So that places the mummy during the Macedonian kingdom, between 331 and 304 B.C.

The mummy's owners are admittedly surprised over all the interest surrounding the

family heirloom. "We always dealt with it as a curiosity rather than a valuable artifact," Austin says. "It was just something the children could take to school occasionally for show-and-tell."

Sherry Baker

"Leap! Leap up, and hot the sky."

—Herman Melville

"Two days before her period a woman can open that crack and step through it into another world."

—Carlos Centeno

WALKER WORKS

Doune Walker's computerized music machine hasn't the fidelity of a digital synthesizer. It won't even fit on your belt. But Walker says that if you slip on the headband that holds its electrodes in place, it can tap into your subconscious mind, learn what you like, and tailor its tunes to fit your taste.

According to Walker, a self-taught Kayakville, Utah, engineer, his device is a kind of automated stereo that must be programmed with music before it is used. As the music plays, the electrodes record the listener's heart and respiration rates as well as the electrical resistance of the skin. "The machine senses those responses as it makes random changes in the music," Walker says, "and whenever a strain of music evokes a particularly strong reaction, a microprocessor just instructs the machine to do more of it."

The results are intriguing. "Some of it sounds like a

chorus," says the engineer's wife, Donna. "There are drums and whistles and some things you've never heard before." You can tell that the inspiration came from the music in Charivari de Fies, but it's very different. "It keeps getting better the longer it plays."

So far, Walker's music machine has attracted at least tentative interest. It's hard to evaluate it without more technical details about how it works," comments Robert Moog, research director at Kurzweil Music and Speech, a Boston-area computer firm and inventor of the famed Moog synthesizer. "But the idea is certainly plausible."

In fact, Walker says that the Air Force is experimenting with similar technology to control airplane and weapons. "I'd really like to be this sort of device in with brain waves," he adds, "but I've been working on the project only in my spare time, so I haven't gotten around to that." —Owen Davies





FLUOROCARBON
Cosmic rays are a real threat.

Remember when the fluorocarbons in aerosol sprays were going to destroy the earth's ozone layer, opening an atmospheric hole for cancer-causing cosmic rays? American manufacturers have long since removed the fluorocarbons from their products, but according to Aliso Aswell, fluorocarbon-based spray cans are still reported by the millions. Says Aswell, a chef and part-time painter from Greensboro, North Carolina, "The danger has not gone away."

To deal with the threat Aswell, whose real name is Chuck Alton, formed the Cosmic Ray Deflection Society back in 1973. And he's been spearheading an effort to lend off cosmic rays ever since.

Today, after more than a decade of work, the 15-member group has developed protective equipment that, they say, shields the body and the brain. There are

cosmic-ray helmets and shirts fastened with costume jewelry airline tickets, and fishing gear, and cosmic-ray deflection motor vehicles—in Aswell's case, a 1988 Mercury station wagon lay draped with magazine clippings and dripping with earrings, bracelets, and beads. On the forward corners of the roof there are also Christmas candles that Aswell says were "added for the Fourth of July."

"We think that cosmic rays are semi-intelligent," Aswell explains. "We celebrate Halloween on Valentine's Day and give out hearts on Halloween. It confuses them. They have to pause and think, and that gives us time to get away."

Aswell admits that the bizarre equipment may not actually fend off cosmic rays, but he is sure it has some benefit. "When we wear our clothes or sit in our cars, we feel rejuvenated," he says. And one time, when he stopped at a traffic light, there was a girl crying in the car next

to me. As soon as she saw the car, it looked like her eyes would pop out. By the time the light changed she was laughing. It just turned her around."

—Caren Davies

The power of tobacco to sustain the system, to keep up nutrition, to maintain and increase the weight, to brace against severe exertion and to replace ordinary food is a matter of daily and hourly demonstration."

—George Black

DEATHFLASH

Is human consciousness an electromagnetic field capable of surviving the shock of death? Maybe so, says physicist Janusz Slawinski, of the Agricultural University in Poznan, Poland.

Slawinski bases his theory on a real phenomenon known as the death flash, in which a cell population emits a powerful burst of electromagnetic radiation as it dies. Traditional researchers have proposed that the death flash results from degeneration of the cells, molecular order, but based on it's computations, Slawinski contends this burst is powerful enough to encode teams of complex information including human memory and consciousness itself.

The death flash, he says, could be temporarily released while a person is still alive, accounting for out-of-body experiences. And it could be the physical corollary of the near-death experience marking the physical release of consciousness from the

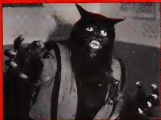
body as it dies.

Although we cannot yet measure and reproduce these fields, Slawinski says, traveling at the speed of light, they might be able to enter a dimension beyond the space-time continuum. Research on radiations of living systems provides a rational basis for dealing with the problem of the afterlife. It may also stimulate personal and social transformations toward a more creative and benevolent life.

Critics, however, disagree. Experiments conducted early by Duke University and the Psychical Research Foundation were specifically designed to detect whether consciousness, in the form of radiation, could leave the body. Says psychologist S. Keith Harary, who helped design the project, "Our experiments didn't suggest anything like what Slawinski is proposing. We didn't detect any electromagnetic radiation consistent with the release of the mind."

—D. Scott Rogo





WHISKEY

As far as blue movies go, *Driller* is unique. Its producer is Timothy Green Beckley, a New Age propher and TV personality known to friends as Mr. UFO. And he cast characters includes zombie women in spider web costumes, werewolves, hooded monks, a Quasimodo look alike with one eye on his forehead and another in his cheek, and the pop star Mr. J.

According to Beckley, *Driller* is loosely based on Michael Jackson's video *Thriller*. Jackson seemed above parody, Beckley explains. "People saw him almost as a new messiah. Don't get me wrong, I think he's a terrific performer. But his pompous approach and conservative attitude toward sex left him open to spoil."

Why would a professional propher get involved in porn? As it turns out, Beckley regularly sees X-rated movies and has even been a

film critic for Hustler and Adult Cinema Review. "My plan for *Driller*," he says, "was to address a crossover audience of bored-minded people over twenty-one, those who can comfortably deal with a blend of hard-core porn, camp horror and a touch of the supernatural."

"With werewolves and zombies running around, a lot of the sex is obviously not taken that seriously," Beckley adds. "It's for someone with imagination, not for the hardcore crowd."

Beckley is editor of UFO Review and Inner Light, a compendium of paranormal news items and advice. He has had a hand in dozens of articles and books targeted at the spiritual community, and he is a favorite guest on late-night radio and TV talk shows. This New Age go-to-all-places says that his search for "worldwide awareness" was prompted by "several UFO sightings, an out-of-body experience, and living in a haunted house."

As for conflict between his

two pot interests, Beckley claims there is none. "You have to keep the physical as well as the mental as well," he says. "I'm sincere about what I'm doing. I'm not just trying to make a buck."

—Nancy Lucas

"At last they are beginning to take me seriously. This imposes a terrible burden on me. I must redouble my laughter."

—Lawrence Durrell

"I had the feeling of things having happened here when I stood under the walls of Zimbabwe—of blood and cruelty, of strange rites and sacrifices, of lust."

—Susan Clouston

MONSTER MOSQUITOES

What can wake you up, put you to sleep, and keep the mosquitoes away all without invading your conscious mind? The only openly subliminal radio station in North America, CIME-FM in Montreal.

According to news director Chris Cole, CIME-FM first introduced subliminal programming to help people rise in the morning and relax at night. Then it decided to go after something a little more concrete: mosquitoes.

The idea emerged after one of the station owners revealed to France. While there, she learned of a repelling system based on the notion that humans are attacked only by female mosquitoes that have already mated and want nothing more to do with males. Re-

producing the sound of male mosquitoes, said the French researchers, would thus keep the biting females away.

Working with a group of scientists, Cole and his colleagues eventually came up with a sound they say repels 30 of the 44 local species. Their program runs from eleven to twelve in the morning and from four-thirty to eight at night. So far it has met with mixed reviews. Some listeners have complained because the sound is audible between records. But others have high praise.

"One person called to tell us he was falling comfortably on a lake with his radio on," says Cole, and he wondered what would happen if he turned it off. When he did, the mosquitoes really started bothering him. So he turned it back on and they went away.

Despite such anecdotal evidence, entomologist Philip S. Getshian of the U.S. Department of Agriculture and the University of Florida, has his doubts. Controlling mosquitoes with sound has been an elusive goal of entomologists for 25 years, he says. The problem is that mosquitoes do not respond to sound alone but to a complex combination of sound and odor. In addition, females will feed on human blood even if making him yet to occur.

"The disappearance and reappearance of those mosquitoes could have been caused by a million things," Getshian estimates. "For instance, a soft breeze."

—Rick Boiling

PREGNANCY

CONTINUED FROM PAGE 56

sexuals requested admittance to the in vitro fertilization program at the Queen Victoria Medical Center in Melbourne, Australia. They wanted to have babies. The Melbourne center turned down the request.

Garrett Oppenheim, a psychotherapist in Tappan, New York, says male pregnancy "would be the most magnificent breakthrough since the sex change program came into effect." As director of Confide Personal Counseling Services, Inc., Oppenheim evaluates and counsels those who apply for a sex change to help them decide whether they should undergo the necessary hormonal treatment and surgery. There are approximately 20,000 transsexuals in the world today. "And most transsexuals want to experience womanhood in all its facets," Oppenheim says.

A social worker currently undergoing a male-to-female transformation verified Money and Oppenheim's views. "It is possible to become impregnated and have a baby," says Jerry (a pseudonym). "I would do it without hesitation and at all costs. I'd walk out on my man if I had to. It came down to choosing between having a baby and staying with the man I love. I would leave the man I love and have a baby." Jerry remained undaunted by the prospect of cesarean section, but he did have one reservation about carrying a baby in the summer months: "with the heat and all."

Transsexuals do have one advantage over other males. They can nurse a baby—at least according to one doctor. Dr. Leo Wolman, a Brooklyn psychiatrist who has treated 2,800 transsexuals, claims he hormonally primed one of his patients so he could breast-feed his own child. This patient had remained married to his wife after transforming from male to female. The wife was carrying their biological baby, and after she gave birth, both parents took turns nursing the baby. Wolman claims his patient had "a breast development to rival his wife's" and that he gave him a drug to induce lactation.

But men who want to have babies may not necessarily want to mimic women in every respect. They are not all transsexuals. When a tabloid erroneously reported that Monash University's Harding had transplanted mouse embryos into male mice (he hadn't) and that his research team was looking for human volunteers (it wasn't), he was deluged with letters, mostly from men. He received phone calls in his Australian lab from as far away as Alaska. Harding suspects that many of those who wanted to carry their own babies were homosexual. But others were heterosexual men who had infertile wives. Said others were single men who wanted to fulfill their need for a child. There were even letters from women who were infertile and who wondered if their husbands could carry their baby. Shettles has received similar inquiries through the years, but says he has never received a call or letter from a transsexual. "The

men who called seemed very normal," he recalls. "I guess they just wanted to have the experience of having a baby." Shettles was also contacted, like Harding, by men whose wives were infertile and who wanted to "take the tension off the wife."

Then, of course, there's womb envy. "If little girls want to have penises," says Dr. John Munro Ross, "boys also, at some level want to have wombs and breasts." Ross, a psychiatrist with Cornell Medical College, cites the phenomenon of Couvade syndrome, in which husbands suffer the symptoms of pregnancy—weight gain, backaches, nausea, and so on—while their wives carry the baby. Most of the men he analyzed during their wives' pregnancies have expressed wishes to have babies and have developed symptoms," Ross says.

In any case, when the time comes for the first embryo transfer into a man, there will be no shortage of volunteers—and no short age of critics, either. Most researchers we talked to admitted that a huge stumbling

Scientists
doing work on the cutting
edge of human
reproduction were deluged
with letters
from men who wanted to
experience
the joys of pregnancy

block to male pregnancy would be ethical and moral objections. Already, the Michigan state senate is sponsoring a study to assess its citizens' attitudes toward new birth technologies, including male pregnancy. Presumably not everyone in Grand Rapids will be overjoyed with the idea of men in maternity clothes shopping for nursing bras.

But how do feminists feel? Do they see male pregnancy as their chance to escape biological destiny?

Gloria Steinem, for one, believes that pregnancy could make men less violent. "Giving birth has made women value life more," says Steinem, an editor and co-founder of *Ms.* magazine, "and we are far less violent by all measures."

