1. ... will reflect the spirit of the Paradigm Shift, wherein the focus will shift from the *number to the essential conditions for population stabilisation* such as Gender Equality and Equity, Reproductive Rights and Reproductive Health, Family: its Structure and Role, Health and Education, Sustainable Development and so on. It will highlight the individual needs instead of demographic targets and reflect the shift from purely population control approach to a broader sustainable development approach.

2. The reconceptualised framework will be based on the understanding of the role of education as a means to promote greater responsibilities and awareness of the interrelationships between population and sustainable development. It will also highlight the criticality of education as an essential condition for population stabilisation.

3. The new framework will incorporate elements of adolescence education as one of its major components and will provide comprehensive treatment to Process of Growing Up, HIV/AIDS and Drug Abuse. It will aim at providing authentic knowledge to learners in respect of these sensitive areas and developing among them rational attitude and responsible behaviour.

4. Population education will be conceptualised as a truly educational programme and not as an adjunct to IEC approach, though it will also make use of interventions being made under IEC programmes for reinforcing and strengthening the educational process and creating a congenial social environment.

5. Since the fresh reconceptualisation of population education is being attempted at for the first time after Revised National Policy on Education-1992, which provides population education a distinct place the policy directions given by it will be reflected in the Reconceptualised Framework of Population Education.

Major Components of Reconceptualised Population Education:

The reconceptualised population education will have the following components which would constitute the base for developing its scheme of contents :

(a) **Family Life** : Structure and Role of Family, Basic Needs, Shared Rights and Responsibilities, Responsible Parenthood, the Girl Child and the Female Members-their prime place

(b) **Gender Equality and Equity**: Education, Health Care and Employment Opportunities outside home for Women, Reproductive Rights and Reproductive Health, Male Responsibilities

(c) **Adolescents and Reproductive Health**: Process of Growing Up, Sexual Health and STDs, HIV/AIDS and Drug Abuse

(d) **Health and Education**: Health, Nutrition and Population, Infant Child and Maternal Health, Safe Motherhood, Literacy and Female Literacy

(e) **Sustainable Development**: Population Situation, Sustained Economic Growth, Consumption, Resource Development, Population, Resources, Technology, Environment and Development

(f) **Urbanisation and Migration**: Population Distribution, Future Directions, Internal and International Migration

Strategies and Modalities :

The changes reflected in the conceptual framework of population education will require identification and adoption of non-traditional strategies and modalities of curriculum transaction. The first task will be to conduct advocacy oriented activities for eliminating inhibitions and apprehensions against adolescence education among parents, teachers and all other educational functionaries. It will also be essential to interact with educational administrators at decision-making level. Suitable strategies will be employed to

MARCH 10, 1997

TIME

FICTION BONUS:
"CLONE ON THE RANGE"
BY DOUGLAS COUPLAND

Will There Ever Be Another You?

A SPECIAL REPORT ON CLONING

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BIZ WATCH

In Deng's Debt

Put this in the asset column of China's late paramount leader Deng Xiaoping: his market reforms helped make China one of America's biggest creditors. Awash in dollars from exports, China now buys more U.S. Treasurys than even the Japanese—$12.1 billion in U.S. notes and bonds through the first nine months of 1996,vs. the $11.6 billion Japan purchased. China owns more than $43 billion of U.S. Treasury debt, the world's fifth largest hoard, and moving up.

By investing in Treasurys, China is helping keep U.S. interest rates low. On the other hand, money talks, and the Chinese might get louder when it comes to settling touchy disputes on trade—or Taiwan. Much louder. Last month Washington reported that America's trade deficit with China jumped to an all-time high in 1996 to $39.5 billion, a gap expected to widen, giving the Chinese yet another fistful of dollars with which to go shopping for U.S. bonds.

He Planned It. He Did It. Meet the New King of Cars

H. WAYNE HUIZENGA IS DRIVing in the passing lane. Since Jan. 1, the billionaire entrepreneur has gone from neophyte car man to the nation's biggest car retailer. His Republic Industries has bought up new- and used-car dealerships whose revenues totaled $2.7 billion last year. That will make Republic bigger than current numero uno Hendrick Automotive Group of Charlotte, North Carolina, with $2.3 billion, *Automotive News* reports. TIME first detailed Huizenga's plans for a

MICHAEL SCHWARZ—GAMMA LIAISON

BIG DEALER: Wayne Huizenga

dealership-acquisition binge in December. Then, Huizenga, 59, had little more than a blueprint and a shopping list.

Now, the man who built Blockbuster and trash collector Waste Management has acquired 36 dealers for about $550 million in stock. He's also opened seven AutoNation and three ValuStop used-car lots. Wall Streeters expect him to spend $5 billion in three years buying dealerships, consolidating yet another mom-and-pop industry.

An Ambassador's Misfortune

HOW DO YOU CREATE A SMALL fortune? Start with a large one. The late Pamela Harriman, British-born U.S. ambassador to France, went through money faster than husbands, and her amazing social and political skills stood in stark contrast to her investing acumen. She seems to have squandered most of the more than $100 million she inherited from her third husband, New York Governor and Ambassador W. Averell Harriman. Her estate: some $15 million to $20 million, mostly in jewelry, property and art.

The Democratic doyen had already paid more than $10 million to Averell's heirs, who had accused her and her advisers of blowing $40 million outright, including $20 million on a doomed hotel project in New Jersey. She also spent lavishly on herself. Alas, she didn't die smartly either. According to the *Washington Post*, she did not set up a trust to shelter the estate from taxes, so her heirs will receive a hefty bill from the IRS.

J. COLBURN—PHOTOREPORTERS

Harriman

The Rich Are Indeed Different

BILL GATES MAY BE THE richest American, but even he can complain that $15 billion ain't what it used to be. According to *The Wealthy 100: A Ranking of the Richest Americans, Past and Present*, by Michael Klepper and Robert Gunther, Gates ranks a mere 31st. He is ahead of the modest Mark Hopkins, one of the powers who built the Central Pacific Railroad, just behind meat-packer Philip Armour, and way, way behind John D. Rockefeller at No. 1.

PHOTOILLUSTRATION BY STEVE HART; GATES BY AFP

Gates doesn't figure to threaten old John D. The authors determined the standings by looking at the tycoons' fortunes in relation to the country's total GNP. So even if Gates ratchets up the billions, the immensity of the economy makes it hard for him to move up very far. By the way, with the exception of Sam Walton of Wal-Mart (No. 14), everyone on the list ahead of Gates made most or all of his fortune before there was an income tax. Other living Americans on the list: Warren Buffett (39), John Kluge (70), Paul Allen (75), Sumner Redstone (87) and Ron Perelman (95).

—BY BERNARD BAUMOHL, DANIEL KADLEC, VALERIE MARCHANT, CHRISTOPHER OGDEN, STACY PERMAN AND BILL SAPORITO

ONE DOESN'T EXPECT Dr. Frankenstein to show up in wool sweater, baggy parka, soft British accent and the face of a bank clerk. But there in all banal benignity he was: Dr. Ian Wilmut, the first man

to create fully formed life from adult body parts since Mary Shelley's mad scientist.

The creator wore chinos. Wilmut may not look the part, but he plays it. He took a cell nucleus from a six-year-old ewe, fashioned from it a perfect twin—adding the nice Frankenstein touch of passing an electric charge through the composite cell to get it growing—and called it Dolly.

Dolly, the clone, is an epochal—a cataclysmic—creature. Not because of the technology that produced it. Transferring nuclei has been done a hundred times. But because of the science. Dolly is living proof that an adult cell can revert to embryonic stage and produce a full new being. This was not supposed to happen.

It doesn't even happen in amphibians, those wondrously regenerative little creatures, some of which can regrow a cut-off limb or tail. Try to grow an organism from a frog cell, and what do you get? You get, to quote biologist Colin Stewart, "embryos rather ignominiously dying (croaking!) around the tadpole stage."

And what hath Wilmut wrought? A fully formed, perfectly healthy mammal—a mammal!—born from a single adult cell. Not since God took Adam's rib and fashioned a helpmate for him has anything so fantastic occurred.

What, then, was the reaction to this breakthrough of biblical proportions?

There is a mischievous story (told mostly in England) that a leading Scottish newspaper reported the *Titanic* sinking with the headline GLASGOW MAN LOST AT SEA. Well, here was a story that deserved the headline MAN CREATES LIFE. And how does it play? A *Wall Street Journal* headline urgently asks, WHO WILL CASH IN ON BREAKTHROUGH IN CLONING? (Answer: "Tiny company could emerge a big winner.") The President of the U.S. calls for a committee of experts to gather and pull their beards.

And the New York *Times*, in a lovely coda to its editorial titled CLONING FOR GOOD OR EVIL, advises that "society will need to sort through what is acceptable and what is the nightmare beyond."

Well, yes. The most portentous scientific achievement since the explosion of the first atomic bomb will need a weighing of pros and cons. No kidding.

And, no doubt, the pro-and-con weighing, the pontificating and the chin pulling will now go into high gear. Wilmut will spawn more ethics conclaves than cloned sheep. No matter. There is nothing to stop cloning, not even of humans.

What the politicians do not understand is that Wilmut discovered not so much a technical trick as a new law of nature. We now know that an adult mammalian cell can fire up all the dormant genetic instructions that shut down as it divides and specializes and ages, and thus can become a source of new life.

You can outlaw technique; you cannot repeal biology. And even the outlawing of this technique—Britain, for example, forbids the cloning of humans—will fail. It is too simple, too replicable. No amount of regulation by the U.S. government will stop it.

Why? Not just because it is so easy, but because its potential for good is so immense. The study of cloning can give the world deep insights into such puzzles as spinal cords, heart muscle and brain tissue that won't regenerate after injury, or cancer cells that revert to embryonic stage and multiply uncontrollably. Replicating Wilmut's work will elucidate what he along the way did right that nature, in these pathologies, does wrong.


REUTERS

Of course, the potential for evil is infinitely greater. But there will be no stopping that either. Ban human cloning in America, as in England, and it will develop on some island of Dr. Moreau. The possibilities are as endless as they are ghastly: human hybrids, clone armies, slave hatcheries, "delta" and "epsilon" sub-beings out of Aldous Huxley's *Brave New World*.

But you don't have to be mad to be tantalized. Being human will do. Think of it: what Dolly—fat, insensible Dolly—promises is not quite a second chance at life (you don't reproduce yourself; you just reproduce a twin) but another soul's chance at *your* life. Every parent tries to endow his child with the wisdom of his own hard-earned experience. Here is the opportunity to pour all the accumulated learning of your life back into a new you, to raise your exact biological double, to guide your very flesh through a second existence.

Oh, the temptation to know what might have been. Or to produce an Albert Einstein, a Martin Luther King, for every generation. Or to raise a Thomas Jefferson in an artificial environment recreating 18th century Virginia. Create, nurture and wait. Then bring him out one day, fully grown, to answer the question of the ages: What would Jefferson do today?

—CHARLES KRAUTHAMMER

THE AGE OF CLONING

A line has been crossed, and reproductive biology will never be the same

By J. MADELEINE NASH

EVEN NOW, A WEEK AFTER news of the achievement first flew around the globe, traces of astonishment linger in the air like a contrail. The landmark paper published late last week in the journal *Nature* confirmed what the headlines had been screaming for days: researchers at the Roslin Institute near Edinburgh, Scotland, had indeed pulled off what many experts thought might be a scientific impossibility. From a cell in an adult ewe's mammary gland, embryologist Ian Wilmut and his colleagues managed to create a frisky lamb named Dolly (with apologies to Ms. Parton), scoring an advance in reproductive technology as unsettling as it was startling. Unlike offspring produced in the usual fashion, Dolly does not merely take after her biological mother. She is a carbon copy, a laboratory counterfeit so exact that she is in essence her mother's identical twin.

What enabled the Scottish team to succeed where so many others have failed was a trick so ingenious, yet so simple, that any skilled laboratory technician should be able to master it—and therein lies both the beauty and the danger: once Wilmut and his colleagues figured out how to cross that biological barrier, they ensured that others would follow. And although the Roslin researchers had to struggle for more than 10 years to achieve their breakthrough, it took political and religious leaders around the world no time at all to grasp its import: if scientists can clone sheep, they can probably clone people too.

Without question, this exotic form of reproductive engineering could become an extremely useful tool. The ability to clone adult mammals, in particular, opens up myriad exciting possibilities, from propagating endangered animal species to producing replacement organs for transplant patients. Agriculture stands to benefit as well. Dairy farmers, for example, could clone their champion cows, making it possible to produce more milk from smaller herds. Sheep ranchers could do the same with their top lamb and wool producers.