Rio Kennedy, the black feminist who popularized the slogan "If men could get pregnant, abortion would be a sacrament," also saw a benefit. "Certainly this is an opportunity for a woman to have a leg up, if she's got brains enough and guts enough to take advantage of it. She should take a rest and let the man do the work. It's a possible slap toward women gaining on men, at least in terms of cocktail party jokes."

But serious doubts remain. In the Seventies

sex feminists were fond of the slogan "A woman without a man is like a fish without a bicycle." Now with male pregnancy on the horizon, Steinem suspects the ladies may be turned. "I have a small nagging fear," she confesses, "that if we women lost our capital on giving birth, we could be even more dispensable than we already are."

An admission We never wanted to write the article. It was the result of a casual comment about John Money's work, unwittingly uttered at an editorial meeting. Our editors were as skeptical as we were but asked us to at least explore the idea. We took the assignment with the assumption that after a few phone calls and a couple of library searches we could honestly report back that there was no real future in, or scientific basis for, male pregnancy. We were wrong. Some important researchers convinced us the idea was altogether feasible.

Granted, many more animal studies are needed to assess the practicality of male pregnancy. As far as endocrinology is concerned, what little research has been done casts serious doubts on our current understanding of the roles of so-called female hormones and what kind of hormonal priming a man would need to support childbirth. And the treatment of abdominal pregnancy must be refined before a fertilized egg can be safely implanted in a man's ovum.

Then again, perhaps some renegade will just go ahead and do it.

In the early Seventies, Landrum Shettles was conducting pioneer work in vitro fertilization at Columbia-Presbyterian Medical Center in New York City. When his boss told him to discontinue his research, ordered that the test-tube culture Shettles had produced be destroyed and finally in 1973, fired him. Perhaps because of this abuse, both England and Australia produced test-tube babies well before America did. Ironically, two years ago Columbia-Presbyterian began its own in vitro clinic, a decade after destroying Shettles' culture. The point is that supposedly crazy responsible ideas are often warmly embraced ten years after they're introduced—often by the same people who condemned them originally.

We asked Shettles, who now runs his own clinic in Las Vegas, to estimate when the first human male pregnancy would take place. As a preface to giving us an answer, Shettles pointed out that a former colleague of his, Dr. John Rock, stated in a medical journal in 1958 that the time had come for in vitro technology. But it took a full 20 years before England's Patrick Steptoe and Robert Edwards actually produced a baby. As for male pregnancy, Shettles says, "I don't think it's going to take as long as it did with their in vitro program. I think anyone who really wanted to get on with it now could achieve success." And who will do it?

"I think it would be really funny if the Australians, who have an international reputation for being the macho men of the world, were the first to achieve a male pregnancy," Shettles says. "I wouldn't be surprised. **DO**

DRAGON

CONTINUED FROM PAGE 19

and started out to do something, but he still did not know what.

Mrs. Davenport was slightly built, pretty, she looked lightened, the same look that Cory got now and then. "Is anything wrong?"

"No, I didn't mean to scare you like that. I just dropped in to make sure they did a good job with the greenhouse. Been morning to check it out for months. Too busy."

She relaxed and admitted him to the house. It was cooler inside than out: the drapes were closed, and a fan moved the air. Whitman had never been here before, he was surprised for a reason he could not put a name to. He had expected poverty maybe, and this was middle-class nice. Cory dressed as if every penny had to be weighed. The house was clean without being antiseptic, there were bookshelves and a stereo and an outside television. No plants, he noticed with disappointment.

In Cory's room he nodded, this was what he had expected. The greenhouse had been built next to her room, a door led to it. A miniature rose in full bloom, each perfect yellow blossom smaller than a fingertip, half a dozen hanging orchids enclosed in plastic bags to conserve moisture during this hot dry weather, a bench covered with pots of blooming flowers—lobelias, begonias, a bronze-leaved geranium in bud.

He looked at the joints of the greenhouse and peered at the lights, the heater while Mrs. Davenport hovered in the doorway. There was room for only one in here.

"Looks fine," he said then. "Just fine. She's enjoying it, isn't she?"

"You've been awfully good to her!" Mrs. Davenport said softly. "I want to thank you, but—"

"She earned it," he said brusquely. "She saved my business last winter. She's a good worker, the best one I've got."

Mrs. Davenport nodded. "She's good with plants."

"With plants," he agreed, and now they looked at each other.

She knew he had come to tell her something, to ask her something, to warn her. She felt the knife in her chest come alive, waiting.

And he found he could not bring any more torment to this woman. He sighed. She had done the best she could. Maybe she had even talked to Cory about boys, about drugs, about sex. It she hadn't and if he brought up any of it now, she would know something had happened, something that forced him to come here. He took a deep breath and smiled at her, and, using the voice he used with Cory, he said, "She's a good girl, Mrs. Davenport. You've done a good job with her."

The next day he talked to Cory himself. What he said, quickly almost roughly, was, "If any guy around here bothers you, you come tell me first thing. Understand?" It was all he could do.

For his sixteenth birthday that fall Cory gave

him the bronze-leaved geranium, it had yellow flowers. "It'll be damned!" he said huskily. "It just be damned!" he said huskily to name it, protect the seeds as if they were Christ's tears, as if they came true. Cory looked from the plant to Cory, and her smile brought tears to his eyes.

A steady rain is falling in Portland. Bruce stands before a glass wall and watches the water on the tarmac. Today is like a repeat of his last trip home. It was raining that day, too. He had the same flights, stood in the same spot. That day he wanted to sing and dance all through the terminal, tell every stranger that he had his Ph.D. and a job and a female. The standing water had an oil swirl that twists and turns, separates, recombines; it has a violent sheen that changes to blue, green.

He drove to all the places he had known, inhaled some muddy trails, swifed beer at the old bars, saw a couple of his old girlfriends—just for a drink or lunch, nothing

*She shook
her head, and now he could
see the fatigue
hunching her shoulders,
drawing lines
under eyes waiting for him
to tell her
what to do, where to go*

more. He was too full of Beatrice for anything more. They were already living together and in one month they would be married and move to Savannah.

He stands at the glass wall watching the rain, the uneasy standing water, fingering the Laste piece in his pocket. If only this could be that day, the intervening time a bad dream. He remembers.

He had no intention of going into the greenhouse or onto the property. It was simply an act of finishing up the past that took him to Whitman's that Saturday. He wanted to say good-bye to all the past, the good and the bad. He drove by slowly, waved, and left that part of his life for good.

A mile or two from the nursery he saw Cory pushing her bicycle on the shoulder of the road. He knew it was she as soon as the figure emerged from the rain and mist and became human, not just a shadow. He slowed down, passed her, then stopped on the shoulder and got out.

"Hey, Cory, remember me? I used to work at Whitman's."

She stopped, peered at him awhile, then came on toward him and said hello. She was encased in a long green poncho with a hood

pulled down nearly to her eyes.

"What happened? You have an accident?" The rain was cold and steady, already soaking through his sweater into his shoes. He remembered the day she had taught them how to bail up the roses, it had rained that afternoon.

She shook her head and pointed to the front car, which was lit.

"Let's put the bike in the station wagon, and I'll give you a ride home."

As soon as she spoke, he was afraid she would remember that other day, connect him with Frank, but she did not hesitate. She nodded and wheeled the bicycle toward the station wagon. They put it in, she sat in the passenger seat, and he got in and started to drive, and he searched for something to talk about. "You'll have to direct me," he said, glancing at her. She looked ahead with no sign of unease.

She directed him, she assumed, the same way she rode her bike to work, through back streets, secondary roads with deep pot holes and no traffic, because she wanted until they were at the corners where he was to turn. He slowed down again and then again. The wagon grated awkwardly as the left rear wheel sank into a hole.

Again he looked at Cory: she had not changed her position or expression. Damn her eyes, he thought, twisting the steering wheel hard, sleeping along.

"You ever plant those funny seeds Frank gave you?" he asked.

She nodded.

He had to drag it out of her. One was a banana plant. There was a fuzzy bush that was too young to flower yet, maybe a tree, she didn't know. And one was a dragon plant with a red dragon flower.

"You're kidding."

She remained silent until they had to turn again, and suddenly they were at her house. "You want to see it?" she asked.

He wanted to get away from her, never see her again, never think of her again, but he found himself nodding. She led him through the house, no one else was there, but lights were on, as if her parents would be back soon. She took him to her room, through it to the small greenhouse, and pointed to a bushy plant with a single red flower and many tiny buds.

He went closer and looked at it curiously, just a red flower. Pretty and unusual, but no more than that. The air in the greenhouse, in her bedroom, was spicy, sharp, and clean. Beyond the glass walls, over his head against the glass ceiling, the rain was beating, running down crazily, the world was gray, and in here the light was green, there was a stillness. He turned abruptly from the greenhouse and looked at Cory, who was standing inside the doorway of her room. He started to say it was just a flower, but he said nothing, he found he did not want to break the silence.

He reached out and touched her cheek, and a look of terror crossed her face. He wanted to shout, "For God's sake, you don't have to be afraid of me!" His hand left her

check and went to her shoulder and she was moving backward, he was following now with his hands on both her shoulders, and he knew she was not going to stop him and he was not going to stop himself. He fumbled with her clothes and his own, and then he was stop her and she was moaning, then keening. And he heard a voice crying, "Oh my God! Oh my God! Oh my God," and finally realized it was his own voice.

When it was over, he pushed himself away from her. She was staring dry-eyed at the ceiling. He grabbed his pants and ran to the bathroom he had seen on their way in. He slammed the door and leaned against it, shaking, and again he heard his strange, thin voice: "Oh my God! Oh my God!"

When he returned to the bedroom she was not there. He looked in the greenhouse, but it was empty. He hesitated, then pulled the bloom from the dragon plant and left.

Sitting in the plane, waiting for takeoff, he watches the rain running crazily down the window, and he realizes at last what he has come back for. He has to give the dragon flower back to her. He has to face her and make her take it back. He looks at his hand and slowly opens it and stares at the Lucite slab with a red flower embedded in it. She has to take it back, he says to himself.

Mrs. Davenport had to tell him, she couldn't make such a terrible decision by herself. For days she put it off, trying to think her way out of it, trying to will Cory back to normal, but it was no use, and finally she knew she had to tell him. They could take Cory away for a week or two, a vacation; they would say, and have it aborted. People did it every day.

He turned aghast, and a low, wordless cry came from his tightly clamped lips. He rushed to Cory's room and banged the door closed. Mrs. Davenport heard cranes, glass breaking. She sat rocking back and forth on a kitchen chair, clutching her head, her arms tight over her ears. When Cory came home, he pulled Mrs. Davenport away from the door and skinned out to meet Cory at the back of the house, where she was parking her bicycle. He grabbed it in both hands and hurled it through the last standing wall of her greenhouse. Cory stared, then turned around and walked away. Raymond held Mrs. Davenport's arm and would not let her run after their daughter.

It was nearly ten when Cory knocked on Whitman's door. He opened it and stood back for her to come in.

"What is it, Cory? What happened?"

She told him, and they looked at each other. Whitman nodded and motioned for her to go into the living room. "You have anything to eat yet?" She shook her head, and now he could see the fatigue hunching her shoulders, drawing lines under her eyes. "Sit down, Cory. I'll get something hot for you." She followed him to the kitchen and sat at the table while he heated up leftover pot roast. She was waiting for him to tell her what to do, where to go. They would have it

aborted, he thought, and he knew they must not do that, not to Cory.

It is only late afternoon when Bruce arrives at the nursery. It seems impossible for such a long day to go on and on and never turn into night, as this one has done. Everything looks exactly the same, as if this little pocket of the universe knows nothing of time and change.

He sees Whitman crossing the drive between the polished and the boiler house, and he starts to go to him. He has to see Cory alone, have a private talk with her, maybe in Whitman's house. He cannot talk to her while she is on her knees pruning roses, or potting up marigolds, or some damn thing. He draws nearer to Whitman, who looks the same, maybe even more vigorous than before, less tired. Bruce starts to call him, then stops as a woman comes from around the petting shed, pulling one of the long wagons. A small boy is sitting on the wagon, trying to drag his feet on the ground. He is too short to reach.

"Cory!" he says, his voice a whisper that no one can hear, but she stops and looks at him, and her smile vanishes, leaving him feeling chilled.

The boy jumps from the wagon and runs across the drive to the boiler house, yelling, "Hey Dad, we've got to go in now. Mommy says it's going to rain real hard."

"You always knew!" Bruce whispers, looking at her. She has not moved. His legs are heavy, his feet leaden, as he stumbles back to the rented car and gets in.

The rain starts as he drives back to his parents' house. It is a hard, pounding rain that the windshield wipers cannot control. He is forced to pull off the road and wait for the rain to let up, he is driving blind.

Only after he stops does he realize that he is weeping. He puts his forehead on the steering wheel and listens to the rain. His son, the son that Beatrice will never have, He hears her voice through the rain. "We can't go on like this, you know. If it isn't physical, it's psychological. It's that simple. You have to see a doctor."

"I have nightmares, Doctor. About dragons. Always about dragons. And it isn't fair!" It worked out for her, she's happy.

"Mr. Enfield, now that you know she's happy, perhaps you won't need to torture yourself with guilt. Perhaps that is why you went back to make amends, and you found none are needed." He groans and starts the car. He won't see a doctor, he knows. There is no way he can ever explain.

"Bruce, what happened? It used to be so good with us. What happened?"

Cory happened, she thinks, and he feels the breath of the dragon on his back, in his chest, in his lungs.

From the shelter of the porch Whitman and the child in his arms watch as Cory reaches out one hand, palm up, and then the other to the first drops of rain.

She lifts her head back, and the rain falls onto her face as she turns in a slow dance, welcoming the rain. ☐

MIND

CONTINUED FROM PAGE 26

been operating on is a human being.

As it is, Brody says, what we now know about the neurological development of an embryo suggests that anyone doing research on a fetus older than twelve weeks is already facing that problem. Brody hopes that medical science will devise noninvasive ways to study a living fetus.

The Supreme Court has ruled that the fetus has no legal rights until the third trimester. "So you can abort a fetus seven-and-a-half or eight weeks into development," Brody explains, "when there is clear evidence of neurological activities we use as indicators of life in a dying patient."

Although learning about how fetuses develop is essential to making difficult moral and legal choices, current attitudes don't favor it. Antifetters oppose the research, since it might involve experimenting with live embryos—considered by them to be unconscionable humans. And the pro-abortionists are not interested either. "There isn't going to be any scientific advance that is going to make the ACLU change its position," insists Janet Benselaw, director of the American Civil Liberties Union program on abortion. "We know what the fetus is, scientifically and biologically. I don't think anything has changed in the last twenty years."

This last observation might come as a surprise to physicians and researchers. Our current understanding of fetal development has come primarily from technological breakthroughs like ultrasound, fetal heart monitoring devices, special scopes capable of peering directly into the uterus—each available only since the Seventies. But Brody himself was "amused" when told of the ACLU position on fetal sciences. "They traditionally have defended those who can't protect their own civil liberties. The fetus at the late stage of development might well be such a person." ☐

CREDITS

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INTERVIEW

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preparation system depends very much on the quality of the semen. Bad semen samples require careful preparation, while good ones are prepared very easily by centrifuging and removing the fluid.

After this preparation procedure, we inseminate the designated number of eggs of which up to three will be inserted by catheter into the woman's uterus, and we freeze or donate the others, depending on the couple's preference.

Q: Does embryo freezing improve a woman's odds of getting pregnant?

T: You first have to consider that with straightforward IVF the success rate is just over twenty percent. About one woman in five will get pregnant. When we freeze the embryo remaining after the first implantation, we expect to lose about forty percent of them during the freezing and thawing procedure. We know that they're unusable because many of the cell membranes have been broken, and the embryo does not have enough cells left to compact. There's too much damage to enable us to warrant the transfer back into the patient. With freezing we end up with a pregnancy rate of twelve and a half percent when we thaw and implant the surviving embryos, and a rate of seven percent when you count the embryos that have not survived. So if you add this

figure of seven percent to twenty percent you get a success rate near thirty percent. Freezing then becomes quite significant.

Q: Are there also medical advantages resulting from embryo freezing?

T: Yes. When we transfer thawed embryos, we leave them unaltered by fertility drugs. A natural cycle, one in which superovulation has not been imposed, creates greater uterine receptivity [for the embryo]. There is also another advantage to embryo freezing. The data available suggest that there is a much lower incidence of birth defects. The genetically defective embryos cannot survive the freezing and thawing process as easily as genetically normal ones.

Q: What about the nonmedical advantages? Would you freeze an embryo for a thirty-five-year-old female corporation head who merely wishes to delay childbirth?

T: No, but only because we already have three and a half thousand couples on our waiting list who have genuine fertility problems. It's unethical to add people who don't have difficulties.

Q: What was your involvement in the celebrated Rios case?

T: Trounstein. The Rios couple came here for treatment because they couldn't get it in the United States. This was in 1981, very early in our development of IVF and they both agreed to have some embryos frozen as an experimental procedure. They were in fact among the first half dozen or so patients who agreed to contribute embryos.

Q: What kind of patient was Elsa Rios?

T: Trounstein. Elsa was really exuberant for life. She would arrive from Los Angeles with gifts for us all. Her excitement at going through an IVF treatment cycle overwhelmed us. But when something went wrong, for example when her eggs would not fertilize, she'd be totally devastated and would want to destroy herself. Then, within a day she'd be back on her feet—bright and cheery saying, "Don't forget I'll be back in three months. See you then," as she left for the States. Elsa Rios was loved by everybody in the program. Everybody had to know Elsa; she was that type of personality.

Q: What was the reaction when the staff learned of the plane crash?

T: Trounstein. Oh, it was like losing a very good friend. After their deaths, it was embarrassing that the situation became as contentious as it did. We were already on the way to solving the legal dilemma when the news of Elsa Rios' two missing embryos and the inheritance problem got to the press. The story was leaked by one of my postgraduates who was on a bit of a high and couldn't control himself. I, of course, was very angry. But you could not have created a more acidic situation—the drama stretched over three continents. We didn't have any idea how much their estate was worth. We just knew them both as the most generous people.

Q: Have Elsa Rios' embryos already been given up for adoption?

T: Trounstein. No, not yet. They're still in the liquid nitrogen storage. I am still waiting to be advised by the Ministry of Health after a proclamation of the law in Victoria. The hospital will then be informed that we are to thaw out the embryos and provide them for another recipient couple.

Q: Your clinic has been successfully freezing embryos for years. Why is it tougher to freeze eggs?

T: Trounstein. We don't know all the answers, but let me give you some possibilities. The egg is a very large cell—twice the size of a cell in a two-cell embryo, four times the size of a four-cell embryo, and eight times the size of a cell of an eight-cell embryo. So first of all, there's a size problem. We have to dehydrate the cell, and dehydrating a large cell is more difficult than dehydrating a small cell.

We also have to protect the membrane of the egg. In a two-cell embryo if we get damage across the membrane of one of those cells, we still have one intact. If we get damage across the membrane of any part of the egg, the whole egg is destroyed. Another factor is that the chromosomes of the egg are set up on the meiotic spindle [the delicate skeletal arrangement of the egg's twenty-three chromosomes]. It's an arrangement of chromosomes especially designed for fertilization by the sperm. We're very concerned that the spindle won't be reformed properly when the egg is thawed out. Chromosomes might drop off the spindle resulting in genetic abnormalities.

Q: Is your team close to perfecting a technique for egg freezing?

T: Trounstein. Yes, but here comes one of the



"Ladies and Gentlemen, before I continue to shower my largesse on the peoples of this earth, I demand formal recognition by the United Nations!"

big bonds of our current situation. Everybody believes that it is more ethical to freeze eggs than embryos. But the laws of the state of Victoria forced us to do research on, or analyze for genetic abnormalities, embryos that have resulted from frozen eggs.

Omni: Should you perfect a technique for freezing human eggs and overcome legal snags: what kinds of patients will benefit?

Trounion: With any form of radiation or chemotherapy, ovaries or testes are affected, and the patient is normally rendered sterile. In 1988 we will be prepared to offer young women—before they undergo chemotherapy—the service of taking some of their eggs and freezing them. The patients the service we offer young men undergoing chemotherapy. We offer to preserve their sperm in liquid nitrogen so that should they recover from their treatment, they may utilize these gametes.

Omni: Theoretically, how long can a human embryo be frozen?

Trounion: Indisputably, there's no known limit. David Whittingham and Mary Lyons in the U.K. exposed mouse embryos to the equivalent of a hundred years' worth of ionizing radiation [a kind of natural radiation that exists in the earth's stratosphere and can have damaging effects on the cells over time]. They looked carefully at the mice that were exposed as embryos to this radiation and found no alteration in their characteristics.

Omni: Let's take that thought further: Interplanetary travel may require voyages of hundreds or thousands of years: voyages that people couldn't survive. One way to seed distant universes might be to place frozen embryos aboard. Is this feasible?

Trounion: It's biologically possible, but the problem is: Who would raise the children born of the thawed embryos? When you get to the other end of the universe, you'd need a functional uterus for those embryos to develop in. Perhaps down the other end of the cosmic universe are creatures with functional uteri. Creatures with well-surrogate wombs could perhaps understand a message sent from this end of the universe, but these propositions are most unlikely.

Omni: Could a time capsule filled with human embryos be used during a nuclear holocaust?

Trounion: Yes, I think so. Ovaries cannot survive all of the resulting radiation, but maybe, if some women survived the holocaust, they would still have uteri. You would need, however, the whole of NASA to have survived the holocaust to retrieve the time capsule or satellite with the embryos aboard. But again, there's this monumental problem of having the maternal component around for the embryos. It's really a big problem. There's no chance at the present time that embryos can be grown outside the body in an artificial womb [ectogenesis].

Omni: Ectogenesis is not a pre-2000 event?

Trounion: No, I think it's more likely to happen near 2500—it's not a close event.

Omni: An Australian right-to-life group has accused you of reducing unborn children to "frozen peas." How do you respond to this?

Trounion: Well, they might see them as frozen peas, but I don't see them as frozen peas at all. I see them as frozen embryos. Also, luckily, frozen embryos.

Omni: If Victoria is a tougher state, in terms of restrictions, than Australia's other six states, why doesn't your research team move?

Trounion: It's a little bit like Chief White Hellcat, in Catch 22, whose tribe was always living near where he was discovered. After a while, they'd predict where this Indian tribe should move and then put down the old wells. Finally, the whole tribe was surrounded by these people with oil derricks. If we moved to another place, another legislature would be formed, and then we'd always be on the run like the Chief. The only thing that was left for him to do was to join the army.

Omni: Is Australia a particularly supportive country for your kind of research? How do freedoms here compare with elsewhere?

Trounion: We haven't any more freedom to do research here than in the United States. The major difference is that in the United

● You'd have to provide the transsexual with hormonal replacement therapy, and you'd have to put the embryo in the appropriate spot. That spot is the bowl! ●

States back in the mid Seventies, the NIH [National Institutes of Health] decided that it was not prepared to support IVF work. It has never changed its position despite the protests of many committees. As a result, the United States, as compared with Scandinavia, the U.K., France, and Australia, is quite primitive in IVF research. But compared with that of any other developed country, Australia's financial support of medical research in general is lousy. We are starved for funds. We had to develop our own funding systems, and that pressure forced us to consider IVF. Australia, a concept developed by an American businessman, Vicki Balchin. She was a patient with us who ended up having two children by IVF. She couldn't believe that a group with out standing in the international medical scene was actually surviving on selling raffle tickets and cakes. And that still goes on.

Omni: Do you personally have to go out and sell raffle tickets?

Trounion: No, the patients do. I often buy a whole book of raffle tickets for the patients. The money helps us buy incubators—the very things that enable the work to go on.

Omni: How well IVF Australia help your clinic financially?

Trounion: Vicki Balchin's realization was that the United States was relatively deficient in successful clinics. Only about a half dozen clinics in the U.S. have produced more than five babies. We could set up a successful satellite clinic in the States and get some money back, in terms of royalties, that would be paid to the Monash University and could underwrite our research.

We're in the process of setting up a satellite clinic in the greater New York area because there are relatively few IVF clinics there. It should open early next year. Since we can operate IVF only under Victorian law, we will not be able to do surrogacy [using surrogate mothers] or experimentation on embryos. They didn't want me escaping from the political system so that I could do research elsewhere.

Omni: Recently, your clinic had to reject several applications from transsexuals wanting to carry a transplanted embryo to term. Is such a thing possible?

Trounion: Theoretically, the patient doesn't have to be a transsexual. Presumably, you could ask the same question about a man. There's very little difference, except one of them, the transsexual, has been castrated. But I don't know if any work currently being done using male animal models. The only experiments I know of were done in the Sixties. When transplanted embryo issues were put under the testis capsules in mice, they formed carcinoma cells, not embryonic cells. But let's take a mouse, a male mouse.

Omni: No, let's take a human.

Trounion: No, no. No one's going to do those experiments on humans.