But it's also easy to imagine the

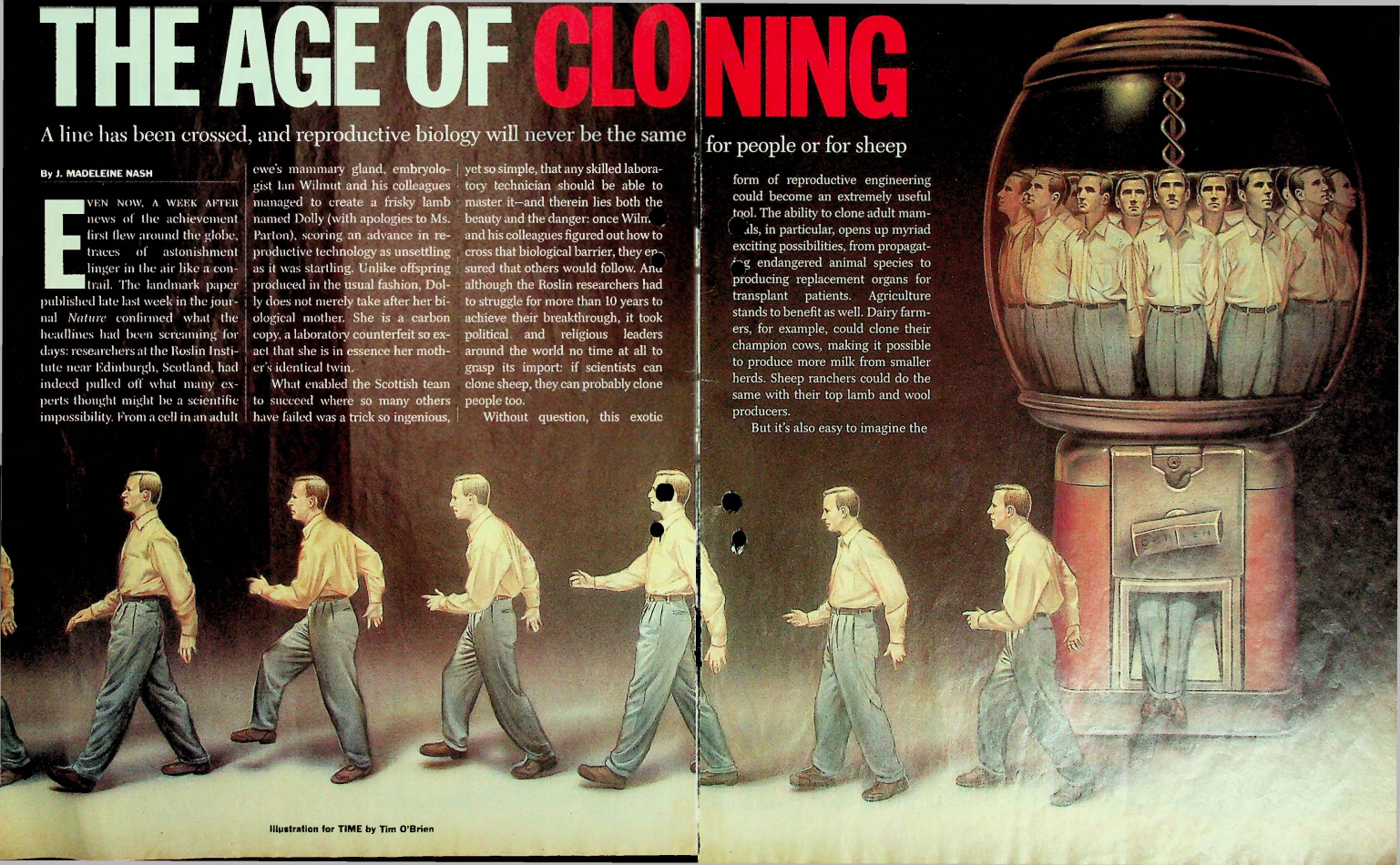
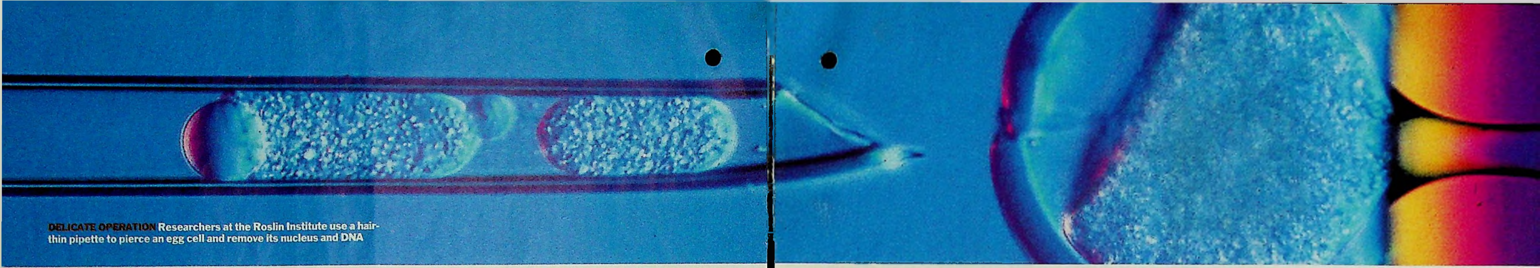


Illustration for TIME by Tim O'Brien



DELICATE OPERATION Researchers at the Roslin Institute use a hair-thin pipette to pierce an egg cell and remove its nucleus and DNA

WILLIAM RITCHIE—ROSLIN INSTITUTE

technology being misused, and as news from Roslin spread, apocalyptic scenarios proliferated. Journalists wrote seriously about the possibility of virgin births, resurrecting the dead and women giving birth to themselves. On the front page of the New York *Times*, a cell biologist from Washington University in St. Louis, Missouri, named Ursula Goodenough quipped that if cloning were perfected, "there'd be no need for men."

Scientists have long dreamed of doing what the Roslin team did. After all, if starfish and other invertebrates can practice asexual reproduction, why can't it be extended to the rest of the animal kingdom? In the 1980s, developmental biologists in Philadelphia at what is now Allegheny University of the Health Sciences came tantalizingly close. From the red blood cells of an adult frog, they raised a crop of lively tadpoles. These tadpoles were impressive creatures, remembers University of Minnesota cell biologist Robert McKinnell, who followed the work closely. "They swam and ate and developed beautiful eyes and hind limbs," he says. But then, halfway through metamorphosis, they died.

Scientists who have focused their cloning efforts on more forgiving embryonic tissue have met with greater success. A simple approach, called embryo twinning (literally splitting embryos in half), is commonly practiced in the cattle industry. Coaxing surrogate cells to accept foreign DNA is a bit trickier. In 1952 researchers in Pennsylvania successfully cloned a live frog from an embryonic cell. Three decades later, researchers were learning to do the same with such mammals as sheep and calves. "What's new," observes University of Wisconsin animal scientist Neal First, "is not cloning mammals. It's cloning mammals from cells that are not embryonic."

EMBRYO CELLS ARE INFINITELY EASIER to work with because they are, in the jargon of cell biologists, largely "undifferentiated." That is, they have not yet undergone the progressive changes that turn cells into skin, muscles, hair, brain and so on. An undifferentiated cell can give rise to all the other cells in the body, say scientists, because it is capable of activating any gene on any chromosome. But as development progresses, differentiation alters the way DNA—the double-stranded molecule that makes up genes—folds up inside the nucleus of a cell. Along with other structural changes, folding helps make vast stretches of DNA inaccessible, ensuring that genes in adult cells do not turn on at the wrong time or in the wrong tissue.

The disadvantage of embryonic cloning is that you don't know what you are getting. With adult-cell cloning, you can wait to see how well an individual turns out before deciding to clone it. Cloning also has the potential to make genetic engineering more efficient. Once you produce an animal with a desired trait—a pig with a human immune system, perhaps—you could make many copies.

In recent years, some scientists have speculated that the changes wrought by differentiation might be irreversible, in which case cloning an adult mammal would be biologically impossible. The birth of Dolly not only proves them wrong but also suggests that the difficulty scientists have had cloning adult cells may have less to do with biology than with technique.

To create Dolly, the Roslin team concentrated on arresting the cell cycle—the series of choreographed steps all cells go through in the process of dividing. In Dolly's case, the cells the scientists wanted to clone came from the udder of a pregnant sheep. To stop them from dividing, researchers starved the cells of nutrients for a week. In response, the cells fell into a slumbering state that resembled deep hibernation.

At this point, Wilmut and his colleagues switched to a mainstream cloning technique known as nuclear transfer. First they removed the nucleus of an unfertilized egg, or oocyte, while leaving the surrounding cytoplasm intact. Then they placed the egg next to the nucleus of a quiescent donor cell and applied gentle pulses of electricity. These pulses prompted the egg to accept the new nucleus—and all the DNA it contained—as though it were its own. They also triggered a burst of biochemical activity, jump-starting the process of cell division. A week later, the embryo that had already started growing into Dolly was implanted in the uterus of a surrogate ewe.

An inkling that this approach might work, says Wilmut, came from the success his team experienced in producing live lambs from embryonic clones. "Could we do it again with an adult cell?" wondered Wilmut, a reserved, self-deprecating man who likes gardening, hiking in the highlands and drinking good single-malt Scotch (but who was practical enough to file for a patent before he went public).

It was a high-risk project, and in the beginning Wilmut proceeded with great secrecy, limiting his core team to four scientists. His caution proved to be justified; the scientists failed far more often than they succeeded. Out of 277 tries, the researchers eventually produced only 29 embryos that survived longer than six days. Of these, all died before birth except Dolly, whose historic entry into the world was witnessed by a handful of researchers and a veterinarian.

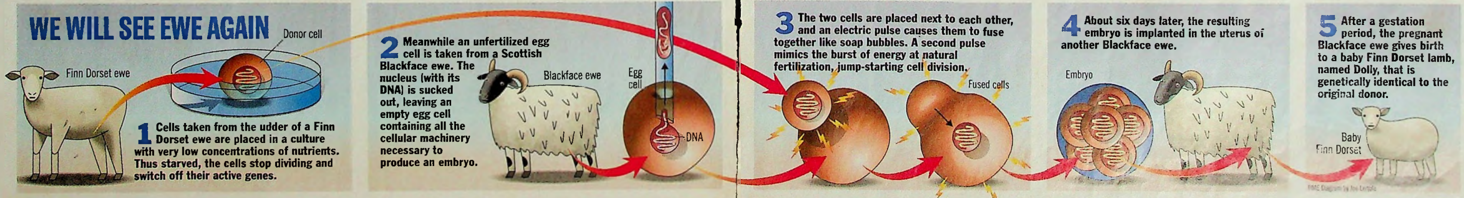
Rumors that something had happened in Roslin, a small village in the green, rolling hills just south of Edinburgh, started circulating in scientific circles a few weeks ago. It was only last week, when the rumors were confirmed and the details of the experiment revealed, that the real excitement erupted. Cell biologists, like everybody else, were struck by the simple boldness of the experiment. But what intrigued them even more was what it suggested about how cells work.

Many scientists had suspected that the key to getting a donor cell and egg to dance together was synchronicity—getting them started on the same foot. Normal eggs and sperm don't have that problem; they come pre-divided, ready to combine. An adult cell, though, with its full complement of genes, has to be coaxed into entering an embryonic state. That is probably what Wilmut did by putting the donor cell to sleep, says Colin Stewart, an embryologist at the U.S. National Cancer Institute. Somehow, in ways scientists have yet to understand, this procedure seems to have reprogrammed the DNA of the donor cell. Thus when reawakened by the Roslin team, it was able to orchestrate the production of all the cells needed to make up Dolly's body.

Like most scientists who score major breakthroughs, Wilmut and his colleagues have raised more questions than they have answered. Among the most pressing are questions about Dolly's health. She is seven months old and appears to be perfectly fine, but no one knows if she will develop problems later on. For one thing, it is possible that Dolly may not live as long as other sheep. After all, observes NCI's Stewart, "she came from a six-year-old cell. Will she exhibit signs of aging prematurely?" In addition, as the high rate of spontaneous abortion suggests, cloning sometimes damages DNA. As a result, Dolly could develop any number of diseases that could shorten her life.

Indeed, cloning an adult mammal is still a difficult, cumbersome business—so much so that even agricultural and biomedical applications of the technology could be years away. PPL Therapeutics, the small biotechnical firm based in Edinburgh that provided a third of the funding to create Dolly, has its eye on the pharmaceutical market. Cloning, says PPL's managing director Ron James, could provide an efficient way of creating flocks of sheep that have been genetically engineered to produce milk laced with valuable enzymes and drugs. Among the pharmaceuticals PPL is looking at is a potential treatment for cystic fibrosis.

Nobody at Roslin or PPL is talking about cloning humans. Even if they were, their procedure is obviously not practical—not as long as dozens of surrogates need to be impregnated for each successful birth. And that is probably a good thing, because it gives the public time to digest the news—and policymakers time to find ways to prevent abuses without blocking scientific progress. If the policymakers succeed, and if their guidelines win international acceptance, it may take a lot longer than the editorial writers and talk-show hosts think before a human clone emerges—even from the shadows of some offshore renegade lab. "How long?" asks PPL's James. "Hopefully, an eternity." *—With reporting by Helen Gibson/Roslin and Dick Thompson/Washington*



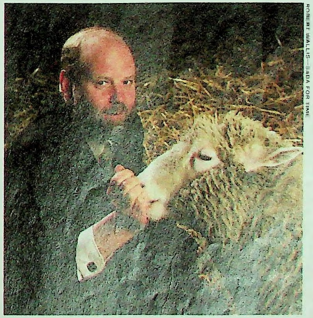
WILL WE FOLLOW THE SHEEP?

By JEFFREY KLUGER

IT'S A BUSY MORNING IN THE CLONING laboratory of the big-city hospital. As always, the list of people seeking the lab's services is a long one—and, as always, it's a varied one. Over here are the parents who have flown in specially to see if the lab can make them an exact copy of their six-year-old daughter, recently found to be suffering from leukemia so aggressive that only a bone-marrow transplant can save her. The problem is finding a compatible donor. If, by reproductive happenstance, the girl had been born an identical twin, her matching sister could have produced all the marrow she needed. But nature didn't provide her with a twin, and now the cloning lab will try. In nine months, the parents, who face the very likely prospect of losing the one daughter they have, could find themselves raising two of her—the second created expressly to help keep the first alive.

JUST A WEEK AFTER SCOTTISH EMbryologists announced that they had succeeded in cloning a sheep from a single adult cell, both the genetics community and the world at large are coming to an unsettling realization: the science is the easy part. It is not that the breakthrough was not decades in the making. It's just that once it was complete—once you figured out how to transfer the genetic schematics from an adult cell into a living ovum and keep the fragile embryo alive throughout gestation—most of your basic biological work was finished. The social and philosophical temblors it triggers, however, have merely begun.