Omni: But let's theoretically take a human.

Trounion: If I describe the mouse, and then you can translate it, you would have to castrate the mouse, which brings us to the transsexual. You would then have to provide the transsexual with hormonal replacement therapy [at least estrogen and progesterone to simulate the female hormonal environment], and you would have to put the embryo in the appropriate spot. The anterior chamber of the eye is a very privileged spot in the body so an embryo could develop functionally very well there. If you were going to do the work, you'd then have to choose a more desirable place in the body, presumably for example on the bowl.

Omni: So you would have to remove the embryo from the eye after it has taken hold?

Trounion: I wouldn't put it in an eye in the first place. I'm just saying it's very difficult to get embryos growing in any place but a uterus, except for some models that have been used in the eye of the mouse.

Omni: Why the eye?

Trounion: Because it's isolated from the rest of the body and it has a natural cavity.

Omni: The eye—wouldn't it be damaged upon removal?

Trounion: Yes, it would be. It depends on how long you left it there. I mean, if you let an embryo implant in there, it's going to damage the eye—my point being that there

are rather low privileged sites in the body in which an embryo can develop, and the eye chamber was certainly found to be one of those sites. Developing a male pregnancy, then, would depend on whether you could lend other privileged sites.

Ortiz: The brain is also privileged, isn't it?

Toussoun: The brain? Well, I don't think any one has put embryos in there.

Ortiz: You know, like Athena popping out of the head of Zeus.

Toussoun: If we come back to the difficulties of putting an embryo on a bowel, it involves a certain amount of danger. And a great deal of trouble. This isn't technically impossible because some women have survived with ectopic pregnancies on the bowel, but pediatrically it's a huge technical problem, and ethically a major dilemma.

Ortiz: Are male pregnancies medically not feasible?

Toussoun: While it's not something we entertain that doesn't stop a transsexual population, or even men married to women who are totally infertile, from approaching us. We have been approached in the past; we have talked about it, and we've needed such techniques. [For another perspective on male pregnancy, see page 50.]

Ortiz: Chromosomally would it ever be possible for a human to carry a fetus of another animal species?

Toussoun: I think the possibilities are almost zero. Even if you were to consider such things, you'd be limited to very few primates. But again, this is purely science fiction.

Ortiz: Currently, all your work involves mature eggs about to emerge from follicles. But in the future, would it be possible for you to take a wedge of the ovary and preserve hundreds of immature eggs?

Toussoun: Possibly, but right now eggs have to be at least normal in size before we can get them to develop further in culture. That only occurs about five or six days before ovulation. When eggs are in a very primordial state, they are much, much smaller than mature eggs. We have no mechanism now to increase the size of these immature eggs. We're limited to collecting eggs that are in the follicles, those of normal size with fluid surrounding them. If you've treated a patient with some gonadotropin, you may get five or fifteen of those immature eggs, but this is relatively inefficient compared with getting thousands or hundreds from a wedge.

Ortiz: A baby girl is born with all the eggs she'll ever have. In the future, will we be able to create more eggs for a woman?

Toussoun: No, I don't think so. It's all finalized in fetal development. The complete complement of egg formation has occurred before birth. I don't see that there's any mechanism available to us at the moment to alter that, particularly when you're dealing with fetal life.

Ortiz: Do you think society will become increasingly more tolerant of the accomplishments of this "bizarre new world"?

Toussoun: Yes. There's a logical series of events occurring in these areas. First, the technology is termed a "miracle" with the press lumping such phrases as "miracle

birth" or "miracle happening." The scientists are put up on pedestals. Nationalism is engendered because it's the world's first. Then a reaction sets in, because people soon realize that this is a departure from what has been going on before. The press will feed this reaction, and then people will believe that they're heading in the wrong direction. There's been a tremendously negative reaction from people associated with religion, particularly the Roman Catholic Church. There's almost a hysterical reaction, and it's very predictable. Finally, there's a certain oscillation until the community manages to gain a local perspective.

Ortiz: Are we gaining a better perspective right now?

Toussoun: No. Societies in general are into a sort of moral crusade. Perhaps it's somewhat greater in the U.S. than in Australia. I expect another pulse forward, a progression engendered by the silicon chip, which will provide a lot of assistance in the household and liberate many people.

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Ortiz: Aldous Huxley suggested in 1932 that the embryo production process could be used for social and political manipulation. Could your own work ever be used in a politically unscrupulous way?

Toussoun: We are a long way from Brave New World. Even though Huxley predicted that we could grow embryos in a test tube, many of his other propositions are untenable in our present society. To create a Huxley-like scenario, you've got to have cloning, without it you've pulled out some of the major building blocks of his propositions.

It's much easier to program people through psychiatric modes than within reproductive technologies. By isolating a group of people and then working on them psychologically, you'll get a much more programmed group of people than you would ever have by selective breeding. You can psychologically control people in any way as a group.

Another more dishonest form of manipulation is genetic engineering—the insertion of DNA into mice or other animals. This is an absolute no-no in human reproduction and should be prevented at all cost. DNA insertion may trigger absolutely unpredictable

events in the genes, possibly producing very weird effects that are then inheritable, right? We face much greater dangers right now from AIDS and genetic or biological warfare and nuclear holocaust than we ever have to fear from reproductive technology.

Ortiz: Did you ever anticipate your meteoric success in the IVF field?

Toussoun: No. As a child, I visualized myself as a farmer and haven't ever jumped off that. I would very much like to return to the farm life, to have my own farm someday. I hope it's not too distant, because it's difficult to go back to a farming life when you're too old.

Ortiz: I'm not quite convinced that you could abandon the international spotlight of IVF and go off to a sheep ranch.

Toussoun: Well, we can assess that only when I do it. The big problem is that I've never made any money out of my work as a member of Monash University. The salaries have always been so low that we've only just been able to survive. Somebody family or friend is going to have to be benevolent.

Ortiz: If someone gave you the funds to move, would you buy the farm?

Toussoun: I'd be delighted.

Ortiz: Before your retirement to the farm, what are your remaining professional goals?

Toussoun: The main goals of my own research—and they're not the goals of the Center—are first to freeze an egg. Second, to surgically inject sperm under the zona pellucida (the protective outer membrane of the egg). This treatment would be for men having sperm that do not fertilize eggs and would involve using sperm taken directly from the testes.

The third major goal focuses on genetic defects. We've already begun using a thalassemic mouse model [thalassemia is a congenital blood disease], which has a gene deletion, hoping to identify those gene defects in early, preimplantation mouse embryos. In the future, we can perhaps offer such early detection to humans. Currently detection techniques require you have more than one thousand cells, but we believe that we can develop techniques that would identify these defects in the very early embryo. While I'm uncertain whether we can continue to work in the field of human reproduction, I'm quite prepared to develop all the appropriate technology, say, in the mouse, and then put it on the doorstep of people in medicine and so on. There's the technique you can apply it in the human if you wish.

Ortiz: Assessing the last eight years, how would you characterize differently?

Toussoun: I would certainly alter the way I led my private life, particularly in the years between 1979 and 1981. Those years really contributed very much to the breakdown of my marriage. I've always regretted that. These years were critical in terms of the progress that we made, but there was a major cost to many of us in our personal lives. If I had that time again, I would try to accommodate some of my family's needs. The rest of it, the science, I wouldn't want to do over again. I don't think I could get it as right as I did the first time around. □

TRAVELS

CONTINUED FROM PAGE 19A

By midmorning he was in such a state of bafflement that he realized he must ever come his dread and climb up into the canopy leaving his pack with Kyle. He shinned up one of the slender trees, probing for handholds on the vines that twisted around it. A racket of small feet scampering over the leaves broke out overhead and receded. As he rose, the amber light grew brighter and then as he wiggled up through the interwoven branches the full dazzle of sunlight made him squint.

"See anything?" Kyle shouted. Garrett blinked the water from his eyes. "Oh my Lord, yes!" he murmured. Thickly strewn with flowers, the canopy of leaves spread away in vast, undulating plains of too in all directions. Farther inland, enormous herds of dark animals were grazing on the treetops. Here and there a lone beast looped stealthily around the edges of a herd. The only break in that roiling scarlet plain was the solitary mountain, gleaming white against the western horizon. As soon as he glimpsed that snowy peak, he called down excitedly to Kyle. "I can see it. Were right on course."

"Good. Let's move!" Kyle hollered. "The company down here's getting a little leardy." Through the binoculars, Garrett took a hasty bearing on the peak. At this latitude the white surface could not be snow. Sand?

he wondered. Pale limestone uplifted from an ancient seabed? Mineral crystals?

From below came the whine of the rifle. "Kyle! Garrett, swing down through the branches. Hit the ground, and brace yourself against a tree with pistol drawn. A few meeks away, Kyle was bending over the sprawled body of a gray hairless animal. "Hey, brother?" said Garrett anxiously.

"I'm okay. I'm okay. Still holding the rifle across his heaving chest. Kyle kept staring at the beast. It looked as though it might weigh as much as a man, but its shape was not even vaguely manlike. A dozen or more legs protruded from the squat torso, each one ending in a pad of flesh as broad and thin as a dinner plate. For scrambling over the treetops? The skin was ash-gray mottled with black, closely resembling the bark of the trees, and it was perforated with hundreds of slits.

His breath still coming in gulps, Kyle said, "Those gashees must do them for eyes and ears and mouth." He pried one of the slits open with his knife.

Scanning the woods, Garrett noticed here and there a tree that looked unnaturally thick near the base as if something had wrapped itself around the trunk. Are there more of them out there?

"A bunch," Kyle stood up from the ashken body. "They kept sniffling closer and closer while you were up top. Then this one came right at me."

"It charged you?"

"Not fast, just right straight at me like a truck in low gear, grinding along. When I nailed it, the others headed for the trees."

The descent from his vision of the crystalline mountain down to this grimy scene left Garrett shakier. He slipped the pistol back in its holster but left the lap unlatched.

"Come on," said Kyle, hefting his pack. "I don't expect they'll stay scared for long."

All that afternoon the ash gray shapes stole along behind them, gliding from tree to tree in the shadows. The brothers made good time, since the forest was older here, the shade deeper and the undergrowth more sparse, and since Garrett now had a clear sense of direction. But no matter how fast they walked, the shadow creepers—as Kyle named the lurking beasts—never fell behind. That night, secure inside the blinding light-dome, Garrett said: How did you know it meant to harm you?

"I didn't," Kyle poked at a chunk of undissolved powder in his stew. "But I couldn't wait until it grabbed hold of me to find out."

"No. I don't suppose you could. Only—"

"Only what?"

"I keep thinking about that pack of scowengers, the way they held me just long enough to take the bone and then let me go. It was as if they were being careful not to hurt me."

"You didn't smell dead enough."

Ignoring his brother's sarcasm, Garrett insisted. "But what about all those other beasts—the branch weavers, the ring watchers, that gray bag of guts you shot—why do they ease up on us so slowly if they mean to kill us? They could just be trying to scare us, to drive us out of their territory. Or maybe they just want to find out what sort of animals we are."

"I could be they want to discuss metaphysics," Kyle scoffed.

"The point is we don't know," Garrett said. "They're as deep a mystery to us as we are to them. And the only thing we can think to do if they get too close is to kill them."

"How was I to know they'd die so easily? A little post, and all their circuits go haywire."

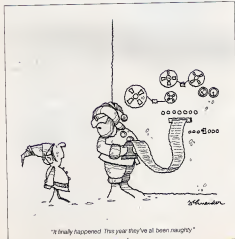
"That's what I'm saying—we don't know anything. We're pig ignorant, and it bothers the hell out of me. We never stay in any wild zone long enough to learn how the animals are made, how the plants grow. We're always pushing on, out and back, and everything's hidden from us, as if we're burrowing through a cloud."

Kyle fixed him with an amused glare. "You're not turning into a scientist on me, are you?"

"No, it's just—"

"I know what it is, and it bothers me, too. But not half as much as it would bother me to get stuck in a laboratory or out in some crowded patch of woods with other scientists behind every bush, studying the same bug for fifty years. What I want is to keep seeing things I never saw before. I don't want to plod along in bootprints that other guys have made."

"But we miss so much, and we make so many mistakes."



"It finally happened. This year they've all been naughty."

Kyle set down his dish and said earnestly, "If you couldn't budge until you understood everything, you'd never get away from Earth. And then you'd never see that roadway of limbs up there, or those acrida growing in the crotches of the trees, or your white mountain."

"Or the butchered animals?"

"Why does that keep nagging you? A few beasts dead?"

"There's more of them every trip." Garrett said sharply.

"That's because we keep going to wilder places. What do you expect? A picnic?" Kyle pointed around inside the perimeter of light showing pieces of green seeds with his boots. "There you sit—all you've got to worry about is the tail. Fine. That's a hard job, and I couldn't do it. I'd get lost in an hour. But I've got to keep us alive." He stopped in front of Garrett, looking dark against the black of the dome. "And if you wandered off by yourself for an hour, something would get you—believe me—no matter what your tender heart tells you about the wilderness."

Garrett did not answer. Looing off his goggles, because he did not want to see what was slouching around outside, he stared through narrowed eyes at the very banner that arched in a binding curve around and above the camp.

Protected from the night beasts inside this simulacrum of daylight, he lulled himself to sleep by summing up his vision of that pale, tranquil mountain.

Each time they stopped for a rest for a drink for Garrett to climb up through the canopy to check his bearings on the white mountain, the beasts closed in. It was as if sickness were an invitation to attack. Or to inquire? Converse? What did the creatures want? There was no way of knowing—no way short of a lifetime's study to find out. Usually Kyle shot the boldest animal, and the others drew back. But sometimes he had to shoot several. The scavengers following along in pecks behind the brothers no longer even waited for them to leave a kill before falling voraciously on the carcass, clearing away every last scale and bone.

"I can't see how they can still be hungry," said Garrett on the morning of the seventh day watching a band of scavengers swarm over the body of a shadow creeper, remembering how the fierce peck of them had swarmed over him with that odd gentleness.

"I expect there's fresh ones coming along all the time." Kyle watched the feast with slanting eyes. "The news gets out through the forest. It's like sharks in the ocean—the rumor of blood."

Despite the frequent kills, the ranks of shadow creepers stalking them through the woods kept swelling. At night these pursuers were visible outside the light dome as an ashen crowd several bodies deep completely encircling the campsite. They might have been antecessors gathering for a parley, or dumb beasts lured by instinct to drive out predators, the way songbirds will mob an owl, or like moths they might simply

have been drawn by the light. Staring out at them, the brothers spoke rarely and then only in whispers, conjecturing. But conjectured nowhere, for the gulf between the brothers and these lurking beasts was deeper than the gulf dividing humans from any species on Earth.

"Here's your peace at the heart of the wilderness," said Kyle one evening after a day of almost constant battles.

There was nothing Garrett could answer to that. He was just trying to hold himself together, subdue his sense of horror until they reached the mountain and could turn back. The glistening peak seemed so out of keeping with this dark and murderous woods that it had become in his imagination a kind of mecca, a resurrection.

On the tenth day out from the station they encountered an even larger beast. They could hear it coming well before they actually spied it, for the weight of its body set off sharp cracks like lightning through the interwoven branches as it swung ponder

◆The watchers overhead kept still, below, in every direction, stealthy shapes crept from tree to tree on the forest floor, drawing his pistol, he was shaking too hard to aim◆

ously toward them under the canopy. Its body was like a huge ginkgo with clusters of pines at each end, the skin a sullen red and gleaming as if smeared with oil. It held on by one set of pines, snarped its hinged length forward until the other end could seize hold, and so whipped along like a trapeze artist. There was a hectic scramble among the ring watchers on top of the canopy and among the skulking shadow creepers in the underbrush; the lesser beasts giving way in panic before this newcomer.

"Looks like trouble," said Kyle, shrugging free of the backpack and bracing himself to fire. Without pausing, the creature swung into position directly above them and dropped, its body spreading open like a fan, heavy ribs unfurling a thick blanket of flesh. Garrett leaped to the side. Kyle fired a burst and an instant later was smashed to the ground and buried under this beast.

Garrett bellowed, tugging furiously at the horny lip of the body trying to pry it loose to peel it away and free his brother. But the muscle was rigid, the ribs would not give. The pines were clamped tightly around tree roots. He bellowed again, but Kyle lay motionless under the smothering weight, so he

drew his knife and began hacking away at the flesh, chopping a hole through until he could see a foot. Then more cautiously to avoid cutting his brother, he chopped the thick muscle and pried the ribs apart, until he had carved a way of escape. Kyle was stunned, but with help he managed to crawl out through the ragged opening.

For a long while the brothers panted for breath. Then Kyle lifted his dirt-blackened face. "You can put that knife away."

Garrett stared at the list holding the knife as if it belonged to a stranger. The knuckles were still white from the fierceness of his grip. His arm was smeared to the elbow with the creature's oil. Slowly he loosened his fingers, cleaned the blade against the fabric of his tunic, and sheathed it again at his waist. A darkness came over his mind, the darkness of utter revision. "Let's turn back," he said carefully, trying to keep the tremor out of his voice.

"Turn back? It'd take more than that to stop me." Kyle thumped himself on the chest. "Look. His night is rain. Nothing's broken."

Shaking uncontrollably now, Garrett said "I just want to go back."

Kyle gave him a searching look. "What's to get worked up about? Nobody's hurt, right? Next time one of those foot swingers comes along, we'll bag it before it gets close enough to drop on us."

"No!" Garrett roared. "I don't want any more killing! I'm sick of it!"

"Hey—easy brother, easy." Kyle rested an arm on his heaving shoulders and spoke soothingly. "How about if we just hike on a little ways, leave the pile of meat behind, grousing at the butchered beast, and set up camp? We'll both unwind, and things will look better in the morning."

Garrett waited until he had regained control of his breathing, and his body had ceased to quake. Then he agreed to camp. As he trudged away from the scene of his brother's death, he was aware of the offending hand dangling at his side. He could hear the scavengers gnawing at the massive bones.

The bout with the roof swinger must have scared away many of the stalking beasts, for that night the woods outside the light dome were still. Yet Garrett slept poorly, troubled by suffocating dreams. In the morning things did not look better, and he said so.

Kyle was losing patience. "Look how much farther it is to your blessed mountain? His mountain—his mecca—let's not now. Garrett shrugged. "A long day. Maybe a day and a half."

So if we go double time we could make it by nightfall?"

"I'm not going!"

Giving way to his anger, Kyle said, "I'm the one who got smothered under that hunk of meat, and you don't hear me talking about quitting. What's the matter? Are you breaking?" He seized Garrett by the shoulders. "After all the bad things we've been through, are you going to desert me now?"

Garrett could feel the waters of hysteria beginning to churn in him, and he forced himself to speak calmly. "I don't think it's

The Artist

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Let's see which
is mightier

Come on!



Two
out
of
three
OK?

worth the cost anymore."

What cost?

The cost in lives. Kyle let out a scolding breath, but Garrett kept on. "It's like we're two blind men stumbling forward, carving our way through the guts of the wilderness, and the deeper we go, the deeper we cut. I'm not just thinking about last night. I'm thinking about everything we've killed—here and in the other wild zones. It's a road of corpses."

After giving him a last brutal squeeze on the shoulders, Kyle let him go. "So where can we go and not be intruders? You tell me that? Tell me where you're going to live without destroying whatever threatens you. Where? Earth? The job's already finished there. An asteroid maybe. Or one of the many distant planets. But if you go anywhere that's got life on it, you're going to have to kill some of it to make room for yourself."

Quietly shouldering his rucksack, Garrett faced back in the direction from which they had come. He would never get to that tranquil mountain. "I just don't have the stomach for it anymore."

Kyle slung his own pack into position and set his face in the direction they had been traveling. "Well, I still do. And by God I'm going to finish what we started."

Neither moved to take a step. They stood with shoulders brushing, eyes averted.

Finally Garrett said, "If you don't come with me, how are you going to find your way back to the station?"

"I'll just have to take my chances on that."

Although it would mean breaking a wilderness code, Garrett offered. "You want me to leave markers?"

Kyle spat in the dirt, then scraped his boot across the silt. "You worry about making friends with the beasts. I'll worry about the trail."

They touched hands briefly, roughly. Kyle glared at him with eyes bruised by a sense of betrayal. Garrett took the first step. A moment later he could hear his brother's boots retreating away behind him.

After less than an hour of solitary hiking while the animals prowled around him in over-lightening circles, Garrett staggered to a halt, overcome by guilt and fear and the weight of his own ignorance. He leaned against a tree—at least nothing could lunge at him from behind. What did they want? Just food? With so many they would get only a mouthful of him apiece. And suppose they merely wanted to touch him, speak to him through their pincered and padded limbs? If he could bear to stand still and let them swarm over him, as the scavengers had perhaps they would be satiated and go away, perhaps they would imprint a message on his body.

He squeezed his eyes shut, but fear immediately forced them open again. "Go away!" he shouted. His heart was clenching and unclenching like a fist.

They crept nearer. He could actually smell them, sour and hot. There was no sound except the occasional creaking of a limb or the scrape of heavy bodies over the ground.



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Stupid brutes. Because of them he had abandoned his own brothers—four hundred kilometers away from the station and no map. He might just as well have shot him.

Leave me alone!

The beasts watching him from the canopy thickened into a solid mass of dark bodies overhead. Picking up a heavy stick he flung it at them. As it clattered on the underside of the limbs, the mass of animals stirred briefly but soon drew together again, like the murky waters of a pond regathering.

He roared—a sound raw and wordless. The watchers overhead kept still. Below in every direction, stealthy shapes crept from tree to tree on the forest floor. He drew the pistol but was shaking too hard to aim it. What did it matter where he aimed? He wanted to spray the entire forest with death, murder everything, drive it back, erase those menacing shadows, clear a highway through the wilderness. He tried wildly squeezing off burst after burst, firing in a blind passion while bodies rained down from the canopy, fired at the creatures stumbling away through the maze of trees, shooting until he could see no living beast anywhere, no least quiver of flesh, no threat. Then he stopped, horrified by what he had done.

Still shaking, he pushed away from the tree where he had been leaning. The scavengers were hustling out from beneath the tree roots to glut themselves on his slaughter! He nearly fired on them as well, but he restrained himself and holstered the gun. Blind with shame and loathing, sobbing out loud he wanted to drop the gun and rucksack, peel away the shameless suit, wander naked into the woods and give himself to the beasts. But no—he had to find Kyle—lead him to safety—tell him about this horror.

Fading about he set off at a trot. Immediately he felt better as if joining with Kyle again would be the healing of a wound. He arrived at the place they had separated, then he pushed on, stooping every now and then to study Kyle's footprints, oblivious to the beasts that were skulking again in his wake, his breath coming in rags. Several times Kyle had stopped to climb a tree—doubtless to make sure he was headed toward the mountain—but Garrett had not need to stop or even slow down, and so he felt certain he was gaining on his brother. By late afternoon the trail was so fresh that the trampled grass was still undented, and footprints stamped in the sandy bank of a creek were still collecting water.

Dusk was gathering like black fog among the trees when Garrett finally saw his brother standing motionless in a clearing up ahead, the unmistakable bulk of his fighter's body starkly visible against the gleaming base of the mountain. The rucksack lay at his feet. The rifle was cracked at a slant in his arms. He seemed to be contemplating the mountain while the lamp on his helmet struck brilliant reflections from the glittering slope.

Knowing it would be suicide to sneak up on him, Garrett slipped free of his pack, ducked behind a boulder and gave a shout.

Kyle spun halfway around before hitting

the dirt where he lay on his belly, rifle and helmet-lamp aimed in Garrett's direction.

"Kyle, it's me! I've come back! Kyle!" Because of the light, Garrett could not see his brother's face, but he stood up anyway, arms lifted. "Kyle?" He repeated uncertainly as he stepped into the sights of the gun.

For a long while the rifle did not waver in its aim. Then Kyle rose onto his knees and called in a jubilant voice: "Back from the dead, big brother?" Flinging down the gun, Kyle surged to his feet and came running. The two collided with such force that they fell sprawling and wrestled over and over in the dirt, glowing joyfully.

When they finally rose and dusted themselves off, laughing, looking into the woods along with their eyes, they held one another at arm's length and stared long and hard, as if each needed to reassure himself that the other had actually been found. Then Kyle suddenly grew anxious: "Come here, you've got to see this."

It was now quite dark. The brothers fol-

●Dusk was gathering like black fog among the trees when he saw his brother motionless, his fighter's body starkly visible against the gleaming white mountain●

lowed the jagged beams of their helmet lights to the clearing. Even while they were still a good distance from the slope, Garrett could tell that whatever made this hill gleam so brightly was not stone. And not jewels or metal. Then he realized what it must be: "Bones," said Kyle softly, "a whole mountain of bones."

As Garrett's vision cleared he gazed numbly at the glittering, jumbled slope. The shapes were not familiar, but the color was—a calcium-keen polished silver-bright by air and weather.