It will be up to science to determine if human cloning can be done. It is up to the rest of us to determine if it should be



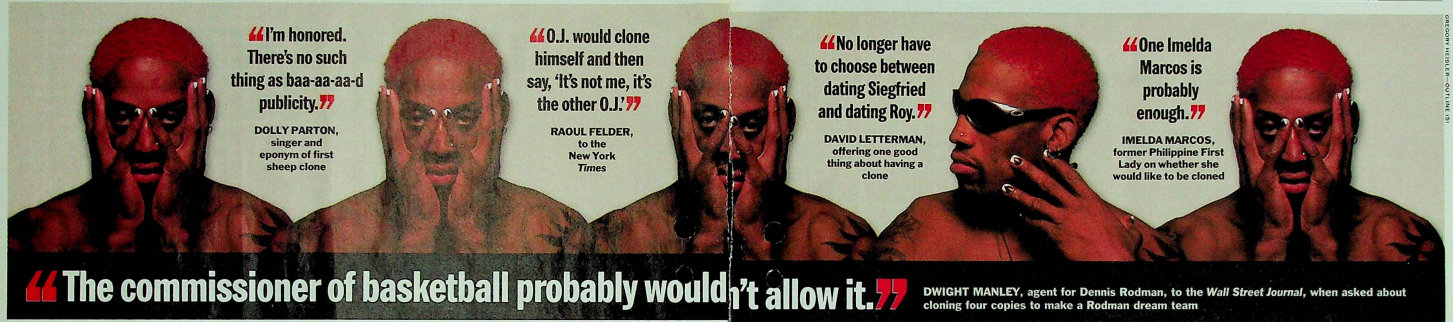
CREATOR AND CLONE Wilmut and the unsuspecting Dolly have made news—and sparked debate—around the world

PHOTOGRAPH BY KEITH DANNEMILLER—SABA FOR TIME

Only now, as the news of Dolly, the sublimely oblivious sheep, becomes part of the cultural debate, are we beginning to come to terms with those soulquakes. How will the new technology be regulated? What does the sudden ability to make genetic stencils of ourselves say about the concept of individuality? Do the ants and bees and Maoist Chinese have it right? Is a species simply an überorganism, a collection of multicellular parts to be die-cast as needed? Or is there something about the individual that is lost when the mystical act of conceiving a person becomes standardized into a mere act of photocopying one?

Last week President Clinton took the first tentative step toward answering these questions, charging a U.S. commission with the task of investigating the legal and ethical implications of the new technology and reporting back to him with their findings within 90 days. Later this week the House subcommittee on basic research will hold a hearing to address the same issues. The probable tone of those sessions was established last week when Harold Varmus, director of the National In-

Illustration for TIME by Matt Mahurin



GREGORY HEISLER—OUTLINE (5)

stitutes of Health (NIH), told another subcommittee that cloning a person is "repugnant to the American public."

Around the globe, the reaction was just as negative. France's undersecretary for research condemned human cloning as "unthinkable," the Council of Europe's Secretary General called it "unacceptable," and Germany's Minister of Research and Technology flatly declared: "There will never be a human clone." Agreed Professor Akira Iritani, an embryology expert at Osaka's Kinki University, "We must refrain from applying [the technique] to human beings."

Though the official responses were predictable—and even laudable—they may have missed the larger point. The public may welcome ways a government can regulate cloning, but what is needed even more is ways a thinking species can ethically *fathom* it. "This is not going to end in 90 days," says Princeton University president Harold Shapiro, the chairman of President Clinton's committee. "Now that we have this technology, we have some hard thinking ahead of us."

ALSO WAITING IN THE CLONING LAB THIS morning is the local industrialist. He does not have a sick child to worry about; indeed, he has never especially cared for children. Lately he has begun to feel different. With a little help from the cloning lab, he now has the opportunity to have a son who would bear not just his name and his nose and the color of his hair but every scrap of genetic coding that makes him what he is. Now that appeals to the local industrialist. In fact, if this first boy works out, he might even make a few more.

OF ALL THE REASONS FOR USING THE NEW technology, pure ego raises the most hackles. It's one thing to want to be remembered after you are gone; it's quite another to manufacture a living monument to ensure that you are. Some observers claim to be shocked that anyone would contemplate such a thing. But that's naive—and even disingenuous. It's obvious that a lot of people would be eager to clone themselves.

"It's a horrendous crime to make a Xerox of someone," argues author and science critic Jeremy Rifkin. "You're putting a human into a genetic straitjacket. For the first time, we've taken the principles of industrial design—quality control, predictability—and applied them to a human being."

But is it really the first time? Is cloning all that different from genetically engineering an embryo to eliminate a genetic disease like cystic fibrosis? Is it so far removed from in vitro fertilization? In both those cases, after all, an undeniable reductiveness is going on, a shriveling of the complexity of the human body to the certainty of a single cell in a Petri dish. If we accept this kind of tinkering, can't we accept cloning? Harvard neurobiologist Lisa Geller admits that intellectually she does not see a difference between in vitro technology and cloning. "But," she adds, "I admit it makes my stomach feel nervous."

More palatable than the ego clone to some bioethicists is the medical clone, a baby created to provide transplant material for the original. Nobody advocates harvesting a one-of-a-kind organ like a heart from the new child—an act that would amount to creating the clone just to kill it. But it's hard to argue against the idea of a family's loving a child so much that it will happily raise another, identical child so one of its kidneys or a bit of its marrow might allow the first to live. "The reasons for opposing this are not easy to argue," says John Fletcher, former ethicist for the NIH.

The problem is that once you start shading the cloning question—giving an ethical O.K. to one hypothetical and a thumbs-down to another—you begin making the sort of ad hoc hash of things the Supreme Court does when it tries to define pornography. Suppose you could show that the baby who was created to provide marrow for her sister would forever be treated like a second-class sibling—well cared for, perhaps, but not well loved. Do you prohibit the family from cloning the first daughter, accepting the fact that you may be condemning her to die? Richard McCormick, a Jesuit priest and professor of Christian ethics at the University of Notre Dame, answers such questions simply and honestly when he says, "I can't think of a morally acceptable reason to clone a human being."

In a culture in which not everyone sees things so straightforwardly, however, some ethical accommodation is going to have to be reached. How it will be done is anything but clear. "Science is close to crossing some horrendous boundaries," says Leon Kass, professor of social thought at the University of Chicago. "Here is an opportunity for human beings to decide if we're simply going to stand in the path of the technological steamroller or take control and help guide its direction."

FOLLOWING THE LOCAL INDUSTRIALIST ON the appointments list is the physics laureate. He is terminally ill. When he dies, one of the most remarkable minds in science will die with him. Reproductive chance might one day produce another scientist just as gifted, but there is no telling when. The physics laureate does not like that kind of uncertainty. He has come to the cloning lab today to see if he can't do something about it.

IF THE HUMAN GENE POOL CAN BE SEEN AS a sort of species-wide natural resource, it's only sensible for the rarest of those genes to be husbanded most carefully, preserved so that every generation may enjoy their benefits. Even the most ardent egalitarians would find it hard to object to an Einstein appearing every 50 years or a Chopin every century. It would be better still if we could be guaranteed not just *an* Einstein but *the* Einstein. If a scientific method were developed so that the man who explained general relativity in the first half of the century could be brought back to create the secrets of naked singularities in the second, could we resist using it? And suppose the person being replicated were researching not just abstruse questions of physics but pressing questions of medicine. Given the chance to bring back Jonas Salk, would it be moral not to try?

Surprisingly, scientific ethicists seem to say yes. "Choosing personal characteristics as if they were options on a car is an invitation to misadventure," says John Paris, professor of bioethics at Boston College. "It is in the diversity of our population that we find interest and enthusiasm."

Complicating things further, the traits a culture values most are not fixed. If cloning had existed a few centuries ago, men with strong backs and women with broad pelvises would have been the first ones society would have wanted to reproduce. During the industrial age, however, brainpower began to count for more than muscle power. Presumably the custodians of cloning technology at that historical juncture would have faced the prospect of letting previous generations of strapping men and fecund women die out and replacing them with a new population of intellectual giants. "What is a better human being?" asks Boston University ethicist George Annas. "A lot of it is just fad."

Even if we could agree on which individuals would serve as humanity's templates of perfection, there is no guarantee that successive copies would be everything the originals were. Innate genius is not always so innate, after all, coming to nothing if the person born with the potential for excellence doesn't find the right environment and blossom in it. A scientific genius who is beaten as a child might become a mad genius. An artist who is introduced to alcohol when he is young might merely become a drunk. A thousand track switches have to click in sequence for the child who starts out toward greatness to wind up there. If a single one clicks wrong, the high-speed rush toward a Nobel Prize can dead-end in a makeshift shack in the Montana woods like the one that hid the troubled soul believed to be the Unabomber.

If you had the chance, would you clone yourself?
Yes 7% No 91%

Is it against God's will to clone human beings?
Yes 74% No 19%

Should the Federal Government regulate the cloning of animals?
Yes 65% No 29%

From a telephone poll of 1,005 adult Americans taken for TIME/CNN on Feb. 26-27 by Yankelovich Partners Inc. Sampling error is ± 3%. Not sums 100%

THE DESPOT WILL NOT BE COMING TO THE cloning lab today. Before long, he knows, the lab's science will come to him—and not a moment too soon. The despot has ruled his little country for 30 years, but now he's getting old and will have to pass on his power. That makes him nervous: he has seen what can happen to a cult of personality if too weak a personality takes over. Happily, in his country that is not a danger. As soon as the technology of the cloning lab goes global—as it inevitably must—his people can be assured of his leadership long after he is gone.

THIS IS THE ULTIMATE NIGHTMARE SCEnario. The Pharaohs built their pyramids, the Emperors built Rome, and Napoleon built his Arc de Triomphe—all, at least in part, to make the permanence of stone compensate for the impermanence of the flesh. But big buildings and big tombs would be a poor second choice if the flesh

could be made to go on forever. Now, it appears, it can.

The idea of a dictator's being genetically duplicated is not new—not in pop culture, anyhow. In Ira Levin's 1976 book *The Boys from Brazil*, a zealous ex-Nazi bred a generation of literal Hitler Youth—boys cloned from cells left behind by the Führer. Woody Allen dealt with a similar premise a lot more playfully in his 1973 film *Sleeper*, in which a futuristic tyrant is killed by a bomb blast, leaving nothing behind but his nose—a nose that his followers hope to clone into a new leader. Even as the fiction of one decade becomes the technology of another, it is inevitable that this technology will be used—often by the wrong people.

If anything will prevent human cloning—whether of dictator, industrialist or baby daughter—from becoming a reality, it's that science may not be able to clear the ethical high bar that would allow basic research to get under way in the first place. Cutting, coring and electrically jolting a sheep embryo is a huge moral distance from doing the same to a human embryo. It took 277 trials and errors to produce Dolly the sheep, creating a cellular body count that would look like sheer carnage if the cells were human. "Human beings ought never to be used as experimental subjects," Shapiro says simply.

Whether they will or not is impossible to say. Even if governments ban human cloning outright, it will not be so easy to police what goes on in private laboratories that don't receive public money—or in pirate ones offshore. Years ago, Scottish scientists studying in vitro fertilization were subjected to such intense criticism that they took their work underground, continuing it in seclusion until they had the technology perfected. Presumably, human-cloning researchers could also do their work on the sly, emerging only when they succeed.

Scientists do not pretend to know when that will happen, but some science observers fear it will be soon. The first infant clone could come squalling into the world within seven years, according to Arthur Caplan, director of the Center for Bioethics at the University of Pennsylvania. If he is right, science had better get its ethical house in order quickly. In calendar terms, seven years from now is a good way off; in scientific terms, it is tomorrow afternoon. —***Reported by Dick Thompson/Washington, with other bureaus***

For more about the ethics of cloning, visit **time.com/cloning** *on the World Wide Web*

MONEY IN MOTION

Daniel Kadlec

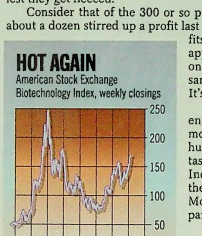
BEARISH ON BIOTECH

Laymen should stay away lest they get fleeced

DORMANT FOR YEARS, THE BIOTECH BUG IS ONCE AGAIN INFESTING stocks. This nasty man-made microbe, hatched in the labs of Wall Street, surfaces every few years to prey on susceptible (i.e., gullible) investors. Symptoms include feverish optimism followed by cold chills of reality.

The cyclical critter was due to hatch again anyway, but last week's revelation that Scottish scientists had succeeded in cloning a sheep amounted to a final whack at the snooze button. Now investors are wide awake to the potential wonders of biotechnology for the first time since a euphoric rally in those stocks in 1991. If you are a doctor or scientist, go ahead and take your best shot. Biotech certainly holds great promise, and you may well understand enough to pick the few stocks that will thrive. But overall the industry has been so consistently disappointing that laymen should stay away lest they get fleeced.

Consider that of the 300 or so publicly traded U.S. biotech firms, only about a dozen stirred up a profit last year. Many are one-drug research outfits in a field where only 1 in 10 drugs gets approved. In many cases, three or four one-note companies are working on the same basic treatment, like wound healing. It's a dicey business.



Recall the Flavr Savr, a tomato bioengineered to ripen on the vine and last months on the shelf. It might have been a huge moneymaker if only the thing had tasted like a tomato. Its maker, Calgene Inc., traded above $20 a share in 1992, but the stock subsequently rotted to $5, and Monsanto Co. has offered to buy the company for $7.25 a share.

That is by no means the most devastating loss stemming from a biotech failure in the '90s. Centocor Inc. fell from $60 to $5; Xoma Corp., from $32 to $1; Synergen Inc., from $73 to $4—all because of hyped septic-shock drugs that didn't work. Inject those babies into your 401(k) retirement fund, and you'll never retire. And these aren't isolated cases. Viren Mehta, a biotech expert at Mehta and Isaly, keeps track of biotech bombs. He says there have been 14 major disasters this decade. But even if you avoid specific product failures, it isn't enough. Biotech stocks fly in swarms. The whole group gets clipped when a few failures surface. In the three years that ended in December 1994, the *average* biotech stock fell 63%.