"Where did they come from?"

Kyle aimed his lamp at a point some few meters up the slope. "The scavengers haul them here."

Transfixed by the light, one of the cat-size sinking beasts paused in its ascent. Protruding from ribs along its flanks were several gleaming bones. From one of its ribs? Garrett wondered. He remembered the sulfolocating hole of bones, the bone twisting violently in his hand. How long had they been building this pile? And why? He thought of elephant graveyards, the mass suicide of leopards, the antler heaps of deer, the midden of skeletons near Eskimo encamp-

ments, the Roman and Nazi and Frontline holocausts—but nothing earthly would explain the raising of this deathly monument. After a moment the scavenger resumed climbing, its passage rousing a herd of elks. The brothers watched it labor up beyond the canopy, beyond the rings of their lamps, up skewed into the darkness.

Releasing his breath with a hiss, Garrett said, "I think of all the deaths it took."

"Damn near everyone on the planet. I'd guess."

"I see now why the old-timers would think about it."

"Would you?"

"No."

They fell silent; their tanned headlamps glaring on the silvery cubes. Then at the same moment confessions burst out of them. Kyle saying, "If you hadn't come back I was a dead man, but in here I had no idea which way was home." Garrett saying, "I went crazy with killing. I was pure hatred, wanted to blow everything away, erase it and start clean." Again there was a shocked silence.

At length, turning his light away from the slope, Kyle bent down and retrieved the rifle from where he had flung it. "You want to wait and explore it in daylight?"

In a hushed voice Garrett said, "To look to sit down and study it and not budge until I could make sense of it. But I'm afraid I'd go mad."

"I'm more scared of beasts than mad-ness," said Kyle. "I say we head back now. What do you say?"

Garrett nodded silently, never taking his eyes off the mountain.

Good. The straps of Kyle's pack creaked as he put it on. "Can you find the way with just the lamp? Maybe go a couple of hours to give us a little breathing space?"

Garrett took a last daunt look at the waxy slope. He had been coming to this place for a long time. Here and there, scavengers were hauling new trophies onto the heap, the talus of skeletons shifting beneath them with the crackling sound of ice about to give way underfoot. Enveloped in the rustle of scurrying bodies, each with its shiny offering, the mountain of bone possessed a terrible beauty. Was it the beauty of inland, like that of a titheful hill or bird nest? Or was it the beauty of intellect, of pyramids and obelisks? And if the work of mind, what was its infernal meaning? He did not know.

"Yes," Garrett said. "I can find the way."

He guided them unerringly. Perhaps because they moved so swiftly or because news of their slaughter had spread through the forest, the brothers were rarely stalked on this return journey, and they left no new carcasses in their wake. The trek into the wild zone had taken them eleven days. In only nine days they were back inside the station, the air lock sealed behind them, three thick-reefs of glass protecting them from the forest. Even in that hushed sanctuary Garrett could not rid his mind of the mountain of bone. The peak rose in his memory up and up, a glittering monument, piercing the sky of understanding. □□

NATIVITY

CONTINUED FROM PAGE 12

a more efficient, less damaging way to transport oxygen. We don't breathe that way naturally because it takes a lot of energy. But with a machine providing the effort, it might be a good way to keep preemies alive.

"We stuck tubes down our throats and tied it," says Dr. Charles Bryan, of the Toronto Sick Children's Hospital, one of the developers of the machine. "It feels like you're getting an internal body rub."

Bryan has used the machine on hundreds of preemies whom conventional respirators might not have helped. So encouraging are his and others' results that the National Institutes of Health have recently begun trials to evaluate the machine with 1,500 babies in ten hospitals in the United States and Canada. Results are expected in about a year.

Another approach, pioneered by Dr. Tetsuro Fujiwara, of the Iwate Province Medical Center, in Japan, is to supply preemies with the lung surfactant they lack. To accomplish that, Tetsuro obtained surfactant from calves' lungs and then treated it to remove most of the protein. (Protein might react with the infant's immune system, while the fatty portion of the surfactant benefits the lungs.) He gave the substance to ten preemies with severe respiratory distress syndrome. Eight of them survived.

That success sparked a series of experiments, the results of which are now coming in. Last June a team of doctors from the University of California in San Diego and Children's Hospital in Helsinki, Finland, reported that they had isolated surfactant from the amniotic fluid of women who had cesarean sections. Over a period of two years, the infants treated with that surfactant had significantly less lung disease than the control group. In August doctors at the University of Toronto reported that infants given surfactant from calves' lungs died less on respirators than the control group did. The treated group also had fewer mild brain hemorrhages. In October doctors at the University of Rochester reported similar results.

The present attitude of many neonatologists is one of great enthusiasm, according to Dr. Donald Shapiro, who with Dr. Robert H. Notter, did the Rochester work.

Other groups are working on completely man-made surfactant and testing it on animals. Meanwhile Abbott Laboratories, the giant drug company, has acquired the American patent to Fujiwara's formula and plans to start clinical trials in a few months. "If the tests work out," says Dr. Alan J. Gold of Abbott Labs, "it could be on the market in four or five years."

With all the intervention, preemies—who would be isolated if left in the womb—are bound to react. Thus, another research frontier involves learning what preemies feel during intensive care treatment. At the University of San Francisco Medical Center, Dr. Peter A. Gorski and his colleagues spent two years recording preemie behavior in exact-

ing detail. They mounted a portable computer on a stand that could be wheeled up and connected to the baby's electronic monitors. The machine also had a keyboard into which nurses could type their observations, such as the infant's activity level, color, and other behaviors.

After nearly 5,200 separate observations, Gorski found that preemies react differently to handling than previously thought. Many doctors think preemies like being handled, that stimulation is good. Gorski's enormous database shows otherwise. He found that several minutes after routine chest massage, preemies often showed depressed heart rates and lowered levels of oxygen in the blood. Social interactions such as stroking or hugging cause similar distress. Indeed, many routine interventions caused blotchy faces, grimacing, irregular breathing—signs of physical stress.

Gorski explains that the nervous system of preemies is still "poorly organized." At 24 weeks the preemie brain is undifferent-

◆ *Several minutes after routine chest massage, preemies often showed depressed heart rates and lowered levels of oxygen. Social interactions, such as stroking and hugging, caused distress.* ◆

iated. It has the general shape but not the creases and folds of the full-term human brain. The cerebral cortex—the center of nervous control and conscious thought—is still being formed. With brain cells migrating at a rate of 100,000 a day, the whole intricate circuitry is still being connected, like the wiring of a giant built at home computer. The result, says Gorski, is that preemies below a certain age lack the ability to filter out stimuli. Too much unfiltered noise, light, or handling can disrupt physiological functions.

"They're really overwhelmed and they cry," says Gorski. "I've had babies so overwired by the social interaction of eye contact that they go limp. What seems kindly to us may not always be best."

His work is buttressed by ongoing experiments at Harvard Medical School. Working with Leighton and other NICU nurses, physiologist Hiedi Als has shown that minimizing disturbances can make preemies healthier. The experiment was based on behavioral observations: A researcher would watch a procedure, record how the baby reacted, and then suggest how to make the baby more comfortable. A baby who was looking for something to suck on was given

a nipple; for example, one with arms and legs flailing was surrounded with a cotton burrito for containment. The results: The preemies who were treated this way had significantly shorter stays on the respirator than others.

Als says the improvement came from limiting sensory input. Like Gorski, she concludes that preemies brains lack the ability to block out stimuli. Als doesn't say that care should be withheld, only that it is being should be geared to preemies' behavior.

"When you look at a preemie, you're really looking at a fetus developed into an environment for which it's not evolutionarily adapted," says Als. "His autonomic nervous system is at the mercy of medical technology. We have to observe preemies rather than just act on them."

Even when all the experimental technology and techniques have been perfected and put in place, survival will be impossible for preemies younger than 24 weeks. Before that the lungs just aren't developed enough.

But suppose the preemie didn't need lungs? Theoretically, that's possible with a technology called extra corporeal membrane oxygenation (ECMO). Essentially a new kind of heart-lung machine, ECMO is an apparatus that removes blood from the body, pumps oxygen into the blood, and sends the oxygenated blood back in. In this way, it acts like the womb, providing oxygen to a fetus that can't breathe on its own. The technology is used on some full-term babies, but it requires the use of anticoagulating compounds that would surely cause brain hemorrhages in preemies. Still, a few experts say that with years of refinement ECMO might someday be used in the care of premature babies.

Still others talk about giving preemies oxygen through the skin. In the lungs, gases pass from thousands of tiny air sacs across membranes to capillary beds. That transfer is impossible in immature lungs because the junction between air sacs and capillaries has not yet been formed. But preemies have thin, capillary-rich skin that covers their bodies. Thus, some doctors speculate that if preemies were placed in high-pressure chambers, oxygen might be absorbed directly by the skin.

Lungs are the only organs unable to function in preemies 16 to 20 weeks of age. Thus with either high-pressure chambers or ECMO, the plateau of viability would take another step down.

Nonetheless, most experts say that medicine will never replace the first crucial months a fetus must spend in the womb. The placenta provides the fetus with oxygen, food, and hormones while removing all its waste. The process is so complex that doctors won't even discuss the possibility of replacing it with technology. Even though doctors can create a test-tube baby by fertilizing the human egg outside the body, there's no getting around the fact that in a few days they must implant it in a woman.

"It's silly to even think about keeping a preemie alive during the first trimester," says

Dr. Jay P. Goldsmith, chairman of pediatrics at the Ochsner Clinic in New Orleans. "What goes on in terms of organogenesis is so critical that any change in the environment could result in deformed babies or miscarriages."

Even now, some doctors wonder how far they should go in saving babies who are very premature.

Some of these physicians say "Give us the money and we'll make anything that moves stay alive," complains pediatrician and medical historian Dr. William Silverman. We should accept the fact that "there are biological errors that naturally cause certain fetuses not to survive. The error rate has never been zero. It's not zero for any species on the planet."

"We don't want to get biological errors to zero," argues Boston City Hospital's Elizabeth Brown. "We want to get mechanical errors to zero." By that she means many preemies are biologically perfect but are born too early because of a "mechanical" problem in the womb. "In many cases you're salvaging a person who would have been lost. As for those preemies who develop serious handicaps, she says, "If the majority do well, I'm willing to live with the ten percent who don't." (Estimates for severe physical and mental handicaps among preemies range from 5 to 20 percent, depending on gestational age. That's two to five times as high as in full-term babies.)

"If we as a society keep an eighty-five year-old with cancer alive," she adds, "why can't we save someone who is just starting his life?"

One reason may be that NICU care is one of the most expensive services a hospital can provide. The costs may exceed \$1,000 a day. Antonette Kimble says Victoria's treatment will cost "eighty thousand dollars or more." Her Blue Cross medical insurance will cover the payments. Poor people rely on publicly funded Medicaid.

Perhaps there's a cheaper way. Prematurely results from a cluster of causes, including smoking, diabetes, alcohol and drug abuse, multiple births, and teenage pregnancies. But the major factors relate to poverty, inadequate nutrition and a lack of prenatal care. That care could include early examinations, advice on living habits, and making arrangements for delivery—all for \$500 to \$800 per pregnancy.

Dr. Stanley Dawson, professor of maternal and child health at the University of Southern Florida, studied prenatal programs for the state of Minnesota. He found that for every hour you prolong a pregnancy between 24 and 28 weeks, you save \$150 in hospital care. Others have shown that nutrition and prenatal care could save the country \$360 million per year in the treatment of low birth-weight babies, most of whom are preemies. Recently the National Academy of Sciences Institute of Medicine recommended that the country "undertake a broad national commitment to ensure that all pregnant women receive high-quality care."

"Technology has done just about everything it can," says Lynn Blewett, an aide to

Senator David Durenberger (R-Minnesota), an advocate of prenatal care. "Now it's time to do something about prevention."

Not the Reagan administration, which claims to support life, has consistently cut or opposed nutritional and prenatal care—the very programs that would keep more babies alive. That, say the experts, is why the infant mortality rate, which dropped sharply in the Seventies, has recently plateaued its decline nationally and is rising in some poor areas. It contributes to the country's rank of seventeenth for infant mortality according to recent United Nations statistics. While behind Finland, Sweden, Japan, even places like Singapore and Hong Kong.

"Weight for weight we do better than any one. We use high-tech and expert care to keep preemies alive," says Dr. Groven. "But we have many more very low birth-weight babies. Other nations wouldn't stand for our level of prenatal care."