The average biotech stock has doubled in two years and reached a four-year high. Following the cloning news out of Scotland, investors indiscriminately bid up stocks of cloning companies. Shares of PPL Therapeutics of Edinburgh, which helped fund the sheep-cloning research, jumped 16% in a day. There have been some genuine commercial successes, such as Biogen Inc.'s drug Avonex, approved last year to treat multiple sclerosis. Still, a dangerous froth is forming. "During the next six months you're going to see quite a few disasters," predicts Evan Sturza of *Sturza's Medical Investment Letter*.

There are lots of reasons to root for these companies. High stock prices raise more money to seek important treatments. But after much exposure, I've been able to develop a resistance to the biotech bug. And until the gene-bending gods can separate the hype from the glory, they're not getting any of my savings. ■

Daniel Kadlec is TIME*'s Wall Street columnist. Reach him at* **kadlec@time.com**

CAN SOULS BE XEROXED?

Your clone might be eerily like you. Or perhaps eerily like someone else

By **ROBERT WRIGHT**

THE WORLD HAS HAD A week to conjure up nightmare scenarios, yet no one has articulated the most frightening peril posed by human cloning: rampant self-satisfaction. Just consider. If cloning becomes an option, what kind of people will use it? Exactly—people who think the world could use more of them; people so chipper that they have no qualms about bestowing their inner life on a dozen members of the next generation; people, in short, with high self-esteem. The rest of us will sit there racked with doubt, worried about inflicting our tortured psyches on the innocent unborn, while all around us shiny, happy people proliferate like rabbits. Or sheep, or whatever.

Of course, this assumes that psyches get copied along with genes. That seems to be the prevailing assumption. People nod politely to the obligatory reminder about the power of environment in shaping character. But many then proceed to talk excitedly about cloning as if it amounts to Xeroxing your soul.

What makes the belief in genetic identity so stubborn? In part a natural confusion over headlines. There are zillions of them about how genes shape behavior, but the underlying stories spring from two different sciences. The first, behavioral genetics, studies genetic differences among people. (Do you have the thrill-seeking gene? You do? Mind if I drive?) Behavioral genetics has demonstrated that genes matter. But does that mean that genes are destiny, that your clone is you?

Enter the second science, evolutionary psychology. It dwells less on genetic difference than on commonality. In this view, the world is already chock-full of virtual clones. My next-door neighbor—or the average male anywhere on the globe—is a 99.9%-accurate genetic copy of me. And paradoxically, many of the genes we share empower the environment to shape behavior and thus make us different from one another. Natural selection has preserved these "malleability genes" because they adroitly tailor character to circumstance.

Thus, though some men are more genetically prone to seek thrills than others, men in general take fewer risks if married with children than if unattached. Though some people may be genetically prone to high self-esteem, everyone's self-esteem depends heavily on social feedback. Genes even mold personality to our place in the family environment, according to Frank Sulloway, author of *Born to Rebel*, the much discussed book on birth order. Parents who clone their obedient oldest child may be dismayed to find that the resulting twin, now lower in the family hierarchy, grows up to be Che Guevara.

This malleability could, in a roundabout way, produce clones who are indeed soul mates. Your clone would, after all, look like you. And certain kinds of faces and physiques lead to certain kinds of experiences that exert certain effects on the mind. Early in this century, a fledgling effort at behavioral genetics divided people into such classes as mesomorphs—physically robust, psychologically assertive—and ectomorphs—skinny, nervous, shy. But even if these generalizations hold some water, it needn't mean that ectomorphs have genes for shyness. It may just mean that skinny people get pushed around on the school playground and their personality adapts. (This is one problem with those identical-twins-reared-apart studies by behavioral geneticists: Do the twins' characters correlate because of "character genes" or sometimes just because appearance shapes experience which shapes character?)

People who assume that genes are us seem to think that if you reared your clone, you would experience a kind of mind meld—not quite a fusion of souls, maybe, but an uncanny empathy with your budding carbon copy. And certainly empathy would at times be intense. You might know exactly how nervous your frail, gawky clone felt before the high school dance or exactly how eager your attractive, athletic clone felt.

On the other hand, if you really tried, you could similarly empathize with people who weren't your clone. We've all felt an adolescent's nervousness, and we've all felt youthfully eager, because these feelings are part of the generic human mind, grounded in the genes that define our species. It's just that we don't effortlessly transmute this common experience into empathy except in special cases—with offspring or siblings or close friends. And presumably with clones.

But the cause of this clonal empathy wouldn't be that your inner life was exactly like your clone's (it wouldn't be). The catalyst, rather, would be seeing that familiar face—the one in your high school yearbook, except with a better haircut. It would remind you that you and your clone were *essentially* the same, driven by the same hopes and fears. You might even feel you shared the same soul. And in a sense, this would be true. Then again, in a sense, you share the same soul with everyone. ◻

SCIENCE FICTION BY DOUGLAS COUPLAND

CLONE, CLONE ON THE RANGE

An aging actor seeks immortality through cloning—and gets more than he bargained for

BACK WHEN THE FIRST NEWS OF SUCCESSFUL human cloning was announced, humanity split into two irreconcilable camps: those who said, "How demonic!" and those, like myself—beloved and durable film star Corey Holiday—who said, "Hey! Where do I send my money?" In those glorious late-1990s days of film screenings, animal-rights rallies and fragrance launches, guests at events invariably divided into the anticloners, with their earnest discussions of ethics, inbreeding and hillbilly'ed gene pools, and those like myself, so eager and so thrilled to be able to bring humanity the gift of such tried-and-true looks, talent and industry savvy.

It was a heady era. Overnight it felt as though so many aspects of life were changing: cremation became a thing of the past as franchised DNA storage-facility stocks became the afterworld darlings of NASDAQ; the cost of most medicines fell to the price of a Mars candy bar; and meat became much tastier. Lawyers experienced what can only be described as a renaissance as all dimensions of law—particularly entertainment, copyright, conveyance, deeds and titles—underwent profound rethinking.

Of course, as the years wore on, the hubbub died. And it was at this time that my poor sweet face, while not becoming fully haggard, was definitely looking somewhat ... puffy. Even worse, it was showing on film. The dailies can be cruel.

Makeup calls got earlier and earlier. One box-office flop and—boom!—I'd enter the never-to-return ghetto of geriatric buddy comedies. Yikes.

Yet as time ravaged my looks, I predicted to anyone who might listen that entrepreneurs in retail human cloning would emerge quickly enough. And so they did. First in abandoned Indian Ocean oil rigs and Antarctica—and then slowly and discreetly in more traversed parts of the world.

Douglas Coupland is the author of Generation X, Shampoo Planet, Life After God *and* Microserfs. *His latest novel,* Girlfriend in a Coma, *will be published this fall by ReganBooks.*

It was at this point that I. Corey Holiday—magnificent, admired, talented and fêted the world over—after countless years of enthusiastic compliance with the rigors of beauty and the surgeon's scalpel, decided at age 50 it was time to obey Mother Nature's gentle call.

I quietly checked into an exclusive (naturally) cow-based Saskatchewan cloning spa—a spa combining the best of Saskatchewan's cattle country with Canada's lax cloning laws. My public relations staff told folks I was up in the fresh air of Lake Tahoe battling chronic-fatigue syndrome triggered by silicone migration—a plausible alibi if ever there was one.

The spa's rates were steep, but its results were guaranteed. Only superior cattle with modified immune systems were used—cows being the cross-species surrogate of choice. (No cow will ever phone the tabloid press with juicy palimony exclusives.) Clonees were allowed up to five babies per surrogate mom (no womb sharing). Those wishing more than five received generous volume-discount rates.

Myself? I chose five. A single clone might take a dislike to me—and then what? Besides, if I wanted just one kid, why not go out and have one the normal way? The whole point of this procedure was to have lots of exact genetic copies of me—to create a flock of worshipful children who would love me as much as I'd enjoy watching them worship me.

REGULATIONS REQUIRED THAT WE REMAIN AT THE SPA FOUR weeks, lest new tissue samples be called for or some other dreary flaw need mending. The spa itself was bags of fun. Most evenings felt like the Polo Lounge in the old days, and dinner was as star-packed as Morton's on a Monday night.

Thus the snowy Canadian winter passed in a zing. One unexpected treat for me was the arrival, shortly after myself, of veteran film star Lori Breckner, who had been my date for the 1998 Academy Awards ceremony, and who played opposite me in the critically successful box-office dud *Car Crash 500.* ("Yes, Don, I know movies are young young young. But what do a bunch of brats in Glendale know about pain?")

Oh, it was a happy, happy time. Lori and I would sit by the windows, sharing our hopes and dreams about how much our new children would love us, of how we could steer them away from certain types of drugs that they might have too much fun with and toward those cosmetic procedures that would flatter their looks. "Imagine," Lori dreamed aloud one night. "Knowing what seasons your colors are before you're even born! Lucky, lucky children."

While sipping Reverse-Scriptase martinis, Lori and I glanced outside to see the hundreds of beautiful Hereford mommies, glorious and dumb as posts under the great Canadian sky, chewing vitaminized, antibioticized alfalfa while inside each of them our own future little fan clubs incubated. "Look, over there, the one with a white patch on the eye, No. 388—that's yours, honey!" Bliss.

Lori and I discussed how we would transmute all our self-knowledge into our clones so completely that when we died we would technically still be alive—our "death" merely being a technical bookkeeping notation. Imagine feeling as if you are sharing a soul with five others! Lori was indeed a special woman to me. She was the only one I'd met who could connect with me on my own level. We were fated for each other.

And then came that dark morning when we stepped down for coffee and brioches to see the staff aflutter, alarms flaring like hangovers and a platoon of Mounties interviewing grieving guests. Other patrons were on the pay phones calling their lawyers to alter their wills. "What's gone on?" I asked a passing nurse. Fretful, she told me the news: cattle rustlers.

Dissolve into: the Chicago stockyards. Cut to: ... Sorry about the movie jargon. I can't help it. Being a part of the posse was the most real thing that had ever happened to me. Lori too. We looked at each other and said, "It's just like a movie!" I felt so close to this woman.

LORI AND I WERE ON SCANNING DUTY, FLUOROSCOPING CATTLE like airport carry-on bags as they galumphed through our stockyard receiving line—a novel [illegible] slaughter activity back then, but now compulsory in the U.S. and Canada. We found two cows, each [illegible] seven embryos—obviously not ours. These cows were then removed to the BMF, the Bovine Midwifing Facility. Only full gestation would reveal the tots' genetic identity. Software mogul? Pop-song diva? Corporation head? Somewhat like waiting for Polaroids to develop over a period of years.

Shortly after finding the rogue septuplets we learned that our "deluxe" Saskatchewan cloning facility had not embedded locator chips in the cows as advertised. That's when we realized our own [illegible]mmy cows could be practically anywhere. Were they [illegible]rtled for their meat? Were t[illegible] taken by terrorists? Kidnappers? Blackmailers? Adoption agencies wanting only pedigree children?

The media got wind of our story, and the Saskatchewan facility was top news for weeks; no doubt the rustlers would be on extra guard now. After Lori spoke with her crystallographer, ChrySanda, in North Hollywood, we roamed northern Montana on an "energy hunch." When we showed up in small-town cafés and feedlots to show photos of cow No. 388 (Lori's brood) and No. 441 (mine), we invariably created a sensation—the old good/evil polarity, plus, well, we were and are stars. Citizens were both righteous and helpful, and we always drove away feeling bathed in love of the common man. Sigh.

Some years passed, and then we got a tip. A garbled cell call told us of a private boarding school and ranch near Bozeman, Montana, where "students" were either exceptionally attractive, exceptionally intelligent, exceptionally devious or all three. So-called school employees signed draconian pre-agreements barring them from revealing anything. One had escaped, garnered our cell number from a local Webzine ad and whispered instructions as dogs barked in the background.

We drove along a thin, wooded road and found the entryway into the ranch: laser-guarded, barbed-wired and accompanied by the anxious *grrrrrr* of concealed attack Dobermans. A good omen—they had something in there worth hiding. A walk around the property's perimeter at first yielded only more of the same. Then we turned a corner and through the trees saw children playing a game of some sort—little houses moved around a board with sticks. The children spotted Lori and me and several of them came over.

"Hello," I said. "I'm film star Corey Holiday."

"And I'm box-office magic Lori Breckner."

The children stared. Then one efficient-looking boy, eight, tops, said, "Excuse me, do you have an appointment? Is somebody expecting you?"

We were agog. His twin (*ha!*) brother asked, "What might this be regarding?"

THE YOUNGER GIRL NEXT TO him said, "Geoff, was there a memo on this? I don't remember getting the memo."

"Perhaps you should wait. Would you like a cup of coffee or some water?" asked the first boy.

Lori asked the young girl, "What's that game you're playing over there?"

"That? Real Estate. It's fun. I just traded Amy's air rights in exchange for altering my TV networks' 9 o'clock slot." A bell rang. "Have to go now," she said. "Facials and colonics. Hope your next pictures gross well." Two of the youngsters slipped us scripts beneath the fence. Bingo. We knew we'd found our rustlers.

Cloning is old news now. We all live with the new reality: blackmailers holding hairbrushes hostage ("Give us your money or we'll make 10 of you") ... grandmothers reading bedtime stories to 118 baby grandmas ... captains of industry rearranging their wills, deeding everything to themselves down the line forever and always. *Plus ça change, plus ça*—wait, that's not really true anymore!

And us? Lori and I married shortly after. It was a big ticket—three helicopters more than my previous wedding. But we didn't go back into movies. Instead, we chose to dedicate our lives, possibly forever, to fighting embryo poaching. Us and our 10 beautiful children: Cori, Corrie, Corry, Korey, Korrey, Laurie, Lorrie, Laurey, Lorrey and Lorri.

DEEPER IN THOUGH

Champion Garry Kasparov will soon battle a smarter version of Deep Blue, the IBM computer that spooked him—and mankind—a year ago

By MICHAEL KRANTZ

IT'S MOVE 16, AND DEEP BLUE IS THINKing. Or rather, Deep Blue's 512 processors are reviewing 200 million chess positions per second in order to create the illusion that Deep Blue is thinking. And it isn't really Deep Blue either. It's what the guys at IBM's Thomas J. Watson Research Center in Yorktown Heights, New York, call Deeper Blue: the second generation of the original Deep Blue, the infamous chess program that one year ago threw a stunning uppercut to human self-esteem by winning the first game of its six-game match against world champion Garry Kasparov. Kasparov, of course, went on to score three victories and two draws to win the match and save mankind; the 33-year-old Russian isn't considered the best player in history for nothing.

The Deep Blue team, led by senior manager C.J. Tan, has been plotting revenge ever since, and is now prepping for the rematch, which will take place in Manhattan in May. Today, in this cramped lab at T.J. Watson, Deep and Deeper are playing their first father-son game, a sort of silicon Oedipal struggle. The first 15 moves are what chess types yawn at as "standard"—established openings. Very safe. No surprises.

Move 16 is when Deeper Blue pauses to "think." Finally, its human monitor announces, "F4." F4? An excited buzz sweeps the room. *F4!* Deeper Blue has advanced the knight's pawn two squares, loosening its kingside defense with an assumption of the superiority of its position that would surely be considered arrogant if a carbon-based life-form were making it. "This move was special," murmurs Joel Benjamin, a former U.S. champion and current Deep Blue consultant. The room nods in agreement. Deeper Blue is thinking.

Pretty soon, Deeper Blue is kicking butt. From F4 onward, its inexorable kingside march swallows one pawn after another, and Deep Blue resigns 18 moves later. The room erupts in applause. The same thought is on everyone's mind: the new program is better. The new program is a *lot* better. We're gonna crush Kasparov like a bug.

What About the 3.2 cr Left Out?

A World Bank report pegs India's literacy rate at 52.2%, but other related social and economic indices give the game away

By **GAUTAM CHIKERMANE**

TWO-thirds full, one-third empty. That's how the World Bank has defined the state of India's primary education glass. For 6.7 crore children between ages six and 10 who attend primary school, there are another 3.2 crore who do not.

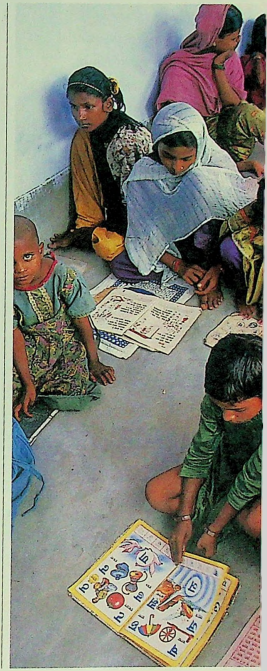
In a comprehensive 307-page report, *Primary Education in India*, principal education specialist and task manager Marlaine Lockheed had more than just structures to reveal: "India's low average educational attainment has not reached the critical threshold where benefits are the greatest and high economic growth rates are sustained." The major findings of the report:

- Although more than four-fifths of six-year-olds do enrol in school, as many as 15 to 20 per cent of these do not attend school regularly.
- Between 1986 and 1993, the enrolment of girls increased by a fifth, but the growth in overall enrolment stood at a modest 3.8 per cent in these eight years.
- About 70 per cent of children between ages six and 10 attend school regularly, but more than a third of them drop out before completing even the primary school cycle.
- There's a severe shortage of teachers and classrooms. In Orissa, if all children enrolled in school started attending, the classroom area available to each of them would be 0.12 sq ft, that's a square 4.2 inches by 4.2 inches, barely enough for a cockroach.
- Between 1881 and 1991, the literacy rate has risen from 6.3 per cent to 52.2 per cent.
- Even so, India lags behind the East Asian economies. Compared to a literacy rate of 71 per cent and 68 per cent for South Korea and Thailand in 1961, India's stood at 28.3 per cent. The country will reach full primary enrolment after other fast-growing Asian economies like Malaysia, Indonesia and China. Some respite for the jingoists: India is ahead of Pakistan.

Says Abusaleh Shariff, associate director, National Council of Applied Economic Research (NCAER): "This is one of the few, rare, good reports and is an excellent effort. In spite of having numerous organisations and universities doing similar work in the country, we have not been able to take this kind of perspective."

The advantages of primary education in the overall development of a country cannot be overstressed, as reams of paper and scores of economists including Nobel contender Amartya Sen have pointed out over the last half-a-century. This report is yet another step in that direction and its findings are supported by hard data.

Consider one factor: infant mortality rate. This is directly correlated to primary education. According to the report, in 1991, Orissa, one of the lesser educated states with a 35 per cent literacy, recorded an infant mor-



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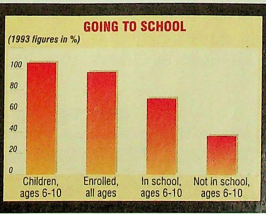

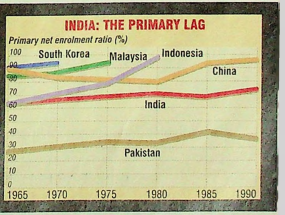

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Consider one factor: infant mortality rate. This is directly correlated to primary education. According to the report, in 1991, Orissa, one of the lesser educated states with a 35 per cent literacy, recorded an infant mortality rate of 112.1 per thousand. For Bihar—with 23 per cent literacy, the lowest in the country—the figure was 89.2. The figures for Uttar Pradesh were 25 per cent and 99.9 respectively. On the other hand, Kerala, with the highest literacy rate of 86 per cent, saw the lowest infant mortality: less than 24 out of a thousand infants died prematurely.

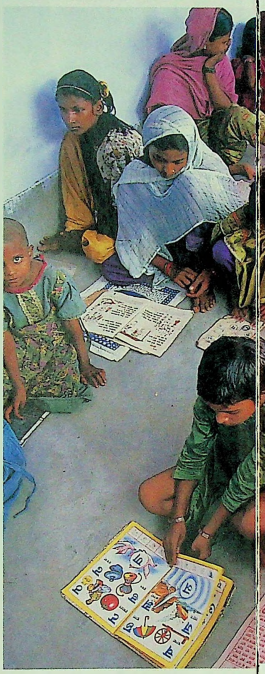
Or, take birth control. In Uttar Pradesh, the more women received education, the more they started using birth control measures. From around 12 per cent of non-literate women using birth control, the figure steadily jumped to 35 per cent for those educated up to secondary level and above.

There is a similar high correlation between the mother's education and her child's immunisation. In Uttar Pradesh, compared to around 17 per cent immunisation for children of non-literate mothers in 1995, the figure was over 50 per cent for secondary educated mothers. In Tamil Nadu, the numbers stood at 58 per cent and 86 per cent respectively.

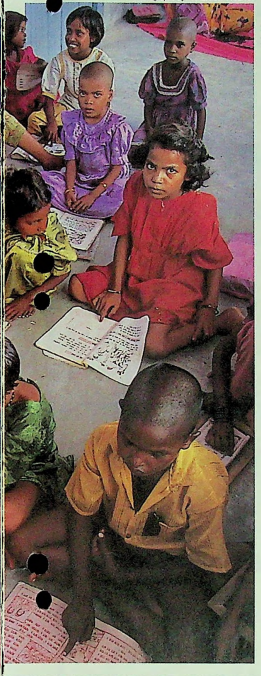
The problem is aggravated by social ills—the hapless ness of the more vulnerable sections—scheduled caste and tribes, Muslims, the poor. In 1986-87, a survey of students of ages six to 22 in Maharashtra found that compared to 54 per cent of rural scheduled caste males dropping out of school, the figure for others stood at 38 per cent. Against 34 per cent of urban scheduled tribe males dropping out, only 29 per cent of general students did so.

If data doesn't convince you, Shariff could. "There is a vested interest of the ruling class to prevent the lower classes from getting educated. In Gujarat for instance, the dominant caste of Patels does not allow children of scheduled castes and tribes to attend school." But there are structural problems too. The report cites two interesting examples.

In Kayipady, a fishing hamlet in Kerala which is also the most literate state in the country, not one of the 250 children between ages five and 14 was enrolled in school, just 3 km away. Reason: to reach the school, the children had to wade through a river, hop across a railway line and then cross the main highway twice. Concerns over their safety prevented the parents from sending them to school. Later, when a



Photographs by PRASHANT PANJIAR



NGO school in Bihar: a drop in the ocean

Graphics by ANOOP KAMATH

THE DROPOUT RATE

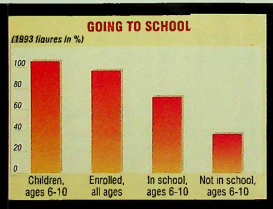
(1993 figures in %)

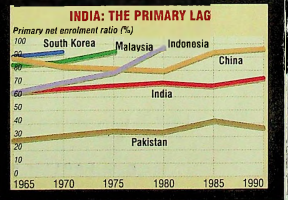
State	Dropouts: Male	Dropouts: Female
Andhra Pradesh	42	42
Bihar	62	66
Gujarat	42	51
Haryana	2	7
Karnataka	37	44
Kerala	0	0
Madhya Pradesh	23	35
Maharashtra	24	32
Orissa	53	52
Punjab	21	23
Rajasthan	35	56
Tamil Nadu	16	18
Uttar Pradesh	20	20
West Bengal	36	46
All India	35	39

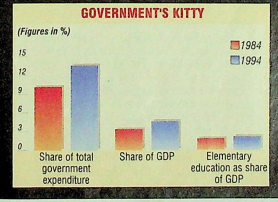
LITERACY AND LIFE

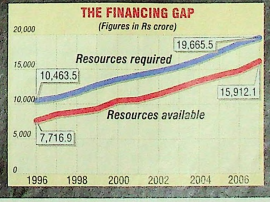
State	Literacy rate, 1991 (%)	Infant mortality rate (deaths per 1000)
Andhra Pradesh	33	70.4
Bihar	23	89.2
Gujarat	49	68.7
Haryana	40	73.3
Karnataka	44	65.4
Kerala	86	23.8
Madhya Pradesh	29	85.2
Maharashtra	52	50.5
Orissa	35	112.1
Punjab	50	53.7
Rajasthan	20	72.6
Tamil Nadu	51	67.7
Uttar Pradesh	25	99.9
West Bengal	47	75.3
All India	39	78.5

About 70 per cent of children between ages 6 and 10 attend school, but more than a third drop out before the primary cycle.









The girl child's plight is the worst in all segments: the dropout rate, infant mortality rate and so forth.

school was established in Kayipady, 185 children between ages five and 10 enrolled.

Likewise, in Andhra Pradesh, researchers studying the Kondareddy and Khammom tribes found that a third of the children of school-going age preferred to spend time "moving freely, swimming, catching fish, climbing trees, hunting birds, riding on buffaloes etc." Reason: socialisation in tribal society presents children with a lot of freedom, conspicuously absent from the highly disciplined and rigid model of a classroom. Shariff reacts: "Indian education has alienated itself from the local society. This has to change."

At the lowest end of the education spectrum is the girl child. Her plight is the worst in all segments. The report found 75 per cent of the rural scheduled caste girl-children and 60 per cent from the scheduled tribes dropping out of school. The figure for urban scheduled tribe girlchildren was 48 per cent. The gender gap was significant: compared to 38 per cent of rural and 29 per cent of urban boys dropping out of school, the respective figures for girls stood at 57 per cent and 36 per cent.

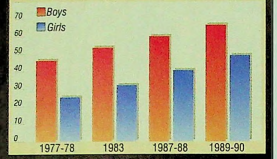
This has invisible but damaging social and economic repercussions. For, the incremental non-market rate of return on education for girls is much higher than for the boys. Or, every Re 1 of primary education spent on girls will generate more non-market benefits—healthier children, birth control, and the like. More, since girls start much behind the boys, the effect of extra education goes longer. Of all scheduled caste women in UP and Bihar between ages 15 and 45—the reproductive age—only 6 per cent are literate, says Shariff.

If this fails to move you, then a dose of economics might work. Consider this: the more literate states are economically better off than the less literate ones. For this, the study compared the state domestic product with growth in educational attainment. The results: Haryana, Punjab and Maharashtra had the highest growth rates, and were among the better educated states. On the lowest rung were Assam, West Bengal and Orissa.

There are severe infrastructural shortages. In Orissa, if all the children enrolled started attending, the classroom area available to each would be barely enough for a cockroach.

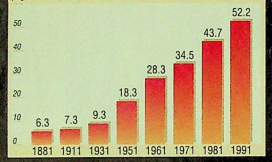
GENDER GAP: CONSTANT

(Figures in %; ages 5-14)



A CENTURY OF LITERACY

(Figures in %)



THE INFRASTRUCTURE

(1993 figures in %)

State	Schools with safe drinking water	Schools with toilet facilities	Schools with chairs for teachers
Assam	21	10	81
Karnataka	41	9	65
Madhya Pradesh	34	16	61
Orissa	26	8	85

In an otherwise remarkable report, the quality of data may be suspect. Government data on enrolment of students is highly overstated. What happens is that state officials find out the number and names of children belonging to a certain age group, which is translated into the school registers. And during spot scrutiny, the balance is termed as "dropouts". Confirms Shariff: "We don't have reliable data on enrolment rates, and the numbers in this report could be overstated and should not be used for planning."