Other issues seem less likely to have an answer. A dozen years ago the Supreme

is technically alive. What should doctors do? No single policy exists. It's determined hospital by hospital, doctor by doctor.

For example, Dr. Lu-Ann Pappe of New Mexico says she told the doctors who do therapeutic abortions at her hospital not to send her any fetuses at all. "If you're doing everything possible to abort a fetus, don't tell me in the next moment to save it. Already so much has been said in motion that it doesn't have a chance."

Other doctors take a less rigid view. At Boston City Hospital any fetus over 350 grams whose heartbeat continues for more than a few minutes is sent to the NICU—just in case the fetus is viable but more often to keep it warm and comfortable until it dies.

"It's draining," says Dr. Brown. "It's very difficult to watch a perfectly formed yet provable baby try to breathe." She adds that in ten years at the hospital she saw just one aborted fetus survive when the mother was mistaken about the stage of her pregnancy. The child was later adopted. "This was not an evil woman," she says. "She was very happy that the child lived."

If all this sounds depressing, remember that it would not be an issue if not for the recent turnaround in premature care. Science has brought life to thousands of babies who otherwise would have died. But progress brings choices. Do we rescue the preemie who seems destined to be handicapped? Do we keep marginally viable children alive? How much should we spend? How do we make decisions in an area in which every step forward is rife with controversy? And who should make the decisions: parents, doctors, or government officials?

Perhaps nothing illustrates the double-edged nature of premature care more than Victoria Kimble, the child who was sustained at the very edge of life. Shortly before she was due to go home, Antonette, her mother, ran into one of her doctors in the hall. The doctor had bad news. He had just come from examining the child. Her retina—now formed at the age she was born—had not properly attached to the eye. It was sad but not surprising, given Victoria's extreme prematurity. The baby would almost certainly be blind.

It hit me like a boom," Kimble recalls. These months of struggle, and now this. But she stopped for a minute before ordering the NICU. She thought about the child and how the nurses had worked so hard to help her. She knew they had grown fond of Victoria and would be nearly as devastated as she by the news. As she entered the NICU and saw nurses Gretchen and Lisa and Brenda and Pat, she could tell they were barely holding back tears. She got their attention.

"Now I don't want to see any of you upset," she commanded them. "I don't want to hear one sad word. Don't you remember how she's always had to battle? How when her toes turned so black we'd thought they'd fall off? And her stomach swelled up? And her heart stopped?" Some of the nurses wept openly now. "There were so many times we didn't think she would make it. But only one thing is important. My baby's alive!" □

◆ The line between abortion and preemie care is becoming increasingly slim. Many hospitals abort fetuses in one wing and save preemies just a few weeks older in another ◆

Court upheld the rights of women to have abortions. The choice rests with the woman and her doctor until the onset of fetal viability, after that the state may intervene. The trouble is that the limits of viability have dropped. In 1973 it was about 28 weeks; now it's anywhere from 24 to 27. The line between abortion and missing care is becoming increasingly slim—so slim that many hospitals abort fetuses in one wing while saving preemies just a couple of weeks older in another. Most keep a safety margin by not aborting fetuses older than 26 weeks.

Most neonatologists we spoke to are pro-choice, arguing that abortion is an issue of religion or personal conscience. Studies also indicate that many countries that permit abortion have lower infant-mortality rates than we do. Still, the issue is so painful that most medical people avoid it.

"In my entire life here I don't think I ever heard the abortion service mentioned by name," says nurse Lawton. "It's a little too close to home."

It's especially close when an aborted fetus has a heartbeat that lasts for more than a few minutes. The fetus may be only 18 weeks old. It has no chance of surviving yet

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GAMES

By Scot Morris and Phil Wiswell

It's time again for our annual roundup of the year's best new games and divisions. We'll give our choices for the ten best general games first, then the best computer and video games.

Two fortunes characterized this year's best general games. First is the rise of the lone inventor. Good ideas can make it on the market without the imprimatur of a big game company. Six of our top ten choices this year go to "lone shot" producers (Aerobie, Chess, Football Fever, Megapido, Mental Blocks, and Supremacy).

The second trend is the fade-out of electronic games (not a single battery-powered item made the list this year) and the rise of party games, in which the whole family plus friends and neighbors get involved. Trivia games inspired by Trivial Pursuit (one of our choices for best of '92) have mushroomed; the new generation ranging from Solid Gold Music Trivia to Sexual Trivia to Bible Trivia. Mystery party games, arising from Who Killed Roger Elbogen? (a best of '93 choice), have also blossomed. How to Host a Murder (Daopher) has three games (each priced at \$25.95). Murder to Go (Jodo) has another three (all in one package for \$35), and more are on the way. Murder-mystery parties are now rumored to be more popular than spoon-bending parties in Washington, DC, or wine-tasting parties in Mill Valley.

Within each category below, the winners are listed alphabetically, not by preference. Prices quoted tend to be on the high side; shop around for discounts.

TEN BEST GENERAL GAMES

1. **Aerobie** (Box 2025, Dallas, TX 75221, \$79.95). Reviewed in last column last July, this is the flying ring that can be thrown farther than any other man-made object. With a distance record of nearly one-fifth of a mile (1,047 feet), the Aerobie is a superb aerial that anyone can throw farther (and some say more easily) than a Frisbee. Invented by a Stanford aerodynamics engineer, the toy crosses one main problem: finding a park big enough for a simple game of catch.
2. **Chess** (two players). Blue Dolphin Games, Box 9632, Fort Lauderdale, FL 33310, \$15.95—\$17.95 by mail. This game is so



Best general games: clockwise from top left, Football Fever, A Question of Scruples, Aerobie, Stage II, Chess, Last Word, Megapido, Supremacy. Not pictured: Clue VCR Mystery Game.

simple you wonder why you didn't think of it yourself. But you didn't. Tom Kruszewski did. Play is on a hexagonal grid using dice as pieces: green dice for me, red dice for you. The dice move along hex rows according to the number of spots they show upmost. Your team of dice (you start with 9) must total 25. The object is to capture two of your opponent's dice so that his four remaining can't add up to a total of 25. On any turn, you may move a die or exchange the speeds of two dice—turning a 2 into a 5, and a 4 into a 1, for example. This adds an exciting dimension. A pair of pieces that are powerless on this turn can become deadly on the next. For a game with such simplicity, Chess has surprising depth and unexpected levels of strategy. The similarity between the name Chess and chess is not accidental.- 3. **Clue VCR Mystery Game** (two or more players, Parker Brothers, \$40). Those old favorites are back—Miss Scarlet, Colonel Mustard, Professor Plum, and the rest. This is an updated version of the classic board game but now with a 60-

minute videotape (VHS or Beta) showing selected scenes between the principals. Watch it closely for important facts about the murderers, victims, rooms, and weapons. Later you may learn that "the person who carried the rope was killed in the conservatory," and a good memory will put you well ahead. The butcher, Dick, introduces the rules and leads you through a sample game on the tape. There are 18 different cases to solve, so the game can be played many times. One problem is that first-time players will find themselves at a distinct disadvantage against those who have seen previous parts of the tape and already recognize the lead characters. And you'll have to do without playing with the traditional models of weapons, such as the wrench and the lead pipe.- 4. **Football Fever** (two players, Orbis Marketing, 490 Lakeville Street, Suite 225, Pelham, CA 94652, \$39.95—\$43.45 by mail). We are tempted to pick this game merely for its production values. For the price, you get a full-covered, background-movie board, a varnished wood pagewood



Mental Blocks: a combination of puzzle and art



Eight of the ten best computer games of the year. Reviews for all ten start on page 148

in which to place timekeeping pieces, and a bag of multicolored 4-, 6-, 8-, 10-, 12-, and 20-sided dice with which you simulate the vagaries of a real football game. The rule book is long—291 pages—but most of the rules turn out to be easily memorizable if you know the rules of real football. The game is very well thought out, with contingencies provided for such events as a blitz, bomb, fake punt, field goal, onside kick, and fumble recovery, all with probabilities that are remarkably close to those of a real game.

5. **Last Word** (two to four players, Milton-Bradley, \$12) This word-games/strategy game is a combination of Boggle and Isolation. Real word-game fanatics may think there is too much strategy and not enough word knowledge involved. Imagine a 10-by-10 Boggle board on which you can begin making words from any square on your side, moving orthogonally or diagonally, and that you remove letters from the board as soon as you pass over them. The object is to collect as many letters as possible and to isolate your

opponent so that he can't make a word and you can—the last word. This is an imaginative and original idea, with typical Milton-Bradley high-quality production and a reasonable price.

6. **Megadodo** (two or three players, Global Games, East 8112 Sprague Avenue, Spokane, WA 99212, \$17.95—\$20.45 by mail) We like games that are simple to learn and to teach, and this one qualifies. It is reminiscent of go-moku or Pentix. You can win by either getting six stones in a row or by capturing six opponents' stones. On the circular board you can place six stones along a spoke in a circular orbit around the center or in a spiral that starts at the center and moves out one orbit and along one spoke each step. You capture opponents' stones Pentix-way, by flanking two at a time, then replacing them with your own. A revised rule allows you to assume that the board is doughnut shaped and that opponents' stones can be captured by a "wraparound" along the spokes of the torus.

7. **Mental Blocks** (Penguin Books, 200 Madison Avenue, New York, NY 10016, \$17.50—\$19 by mail) Don't look for months of entertainment from this "puzzle and game." After you show it to a few despondent friends you may decide to leave it on the shelf. But it is an absolutely new and original concept in geometry and art, and we can't resist plugging it. You start with 15 small paper cubes, each colored on all sides, in a 4-by-4 arrangement on the table. They make a coherent picture with all pieces fitting together. If you pick up the entire top row of blocks (by exerting finger pressure on the two outermost blocks), give it a quarter turn toward you, and replace it at the bottom of the design, you will extend the picture down a row. You can repeat the three more times, each time exposing a new view. Then you can move the columns from left to right, again with a quarter turn each time, to extend the picture in that direction. In effect, there is a large 8-by-12 painting (called *The Black Party*) ingeniously designed so that it wraps around top to bottom and left to right, and the blocks give you only a 4-by-4 "window" at any time, which you can move

around the painting to look at any part. You can take any face of any cube and designate it as the top left corner, say, and then place the other 15 cubes appropriately, so there are a total of 6×16 , or 96 different windows.

The inventors of Mental Blocks, Jackie Lambert and Jeffrey Samborski, of Richmond, Virginia, originally hand-painted their puzzles on solid maple blocks. With prices in the \$200 range, they were out of reach for all but serious collectors. The version on stiff paper is an affordable introduction to the novel idea. The cubes come preassembled, packed correctly side up in a box, with an instruction booklet that includes suggested games and variations and a copy of the master painting on the cover.

8. **A Question of Scruples** (four to eight players, Maruca Industries, \$18) This isn't a game in the usual sense, but it is a hall of a conversation opener at parties. You are dealt one answer card—no, say (or yes or otherwise)—and five question cards, posing such dilemmas as: (1) A friend asks you to write a letter of reference. You feel hesitantly qualified for the job. Do you refuse? (2) Would you tell a friend that his or her fiancé or fiancée is making advances at you? (3) \$9 in quarters comes spilling out of a pay phone. Do you report it?

Your job would be to pick the opponent most likely to give you a "no" answer. If an answer is challenged, players debate whether a question was answered truthfully and decide by a vote. The fun is in discussing those little moral dilemmas that we face every day but don't often talk about. That subject matter can be absolutely addicting. There are only 245 questions so a second edition is called for. 9. **Stage II** (two or more players, Milton-Bradley, \$30) The title is well chosen. This is the second stage of trivia games (the instruction booklet even says, "Once you've played Trivial Pursuit, you're ready for Stage II"), and the object is not only to get the answers right but to figure out a theme for all six trivia answers in a given round. Answer a question correctly and take a one-point chip from the pot (no penalty for wrong guesses); then guess the theme

correctly and take whatever is left in the pot (with a one-point penalty for guessing wrong). For example: What kind of ball is a baseball pitched at the batter's head? What's the last name of the cowboy who chased villains on his faithful horse Topper? What magazine does Larry Flynt publish? Which author of one of the Gospels studied medicine? What's the first name of the author who wrote the novel *To Kill a Mockingbird*? What's the abbreviation of the department of government that's been headed by George Romney and Samuel Pierce?

After a few rounds we gained great respect for the writers of these questions. They inspired very few arguments (and magazine editors are notorious know-it-alls), and their "theme" answers seemed fair and satisfying. In the case of the series above, the writers had to come up with questions that would lead to these answers: Bean(ball) (Hoping), Cassidy, Kuster, Luke, Harper (Live), and HUD. That task isn't easy, but it's necessary if anyone is to get to Stage II—that all answers are 100 characters played by Paul Newman. The writers should have gotten a byline.