Shariff also feels the report has "grossly understated" the financial needs for making the country fully literate. While NCAER's own survey placed the outlay at Rs 22,810 crore in 1996, the report puts it at just Rs 10,464 crore. The government spends only 1.6 per cent of its GDP on elementary education. "This should rise to 4 per cent—even of a higher GDP," he says.

The problem of primary education does not end here. The next step is child labour. India has the largest number of child labourers in the world who, according to the voluntary organisation, The Concerned for Working Children, contribute 20 per cent of its GNP. Almost 8 crore children begin work very early and toil for more than 12 hours a day. According to voluntary groups, any non-school going child is a child labourer. That should be reason enough to make primary education a fundamental right. ■

Sundown in Exile

Old-age homes for Asians boom in England as piety dies

By **SANJAY SURI** in London

GROW old along with the old. The best is over, but actually it's not so bad in one of those homes we thought were only for White people who grew old and unwanted. One after another, now 'homes' are coming up in Britain for the Indian elderly. Thousands of Indian parents have been sent to these homes, and the waiting lists are lengthening with time.

Pratapbhai has forgotten his age, he has almost forgotten his two sons and daughters who live in London. One of them last came to visit him two months ago. He has not seen two of his children in years. There are other parents in the same home in Leicester, about 100 miles north of London, whom no one visits. A nursing home built on a road named Asha Marg in Leicester provides plenty of parking space for families visiting parents. It's a lot of wasted space. A couple of cars or so on weekends is all that comes.

"We are now one another's family," says Sushilaben, an elderly Gujarati woman at the Mahatma Gandhi House in Leicester. "Let them not come to us, we do not wait for them anymore." Sushilaben is not angry. "My grandchildren were growing up, they needed the rooms," she says. "My children put me in the drawing room but it did not look nice when guests came. So they sent me here. They said they will see me every weekend. Now nobody comes but it's all right. They never looked after us but now we are here to look after one another." A neighbour who has walked up agrees. "They didn't want me then, I don't want them now either."

Two other women walk up to join the chat. "You want to bring your parents here? Wait," says one. Down the corridor she fetches the agreed spokesman for the lot. "There are no rooms just now," he says in clipped English. He has known years of success in Kenya. "You will have to wait for one of us to die, and there are plenty waiting for rooms before you." But, he says, "we keep getting vacancies".

Inside a 'home' in Leicester; (bottom left) Jalaram Jyot: Indian flavour in the West

Downstairs in the common room a portrait of Gandhi and a map of India are put up on the walls to make inmates feel at home. An old man is watching TV alone. His wife died years ago, his son went back to Kenya. He is now alone but insists he is not unhappy. "We all get along very well." he says. "Singhs, Muslims, Gujaratis, people of all castes, we are now one family here." Finally, everyone has come together in this pre-death club.

Bipinbhai is partially paralysed after a stroke. He came to Britain during the Uga-

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Bipinbhai is partially paralysed after a stroke. He came to Britain during the Uganda expulsions of 1972 with a brother and seven sisters. Over the last three years only one sister has ever called him. "We were like one family there. Here I don't know what happened, it must be this country, what else can it be?" Conservative leader John Major never tires of pointing to Indian family values as a model for the crumbling British family to follow. But in the nuclear times, the Indian family itself seems eager to go the other way.

The homes carry the quietness of death. "We like it here because we have to," Kumudben says. "You don't always get what you want." And what does she think of her son who sent her here? "No, it was not him, it was his wife, what could he do?" Kumudben is waiting only for days to repeat themselves. "We do what we would do anywhere," she says. "Get up, make breakfast, clean, cook lunch, sleep, come to the common room for tea, watch TV, have dinner, then sleep." But two days last year were different. "We were taken in a bus on a day trip for picnics." There are other days to wait for. The government council, which pays for these homes, also funds parties for Christmas and Diwali.

> **John Major used to hold up the Indian family as a model. But granny-bashing is now a well-adopted habit among Indians in the UK as well.**

Leicester, where a third of its population of about 280,000 is Asian, is among the first cities where homes for the Asian old with familiar names—Mahatma Gandhi House, Jalaram Jyot et al—began to mushroom. Polite social workers say they were driven out by "family conflicts." The English have another term for it: granny-bashing. Offers of refuge for the Asian elderly were pioneered by a group called ASRA (Asian Sheltered Residential Accommodation). Its report on the need for such homes speaks of the "myth that Asian people in this country are able to care for their old as well as their young under one roof because of the extended family." The truth, the report says, is that "some Asians are treated degradingly

Mahatma Gandhi House: Indian haven

by their children and such treatment would include granny-bashing, taking away of supplementary benefits, not giving them enough food to eat, locking them out, making them do the housework and so on."

HER Majesty's government has opened the doors for parents to leave, or be thrown out. Social security is alive at £90 billion (Rs 5.3 lakh crore) a year despite the trimmings by Thatcher. The Leicester city council spends something between £212 (Rs 12,500) and £330 (Rs 19,500) a week on an elderly person in a private nursing home. In London, the expenses range up to £384 (Rs 22,500) a week. That includes room rent and a personal allowance for an elderly person of about £70 a week paid out by the Benefits Agency.

"The state is our mother, the state is our father," says Nitesh Chohan. The children know their parents can stay there for free and get enough money to live on. "They say why should they look after us when the state can do it better?" Parents who get thrown out usually have more spending money. "Yes, we manage to save some money from what we get," says Ashaben, nearing 70, who has moved several homes over the past three years because the next one seemed better. "But we don't know what to do with the money we save."

Children who push parents out are not usually short of money. A young Gujarati woman drives up in her red Mercedes sports car to visit her mother now and then. She left the mother at a city council shelter as a homeless woman. Social workers brought her into residential care. Ramanbhai Kotecha sees her come and go with some bitterness. "In India, the children have no choice but to be tolerant, where will they send their parents?" he asks. "Maybe that is good, maybe not, I don't know." But he did not hope to retire in such independence. "The government will cremate us," he says. "We will die on our own two feet."

For the enterprising, there is money in eviction of parents and the duty of the state to shelter them. There is no business like the nursing home business now. Everyone is growing older, most people are living longer. More and more want them to live in government homes at government expense. It's a growing market. "We don't have enough place in our homes any more," says a spokeswoman for the Leicester city council. "It is easier to pay private nursing homes than set up more of our own."

The nursing home business is growing. An Indian doctor who has set up several is now on the list of Asian millionaires.

Nursing homes to look after the south Asian elderly are coming up quickly in London, Leicester, Birmingham, Wolverhampton and other cities with a large Asian population. *The Times* recently ran a story on an Indian doctor who gave up his practice to open nursing homes. He is now on one of those lists of Asian millionaires.

Property is still cheap in many places. Backed by bank loans, nursing homes can be opened with relatively small personal capital. Much of the government grant averaging £300 per person per week goes to nursing home or residential care managers. This breed of people never discusses budgets. But there seems to be plenty left over for them, enough to make quick millionaires of the men who launched into this business early. Resigned to professional care, the old are more defiant of the past than bitter. ■

Great Beams of Antimatter

A vast plume of exotic particles is shooting out from the center of the Milky Way. What's it doing there?

ASTROPHYSICIST WILLIAM PURCELL knew that if he looked at the center of the Milky Way, he would see what is known as antimatter: bizarre subatomic particles that resemble ordinary protons and electrons but carry an opposite charge. But when National Aeronautics and Space Administration controllers aimed the orbiting Compton Gamma Ray Observatory on this core region and beamed the data back, Purcell saw something on his computer screen at Northwestern University that nobody could have predicted: a colossus of antimatter, a vast fountain spewing out from the center of our galaxy and reaching trillions of kilometers into space.

What could have produced such a huge outpouring? That's what mystified astrophysicists meeting in Williamsburg, Va., last week. As most college freshmen know, antimatter is unstable stuff. Whenever antimatter and matter collide, they annihilate each other, disappearing in a blast of intense radiation. Thus while the Big Bang probably created almost as much antimatter as matter, virtually all of it, scientists believe, was consumed in a frenzy of annihilation long ago. In today's universe, antimatter must be created anew. And it is—in the form of subatomic particles, at least—in giant particle accelerators on earth and, in space, by one of several physical processes.

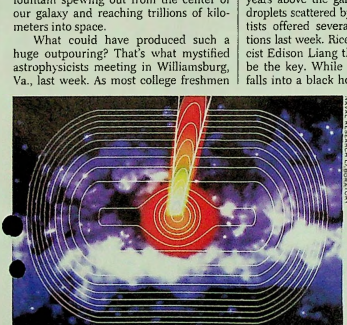
When massive stars explode as supernovas, for example, they create a periodic table's worth of radioactive elements, some of which decay into antielectrons, known as positrons. A black hole, scientists believe, can also produce electron-positron pairs by superheating the material that spirals into its gravitational sinkhole. It was the radiation produced by annihilating positrons and electrons, not the antimatter itself, that was actually observed by Purcell at Northwestern and his collaborators at the U.S. Naval Research Laboratory in Washington.

The real mystery, scientists say, is not that the positrons were created. It's that they were lobbed so many thousands of light-years above the galactic plane, like water droplets scattered by a giant geyser. Scientists offered several competing explanations last week. Rice University astrophysicist Edison Liang thinks black holes may be the key. While most of the stuff that falls into a black hole stays there, he observes, some of it gets blasted out in the form of a hot wind. Liang's hypothesis draws strength from the fact that there appear to be a good half a dozen black holes near the center of the Milky Way.

A competing theory, which Purcell favors, suggests that exploding supernovas may be the force that creates the positrons and catapults them to such great heights. There are certainly plenty of massive stars close to the Milky Way's core that are capable of generating explosions with sufficient force. The rate at which such explosions would have to occur, however, is mind-boggling: around one a century, Purcell estimates. Since supernovas have never been observed to go off at that rate in our galaxy, this theory suggests that the antimatter fountain originated in a more violent epoch in the distant past.

It's a puzzle, in other words, that could take years to solve. And that's what Purcell and others find most exciting. The Milky Way—so familiar and in many ways so humdrum—still hasn't lost its ability to surprise.

—By J. Madeleine Nash



STAR BURST: Computer model of the galactic fountain

PHOTOFEST

HERE HE COMES: Science imitates old children's cartoons

Mighty Mouse

Muscle-bound mutants could point the way to beefier cows and humans

FROM THE OUTSIDE, THE NEW STRAIN of mice looked a little, well, lumpy. But when scientists peeled back their fur and skin, what had seemed like extra baggage in the shoulders and hips turned out to be pure muscle—two to three times the muscle mass of the average pipsqueak rodent. These were not your ordinary genetically engineered laboratory mice; these were Mighty Mice.

Dr. Se-Jin Lee and his colleagues at the Johns Hopkins School of Medicine didn't set out to create muscle-bound lab specimens. As reported in last week's *Nature*, they wanted to find out how a particular protein, a growth factor called myostatin, regulates the development of tissue. So they produced a strain of mice in which the gene that codes for myostatin had been deleted, or "knocked out." The resulting mutant animals grew up normal in every way—except for their extraordinarily well-developed musculature.

Why hasn't evolution produced more mice with rippling chests? "We're just starting to look into this," Lee explains. The burly mice seem to be a little slower and less timid than their normal counterparts. "That probably wouldn't be much of an advantage in the wild," says Lee.

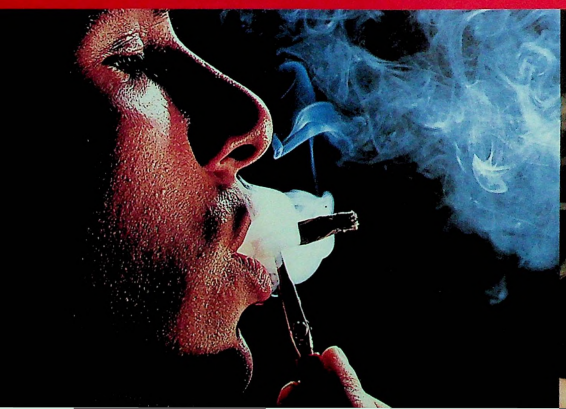
It could prove to be an advantage to farmers, however, since chickens and cows make their own myostatin. In the future, artificially brawny beef cattle could be a profitable source of fat-free meat.

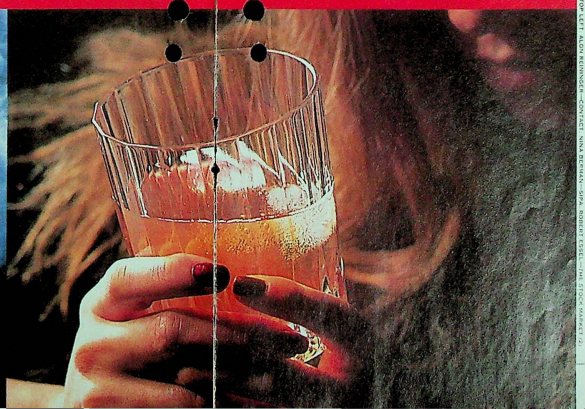
Humans make myostatin as well, and researchers speculate that a myostatin-blocking drug could one day add muscles to the frames of people wasting away from cancer or AIDS. A drug that could triple muscle mass might also find a market among body builders, but that's a long way off. Scientists today know only what myostatin does in mice, and they still haven't determined at what cost to the animals' health or longevity.

—By Christine Gorman

ADDICTED

Why do people get hooked? Mounting evidence points to a powerful brain chemical called dopamine





By J. MADELEINE NASH

IMAGINE YOU ARE TAKING A SLUG OF WHISKEY. A PUFF OF a cigarette. A toke of marijuana. A snort of cocaine. A shot of heroin. Put aside whether these drugs are legal or illegal. Concentrate, for now, on the chemistry. The moment you take that slug, that puff, that toke, that snort, that shot, trillions of potent molecules surge through your bloodstream and into your brain. Once there, they set off a cascade of chemical and electrical events, a kind of neurological chain reaction that ricochets around the skull and rearranges the interior reality of the mind.

Given the complexity of these events—and the inner workings of the mind in general—it's not surprising that scientists have struggled mightily to make sense of the mechanisms of addiction. Why do certain substances have the power to make us feel so good (at least at first)? Why do some people fall so easily into the thrall of alcohol, cocaine, nicotine and other addictive substances, while others can, literally, take them or leave them?

The answer, many scientists are convinced, may be simpler than anyone has dared imagine. What ties all these mood-altering drugs together, they say, is a remarkable ability to elevate levels of a common substance in the brain called dopamine. In fact, so overwhelming has evidence of the link between dopamine and drugs of abuse become that the distinction (pushed primarily by the tobacco industry and its supporters) between substances that are addictive and those that are merely habit-forming has very nearly been swept away.

The Liggett Group, smallest of the U.S.'s Big Five cigarette makers, broke ranks in March and conceded not only that tobacco is addictive but also that the company has known it all along. While RJR Nabisco and the others continue to battle in the courts—insisting that smokers are not hooked, just exercising free choice—their denials ring increasingly hollow in the face of the growing weight of evidence. Over the past year, several scientific groups have made the case that in dopamine-rich areas of the brain, nicotine behaves remarkably like cocaine. And late last month a federal judge ruled for the first time that the Food and Drug Administration has the right to regulate tobacco as a drug and cigarettes as drug-delivery devices.

Now, a team of researchers led by psychiatrist Dr. Nora Volkow of the Brookhaven National Laboratory in New York has published the strongest evidence to date that the surge of dopamine in addicts' brains is what triggers a cocaine high.

PRIME SUSPECT

They don't yet know the precise mechanism by which it works, but scientists are increasingly convinced that dopamine plays a key role in a wide range of addictions, including those to heroin, nicotine, alcohol and marijuana.

DOPAMINE MAY BE LINKED TO GAMBLING, CHOCOLATE AND EVEN SEX

In the latest edition of the journal *Nature* they described how powerful brain-imaging technology can be used to track the rise of dopamine and link it to feelings of euphoria.

Like serotonin (the brain chemical affected by such antidepressants as Prozac), dopamine is a neurotransmitter—a molecule that ferries messages from one neuron within the brain to another. Serotonin is associated with feelings of sadness and well-being, dopamine with pleasure and elation. Dopamine can be elevated by a hug, a kiss, a word of praise or a winning poker hand—as well as by the potent pleasures that come from drugs.

The idea that a single chemical could be associated with everything from snorting cocaine and smoking tobacco to getting good grades and enjoying sex has electrified scientists and changed the way they look at a wide range of dependencies, chemical and otherwise. Dopamine, they now believe, is not just a chemical that transmits pleasure signals but may, in fact, be the master molecule of addiction.

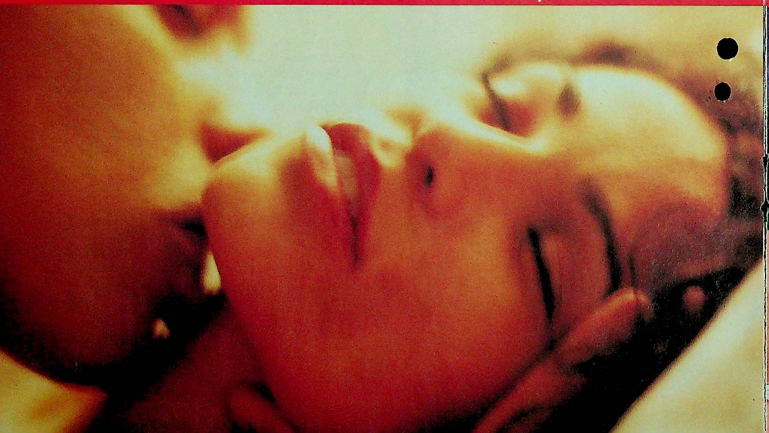
This is not to say dopamine is the only chemical involved or that the deranged thought processes that mark chronic drug abuse are due to dopamine alone. The brain is subtler than that. Drugs modulate the activity of a variety of brain chemicals, each of which intersects with many others. "Drugs are like sledgehammers," observes Dr. Eric Nestler of the Yale University School of Medicine. "They profoundly alter many pathways."

Nevertheless, the realization that dopamine may be a common end point of all those pathways represents a signal advance. Provocative, controversial, unquestionably incomplete, the dopamine hypothesis provides a basic framework for understanding how a genetically encoded trait—such as a tendency to produce too little dopamine—might intersect with environmental influences to create a serious behavioral disorder. Therapists have long known of patients who, in addition to having psychological problems, abuse drugs as well. Could their drug problems be linked to some inborn quirk? Might an inability to absorb enough dopamine, with its pleasure-giving properties, cause them to seek gratification in drugs?

Such speculation is controversial, for it suggests that broad swaths of the population may be genetically predisposed to drug abuse. What is not controversial is that the social cost of drug abuse, whatever its cause, is enormous. Cigarettes contribute to the death toll from cancer and heart disease. Alcohol is the leading cause of domestic violence and highway deaths. The needles used to inject heroin and cocaine are spreading AIDS. Directly or indirectly, addiction to drugs, cigarettes and alcohol is thought to account for a third of all hospital admissions, a quarter of all deaths and a majority of serious crimes. In the U.S. alone the combined medical and social costs of drug abuse are believed to exceed $240 billion.

FOR NEARLY A QUARTER-CENTURY the U.S. has been waging a war on drugs, with little apparent success. As scientists learn more about how dopamine works (and how drugs work on it), the evidence suggests that we may be fighting the wrong battle. Americans tend to think of drug addiction as a failure of character. But this stereotype is beginning to give way to the recognition that drug dependence has a clear biological basis. "Addiction," declares Brookhaven's Volkow, "is a disorder of the brain no different from other forms of mental illness."

That new insight may be the dopamine hypothesis' most important contribution in the fight against drugs. It completes the loop between the mechanism of addiction and programs for treatment. And it raises hope for more effective therapies. Abstinence, if maintained, not only halts the physical and psychological damage wrought by drugs but in large measure also reverses it.



Genes and social forces may conspire to turn people into addicts but do not doom them to remain so. Consider the case of Rafael Rios, who grew up in a housing project in New York City's drug-infested South Bronx. For 18 years, until he turned 31, Rios, whose father died of alcoholism, led a double life. He graduated from Harvard Law School and joined a prestigious Chicago law firm. Yet all the while he was secretly visiting a shooting gallery once a day. His favored concoction: heroin spiked with a jolt of cocaine. Ten years ago, Rios succeeded in kicking his habit—for good, he hopes. He is now executive director of A Safe Haven, a Chicago-based chain of residential facilities for recovering addicts.

How central is dopamine's role in this familiar morality play? Scientists are still trying to sort that out. It is no accident, they say, that people are attracted to drugs. The major drugs of abuse, whether depressants like heroin or stimulants like cocaine, mimic the structure of neurotransmitters, the most mind-bending chemicals nature has ever concocted. Neurotransmitters underlie every thought and emotion, memory and learning; they carry the signals between all the nerve cells, or neurons, in the brain. Among some 50 neurotransmitters discovered to date, a good half a dozen, including dopamine, are known to play a role in addiction.

The neurons that produce this molecular messenger are surprisingly rare. Clustered in loose knots buried deep in the brain, they number a few tens of thousands of nerve cells out of an estimated total of 100 billion. But through long, wire-like projections known as axons, these cells influence neurological activity in many regions, including the nucleus accumbens, the primitive structure that is one of the brain's key pleasure centers. At a purely chemical level, every experience humans find enjoyable—whether listening to music, embracing a lover or savoring chocolate—amounts to little more than an explosion of dopamine in the nucleus accumbens, as exhilarating and ephemeral as a firecracker.

Dopamine, like most biologically important molecules, must be kept within strict bounds. Too little dopamine in certain areas of the brain triggers the tremors and paralysis of Parkinson's disease. Too much causes the hallucinations and bizarre thoughts of schizophrenia. A breakthrough in addiction research came in 1975, when psychologists Roy Wise and Robert Yokel at Concordia University in Montreal reported on the remarkable behavior of some drug-addicted rats. One day the animals were placidly dispensing cocaine and amphetamines to themselves by pressing a lever attached to their cages. The next they were angrily banging at the lever like someone trying to summon a stalled elevator. The reason? The scientists had injected the rats with a drug that blocked the action of dopamine.

In the years since, evidence linking dopamine to drugs has mounted. Amphetamines stimulate dopamine-producing cells to pump out more of the chemical. Cocaine keeps dopamine levels high by inhibiting the activity of a transporter molecule that would ordinarily ferry dopamine back into the cells that produce it. Nicotine, heroin and alcohol trigger a complex chemical cascade that raises dopamine levels. And a still unknown chemical in cigarette smoke, a group led by Brookhaven chemist Joanna Fowler reported last year, may extend the activity of dopamine by blocking a mopping-up enzyme, called MAO B, that would otherwise destroy it.

The evidence that Volkow and her colleagues present in the current issue of *Nature* suggests that dopamine is directly responsible for the exhilarating rush that reinforces the desire to take drugs, at least in cocaine addicts. In all, 17 users participated in the study, says Volkow, and they experienced a high whose intensity was directly related to how extensively cocaine tied up available binding sites on the molecules that transport dopamine around the brain. To produce any high at all, she and her colleagues found, cocaine had to occupy at least 47% of these sites; the "best" results occurred when it took over 60% to 80% of the sites, effectively preventing the transporters from latching onto dopamine and spiriting it out of circulation.

HIGH AND LOWS

Number of U.S. users in the past month

Heroin — 200,000
Triggers release of dopamine; acts on other neurotransmitters

Amphetamines — 800,000
Stimulate excess release of dopamine

Cocaine/Crack — 1.5 million
Blocks dopamine absorption

Marijuana — 10 million
Binds to areas of brain involved in mood and memory; triggers release of dopamine

Alcohol — 11 million abusers
Triggers dopamine release; acts on other neurotransmitters

Nicotine — 61 million
Triggers release of dopamine

Caffeine — 130 million*
May trigger release of dopamine

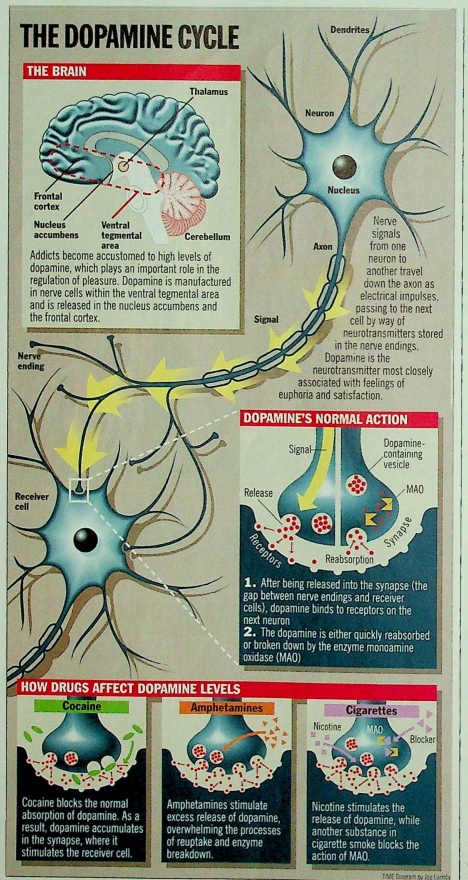
Sources: SAMHSA, National Coffee Association *Coffee drinkers

WHAT ELSE?

Preliminary evidence suggests that dopamine may be involved even when we form dependencies on things—like coffee or candy—that we don't think of as drugs at all

SCIENTISTS BELIEVE THE DOPAMINE system arose very early in the course of animal evolution because it reinforces behaviors so essential to survival. "If it were not for the fact that sex is pleasurable," observes Charles Schuster of Wayne State University in Detroit, "we would not engage in it." Unfortunately, some of the activities humans are neurochemically tuned to find agreeable—eating foods rich in fat and sugar, for instance—have backfired in modern society. Just as a surfeit of food and a dearth of exercise have conspired to turn heart disease and diabetes into major health problems, so the easy availability of addictive chemicals has played a devious trick. Addicts do not crave heroin or cocaine or alcohol or nicotine per se but want the rush of dopamine that these drugs produce.

Dopamine, however, is more than just a feel-good molecule. It also exercises extraordinary power over learning and memory. Think of dopamine, suggests P. Read Mon-



tague of the Center for Theoretical Neuroscience at Houston's Baylor College of Medicine, as the proverbial carrot, a reward the brain doles out to networks of neurons for making survival-enhancing choices. And while the details of how this system works are not yet understood, Montague and his colleagues at the Salk Institute in San Diego, California, and M.I.T. have proposed a model that seems quite plausible. Each time the outcome of an action is better than expected, they predicted, dopamine-releasing neurons should increase the rate at which they fire. When an outcome is worse, they should decrease it. And if the outcome is as expected, the firing rate need not change at all.

As a test of his model, Montague created a computer program that simulated the nectar-gathering activity of bees. Programmed with a dopamine-like reward system and set loose on a field of virtual "flowers," some of which were dependably sweet and some of which were either very sweet or not sweet at all, the virtual bees chose the reliably sweet flowers 85% of the time. In laboratory experiments real bees behave just like their virtual counterparts. What does this have to do with drug abuse? Possibly quite a lot, says Montague. The theory is that dopamine-enhancing chemicals fool the brain into thinking drugs are as beneficial as nectar to the bee, thus hijacking a natural reward system that dates back millions of years.

The degree to which learning and memory sustain the addictive process is only now being appreciated. Each time a neurotransmitter like dopamine floods a synapse, scientists believe, circuits that trigger thoughts and motivate actions are etched onto the brain. Indeed, the neurochemistry supporting addiction is so powerful that the people, objects and places associated with drug taking are also imprinted on the brain. Stimulated by food, sex or the smell of tobacco, former smokers can no more control the urge to light up than Pavlov's dogs could stop their urge to salivate. For months Rafael Rios lived in fear of catching a glimpse of bare arms—his own or someone else's. Whenever he did, he remembers, he would be seized by a nearly unbearable urge to find a drug-filled syringe.