10. **Supremacy** (two to six players). Supremacy Games, Box 533, Buffalo, NY 14209, \$39 plus \$2.50 postage. This board game will appeal to lovers of Risk or Diplomacy. The players control up to six superpowers: the United States, the Soviet Union, China, Eu-

rope, Africa, or South America. The game is set in the future; all powers start with equal strength. With fewer than six players, the unused areas of the world become neutral. The game box, board, and logo are all beautifully designed.

This is a game of military and/or economic conquest. You can win in the traditional way by invading and conquering, or more subtly and shrewdly by buying or selling supplies of oil, grain, or minerals, driving up or down the price of these necessities for future rounds of play, thus bankrupting the opponents. As with real warfare, you need grain to move an army over land, you need oil to move a navy or to airlift an army to a new territory, and you need minerals to build new forces and weapons. This is the sort of game that can easily take a whole evening just to get the rules straight and to play the first few rounds. After that, you can try out various strategies long enough to make you eligible for a cabinet post.

BEST COMPUTER GAMES

In the world of computers, there were fewer games from which to pick this year's top ten yet their quality seems to have doubled. For each of the five computer systems—Amiga, Apple II, Commodore 64, IBM PC, and Macintosh—we have chosen two programs as being the most fun to play with on these machines. Many of these are available for the other computer systems, too.

FOR AMIGA. The Amiga is so new that there is no game software yet. We previewed the following pair of very playful and exciting programs, however.

GraphCraft, which Commodore will sell specially for the Amiga, is a free-form drawing/engraving program and the flagship of the system, utilizing the increased power of the next generation of home computers.

Unique to this program, you can custom-tailor a palette of 32 active colors from the Amiga's range of 4,096. So, for example, to build yourself a palette of 32 Caribbean pinks, you can simply enter two different shades of pink for the extremes, and the program does the rest.

GraphCraft contains many singular features that help to automate the creative process. The most interesting option—cycle draw—lets you draw with a brush that changes color automatically.

Harmony (\$80 from Cherry Lane Technologies) is a brilliant program that makes the Amiga into a musical accompanist. It is like sitting in with a quartet of musicians who never lose patience with the claims you occasionally hit.

The fun begins when you select a part to play and the other parts play along with you. When you speed up, the other four musicians speed up to match your tempo. Play softer and they all play softer.

It's a great teacher, too. Harmony is based on the principle that when you don't sound



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good, the rest of the band isn't so hot either. So it's practice or stink.

FOR APPLE II: Under the category of Best Fantasy Role-Playing Computer Game of the Year comes *Ultima IV: Quest of the Avatar* (\$30, from Origin Systems). It is a strategic quest, filled with battles and magic and strange adventures in a mythical land.

Your personality is part of the game. Initially, you are asked a series of difficult questions, such as, "You are entrusted on a royal mission to deliver a large bag of gold when you meet a poor beggar asking for a single coin. Do you toss him one or remain faithful to your mission?"

Once you've answered the questions, the computer determines your characteristics, and for the rest of the game it keeps tabs on traits such as compassion and loyalty. Everything you do affects these traits, though you have no way of knowing how close you are to solving the puzzles until you actually solve them.

Marball (\$35, from Accolade) is a two-player computer baseball game with such realistic strategy and graphics that you may find yourself standing on your feet and cheering your man along.

The balling screen displays a view from just behind the pitcher plus a small window showing fielders and base runners. To pitch you first select from an extensive repertoire of deliveries, including off-speed, slider, change-up or curve. Then you add an option of high, low, inside or outside. The result is a range of 16 pitches that you can throw, from meatballs to garbage.

Once the ball has been hit, the screen pans the field to pick up the action, and the player nearest the ball is automatically under joystick control. Throwing puts the burden of coordination on you, however. The winners are not necessarily the player with better reflexes, but the one who knows more about baseball strategy.

FOR COMMODORE 64: Hacker (\$30, from Activision) is a clever program that straddles the fine line between game and reality. The scenario reads like a story from today's newspaper about teenagers cracking corporate computer systems.

The screen is blank at the start except for one message: LOGON PLEASE. You don't know what to do, but you try typing HALLO, or your name, or something else. The computer responds with your first clue: LOGON PASSWORD HAS BEEN CHANGED...CURRENT PASSWORD IS LOCATION OF T82T SITE.

You don't know much more when, after repeated guesses at the password, the computer begins to disconnect you. But, miracle of miracles, their security system malfunctions and you slide in undetected. You know you shouldn't be here, but as long as you are.

You can remain undetected by security for only a short time, though you can learn tricks to fool the system into thinking that you are an authorized operator. There are no instructions included with Hacker. You must

discover them through careful observation which is exactly the way true life hackers must go about things.

Project Space Station (\$40, from HiWare) is an authentic science simulation involving the planning, design, launch, and operation of a manned space station—in short, a mission simulator.

The first stage involves getting a shuttle mission approved and funded by NASA. You'll have to stick to budget in your selection of crew, equipment, and space-station modules, then actually launch and control the shuttle's flight into orbit. And every detail counts, right down to the personalities of individual crew members.

You will return to Earth for extra funding and to pick up one of 40 different research projects to earn even more money. Unlike most computer games, there is no single structured goal, nor is there necessarily an end to your space odyssey if you plan things effectively enough.

FOR IBM PC/PCJR: Software Golden Oldies (\$30, from Software Country). The title may sound something like an easy-to-refuse offer from K. I. L. Records, but it is actually an excellent bargain, a collection of four popular games. And each of the four programs, originally developed on university mainframe computers, is enjoyable in its own very different way.

For \$30 you get the original *Adventure*, *Eliza*, *Life*, and *Pong*. Yes, the programs are old, but they're classics, and like old Elvis 45s, they seem timeless. Besides, *Software Golden Oldies* contains the original code for the programs, the only such collection.

Adventure and *Pong* started the computer video-game revolution, the former being a test of mental prowess that begat an entire genre of interactive fiction; the latter, a test of dexterity that led to the rise of coin-op arcade.

Eliza is the early artificial-intelligence program that turns the computer into a drudge and often humorous psychiatrist. It is a silly program, but everyone gets a kick out of it. *Life* (see Games, October 1984) is more a serious effort, visually demonstrating methods of generating random patterns. Neither is a game as much as a puzzle or an amusement, but both are equally enjoyable alone and in social situations.

A more solitary endeavor but no less engrossing is *Wizard of Wall Street* (\$45, from Synapse), a real-time simulation of trading in the stock market. Warning: If you have no particular interest in financial matters or in how money is used to make more money by investing it in paper, don't bother with *Wizard of Wall Street*.

Before you know it, you'll be buying on margin, selling short and conducting elaborate market research on a company's BEA numbers—or you won't be making much money.

Three skill levels increase the challenge by giving you access to more money at greater degrees of risk, though the beginner's game is difficult enough for most people.



PHENOMENA

A crystallized sea of red desert sand in Arizona's Monument Valley sparkles with the last of morning light in this picture by landscape photographer Kathleen Noma Cook. "I was on a pre-dawn photo reconnaissance of the area," Cook explains. "There was no breeze that morning, so every grain of sand was still in place from the evening before, when the wind had sculpted the face of the dunes. As the sun came up and the light began to hit the desert, I suddenly saw the sand sparkle as if it were covered with diamonds. The effect was caused by frost, which is very unusual in such an arid place." Quickly, Cook grabbed her camera and began photographing this ephemeral scene. "The frost was evaporating before my eyes as I shot. In less than two minutes all of it was gone. It was a rare photographic experience," recalls Cook, who used a Pentax 6x7 camera loaded with Ektachrome 64 film to record what she describes as "the special gift from nature." **GG**



LAST WORD

By Parker Bennett

☛ Hate cola, the cola you hate to love, has twice the sugar, five times the carbonation, and thirty times the caffeine of regular cola ☛

It happened sometime in the Seventies. Maybe it was the UFOs. Or a communist plot. No one is sure, but somehow our favorite products began to undergo subtle, helpless changes. They got lighter, kinder, kinder in alcohol, lower in calories. Some got decaffeinated.

That's right, the sodium, the cholesterol—all the substances that made our favorite products, well, our favorites—were removed, reduced, or replaced.

But now, thanks to R&D and men like him, America has come to its senses. We're not going to take it anymore. We're products are out. Americans are demanding power, glucose, "headier" products, and manufacturers have more than met the corporate research labs to satisfy this demand.

A sampling of some of the newer products we can look forward to:

WHITE COLA. Although the cola wars have subsided, the appearance of "hats" will set off a new round of battles because of its special formula and its unique sales campaign. "You don't need caffeine, but you're goddamn well gonna get it! Introducing Hite, the cola you hate to love."

It has twice the sugar, five times the carbonation, and 30 times the caffeine of regular cola. Let's face it: Your body needs the caffeine, you enjoy burping, and a cola just isn't a cola unless it has enough processed sugar to risk a wedding cake DENSE BEER. The long regional nightmare is over. Real beer is back. The light beers and low-alcohol exposures are now listed chiefly to water the house plants. Available everywhere. See, discovering that beer is Good Food.

And so there will be Dense beer. Great taste, more filling. It's everything you've always wanted in a beer—and then some. Dense beer is made with 30 percent pure grain alcohol—to get you drunker faster—and plenty of real beer sediment giving you 42 times the calories of regular beer. Best of all, Dense Beer will really fill you up because it is brewed with heavy water, used directly to the brewery from two rivers, nuclear power plant.

SCOTCH COOLERS. Like its wimpy counterpart, the soon-to-be extinct wine cooler, the Scotch cooler is a refreshing, lightly carbonated alcoholic beverage, but it's not only Scotch and taste, it's alcohol and only a little less in a convenient 12-ounce bottle with a handy twist-off cap. This is just the beginning of a new line of products. Stay looking for Bourbon coolers, polka-meister coolers, and double-malts coolers in handy six-packs.

RECAFFEINATED COFFEE. If you love the taste of decaffeinated coffee but miss the caffeine, this is the coffee for you. Through a costly and time-consuming process, the caffeine is first removed from the beans for that light, decaffeinated flavor. Later, while the beans are being ground, an

even costlier and more complicated process moves in nappies of pure caffeine. Sure, it costs a whole lot more, but with that great taste and at least twice the zip of regular coffee, it will be worth it.

SUGARDOS. Is it a cereal? Is it a candy? It's hard to tell what you bite into these delicious, crunchy-sweet rings of sugar-trapped sugar. People can't seem to get enough sugar, which will only a huge surge in popularity when NutraSweet is banned by an act of Congress.

Sugarbites are the answer. They're made with the golden goodness of glucose, and they're fortified with 12 essential sweeteners. Any time is great for Sugarbites, the fast-prosestified cereal that is carb-sweetened, too.

GRANOLA-FREE CANDY. For the past decade granola has indolently crept into the candy aisle, multiplying and muting until it has even started to resemble candy—digging itself into peanut butter, chocolate chips, even marshmallows. Now the candy industry is fighting back. Candy bars are proudly displaying the obvious, more subtle on their wrappers. Let's hope they win the fight and that future generations will never have to experience the horrors of granola.

WORTH-WATCHERS FROZEN DINNERS. They may not look like much at first, but these babies really pack a punch. Because of the latest breakthroughs in food-combination technology, each Worth-Watchers frozen dinner has all the calories of an eight-course meal and twice the minimum daily requirements of carbohydrates and calories total. Plenty of salt, too.

Take the Meat and Potatoes Special, for example. This is no silly entree but a full-blown, gut-slanching feast it comes with red meat (artificially colored with red dye numbers one and two), mashed potatoes, butter, and four different desserts (none made with either natural substances or a flick of granola). The wonders of food technology are such as producing other heavy delights: Mean Cuisine: Mean Meat, the Angry Meat Dinner, and the Beginning Gourmet.

LEAD-BYTES GASOLINE. If God had meant for gasoline to be unleaded, he wouldn't have created the V-8 engine. Furthermore, with the return of the American muscle cars—the Corvette, the Mustang GT, the V-12 Chevrolet—regular gas, even premium, just doesn't make it. That's why lead technology has produced one lead speed-dangerous gas for dangerous cars. This high-lead fuel boosts the octane, reduces engine knock, and the fumes dense enough to shield you from radiation in the event of a nuclear blast. ☐

Parker Bennett is a "heavy" freelance writer from Chicago who has twice been rejected after a few regular contributors.