Indeed, the brain has many devious tricks for ensuring that the irrational act of taking drugs, deemed "good" because it enhances dopamine, will be repeated. PET-scan images taken by Volkow and her colleagues reveal that the absorption of a cocaine-like chemical by neurons is profoundly reduced in cocaine addicts in contrast to normal subjects. One explanation: the addicts' neurons, assaulted by abnormally high levels of dopamine, have responded defensively and reduced the number of sites (or receptors) to which dopamine can bind.

In the absence of drugs, these nerve cells probably experience a dopamine deficit, Volkow speculates, so while addicts begin by taking drugs to feel high, they end up taking them in order not to feel low.

PET-scan images of the brains of recovering cocaine addicts reveal other striking changes, including a dramatically impaired ability to process glucose, the primary energy source for working neurons. Moreover, this impairment—which persists for up to 100 days after withdrawal—is greatest in the prefrontal cortex, a dopamine-rich area of the brain that controls impulsive and irrational behavior. Addicts, in fact, display many of the symptoms shown by patients who have suffered strokes or injuries to the prefrontal cortex. Damage to this region, University of Iowa neurologist Antonio Damasio and his colleagues have demonstrated, destroys the emotional compass that controls behaviors the patient knows are unacceptable.

Anyone who doubts that genes influence behavior should see the mice in Marc Caron's lab. These tireless rodents race around their cages for hours on end. They lose weight because they rarely stop to eat, and then they drop from exhaustion because they are unable to sleep.

Why? The mice, says Caron, a biochemist at Duke University's Howard Hughes Medical Institute laboratory, are high on dopamine. They lack the genetic mechanism that sponges up this powerful stuff and spirits it away. Result: there is so much dopamine banging around in the poor creatures' synapses that the mice, though drug-free, act as if they were strung out on cocaine.

For years scientists have suspected that genes play a critical role in determining who will become addicted to drugs and who will not. But not until now have they had molecular tools powerful enough to go after the prime suspects. Caron's mice are just the most recent example. By knocking out a single gene—the so-called dopamine-transporter gene—Caron and his colleagues may have created a strain of mice so sated with dopamine that they are oblivious to the allure of cocaine, and possibly alcohol and heroin as well. "What's exciting about our mice," says Caron, "is that they should allow us to test the hypothesis that all these drugs funnel through the dopamine system."

Several dopamine genes have already been tentatively, and controversially, linked to alcoholism and drug abuse. Inherited variations in these genes modify the efficiency with which nerve cells process dopamine, or so the speculation goes. Thus, some scientists conjecture, a dopamine-transporter gene that is superefficient, clearing dopamine from the synapses too rapidly, could predispose some people to a form of alcoholism characterized by violent and impulsive behavior. In essence, they would be mirror images of Caron's mice. Instead of being drenched in dopamine, their synapses would be dopamine-poor.

The dopamine genes known as D2 and D4 might also play a role in drug abuse, for similar reasons. Both these genes, it turns out, contain the blueprints for assembling what scientists call a receptor, a minuscule bump on the surface of cells to which biologically active molecules are attracted. And just as a finger lights up a room by merely flicking a switch, so dopamine triggers a sequence of chemical reactions each time it binds to one of its five known receptors. Genetic differences that reduce the sensitivity of these receptors or decrease their number could diminish the sensation of pleasure.

The problem is, studies that have pur-

COKE'S HIGH IS DIRECTLY TIED TO DOPAMINE LEVELS

CRACK

Prolonged cocaine use deadens nerve endings in the brain's pleasure-regulation system. A brain scan of a cocaine abuser, below, shows a marked drop in the number of functioning dopamine receptors

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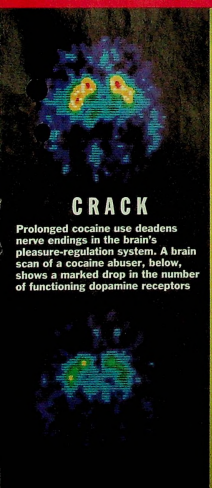

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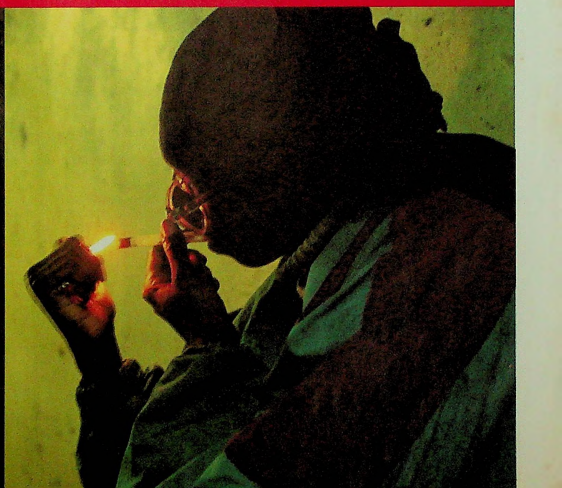


NINA BERMAN—SIPA FOTOPRESS

ALCOHOLICS NEED TO STRIVE FOR TOTAL ABSTINENCE

ported to find a basis for addiction in variations of the D2 and D4 genes have not held up under scrutiny. Indeed, most scientists think addiction probably involves an intricate dance between environmental influences and multiple genes, some of which may influence dopamine activity only indirectly. This has not stopped some researchers from promoting the provocative theory that many people who become alcoholics and drug addicts suffer from an inherited condition dubbed the reward-deficiency syndrome. Low dopamine levels caused by a particular version of the D2 gene, they say, may link a breathtaking array of aberrant behaviors. Among them: severe alcoholism, pathological gambling, binge eating and attention-deficit hyperactivity disorder.

The more science unmasks the powerful biology that underlies addiction, the brighter the prospects for treatment become. For instance, the discovery by Fowler and her team that a chemical that inhibits the mopping-up enzyme MAO B may play a role in cigarette addiction has already opened new possibilities for therapy. A number of well-tolerated MAO B-inhibitor drugs developed to treat Parkinson's disease could find a place in the antismoking arsenal. Equally promising, a Yale University team led by Eric Nestler and David Self has found that another type of compound—one that targets the dopamine receptor known as D1—seems to alleviate, at least in rats, the intense craving that accompanies withdrawal from cocaine. One day, suggests Self, a D1 skin patch might help cocaine abusers kick their habit, just as the nicotine patch attenuates the desire to smoke.

Like methadone, the compound that activates D1 appears to be what is known as a partial agonist. Because such medications stimulate some of the same brain pathways as drugs of abuse, they are often addictive in their own right, though less so. And while treating heroin addicts with methadone may seem like a cop-out to people who have never struggled with a drug habit, clinicians say they desperately need more such agents to tide addicts—particularly cocaine addicts—over the first few months of treatment, when the danger of relapse is highest.

REALISTICALLY, NO ONE BELIEVES better medications alone will solve the drug problem. In fact, one of the most hopeful messages coming out of current research is that the biochemical abnormalities associated with addiction can be reversed through learning. For that reason, all sorts of psychosocial interventions, ranging from psychotherapy to 12-step programs, can and do help. Cognitive therapy, which seeks to supply people with coping skills (exercising after work instead of going to a bar, for instance), appears to hold particular promise. After just 10 weeks of therapy, before-and-after PET scans suggest, some patients suffering from obsessive-compulsive disorder (which has some similarities with addiction) manage to resculpt not only their behavior but also activity patterns in their brain.

In late 20th century America, where drugs of abuse are being used on an unprecedented scale, the mounting evidence that treatment works could not be more welcome. Until now, policymakers have responded to the drug problem as though it were mostly a criminal matter. Only a third of the $15 billion the U.S. earmarks for the war on drugs goes to prevention and treatment. "In my view, we've got things upside down," says Dr. David Lewis, director of the Center for Alcohol and Addiction Studies at Brown University School of Medicine. "By relying so heavily on a criminalized approach, we've only added to the stigma of drug abuse and prevented high-quality medical care."

Ironically, the biggest barrier to making such care available is the perception that efforts to treat addiction are wasted. Yet treatment for drug abuse has a failure rate no different from that for other chronic diseases. Close to half of recovering addicts fail to maintain complete abstinence after a year—about the same proportion of patients with diabetes and hypertension who fail to comply with their diet, exercise and medication regimens. What doctors who treat drug abuse should strive for, says Alan Leshner, director of the National Institute on Drug Abuse, is not necessarily a cure but long-term care that controls the progress of the disease and alleviates its worst symptoms. "The occasional relapse is normal," he says, "and just an indication that more treatment is needed."

Rafael Rios has been luckier than many. He kicked his habit in one lengthy struggle that included four months of in-patient treatment at a residential facility and a year of daily outpatient sessions. During that time, Rios checked into 12-step meetings continually, sometimes attending three a day. As those who deal with alcoholics and drug addicts know, such exertions of will power and courage are more common than most people suspect. They are the best reason yet to start treating addiction as the medical and public health crisis it really is. —*With reporting by Alice Park/New York*

For more on addiction and alcoholism, see our Web report at **time.com/alcoholism**

Illustrations: Saurabh Singh

Piratechnics

YET another software breakthrough from India. Top executives of global software majors are queuing up in a nondescript Kerala village to

negotiate with a 25-year-old computer programmer who claims to have created perhaps the most solid anti-piracy software. Divine Logic 2000, created by Shaju Chacko, a diploma holder in software applications, can both detect pirated software and destroy it. And this program cannot be detected or debugged using any assembly language. Once installed, no one can copy an illegal applications or software from that system. Manufacturers can specify the number of copies to be taken from a licensed program included in floppies or CDs and illegal copying beyond that specified number will be detected and stopped by the programme. Divine Logic also prevents crackers from breaking into the programme since they cannot read or modify any file. Despite lucrative offers, Chacko refuses to sell the product to global IT biggies and is in the process of patenting the program. Another Bill Gates in the making?

Satellite Deal

REMEMBER Iridium, the satellite phone company that went bust and was last seen frantically seeking a buyer? Well, it has at last managed to find one. If things work out the way Iridium hopes, all those satellites won't be lost in space for much longer. The former satellite communications firm, which went broke after sinking millions into a telephone network nobody uses, has asked a court to allow the investment firm of Castle Harlan to buy most of its assets. Castle will purchase the assets for $50 million in cash plus $900,000 a month. It would also give Iridium's senior lenders 5 per cent of the equity of the purchasing entity. The purchase is also likely to include inventory, rights to satellites, certain related contracts and licenses, trademarks, patents and even Iridium's furniture.

Cardinal Sin

ADULT websites have really been hit below the belt. Miffed at American Express' decision to reject transactions from porn sites, adult Internet associations have formed a lobby group saying credit card companies are treating them like 'redheaded stepchildren'. This was the final straw for the Adult Internet Trade Associations who launched Credit Card Watch, a "watchdog group of adult industry leaders" to lobby for better treatment from the card companies. They claim the major card companies have been lax in helping develop technology to reduce credit fraud and other card disputes at porn sites, choosing instead to levy heavy "chargeback" penalties for card disputes. Amex, however, is not ready to budge.

Top 10 Sites of May 2000

Rank	Website	Unique Visitors (000)
1.	yahoo.com	51,165
2.	aol.com	43,546
3.	msn.com	40,329
4.	geocities.com	30,930
5.	microsoft.com	29,348
6.	passport.com	28,929
7.	AOLProprietary.aol	27,351
8.	lycos.com	21,482
9.	altavista.com	19,303
10.	excite.com	18,440

Source: Dun & Bradstreet

Mobile Bite

AND now even mobile phones are becoming the target of cyber villains. A new computer virus targeting mobile phone users—calling them up to deliver an insulting e-mail about a telephone company—has dramatically demonstrated what could be the newest headache to afflict the wireless world. The worm-type virus, called "Timofonica", hit customers of Spain's Movistar service, sending text messages scrolling across the phone screens.

Although mobile operators say the virus isn't a big threat, the most important thing is it's wireless and the first virus that targets cellphones. Security researchers say the virus, transmitted by e-mail, didn't destroy computer files and was more an annoyance than a real danger. But by taking the same basic recipe that spread the notorious "I Love You" virus around the globe last month and applying it to cellphones, the Spanish bug could presage a new breed of viral attack against pocket communicators, palm organisers and the rest of the wireless world. In fact, it's already invaded the short Messaging Services (SMS) by sending a message to an SMS gateway, a computer server that converted the message to telephone signals reaching thousands of cellphone users.

Hard Drive

WHEN the world is focused on the Net, can big companies be far behind? Auto giant General Motors has unveiled the auto industry's largest sales promotion on the Internet, just in time for the summer selling blitz, GM, the world's largest automaker, launched the website, Ticket to Ride, offering incentives of up to $750 available only on the Net. The deals are on selected mid-size cars and sports utility vehicles from Chevrolet, GMC, Oldsmobile, Buick and Pontiac. Such incentives were hitherto available only for consumer

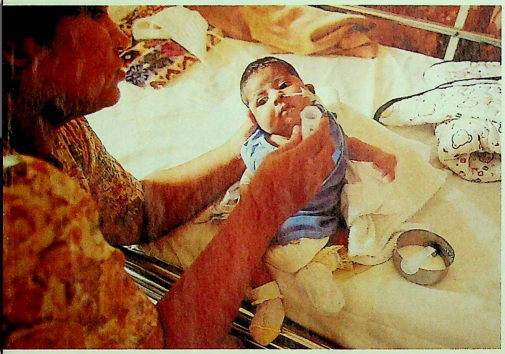
durables, books and CDs. GM says Ticket to Ride uses the Internet to drive consumers to GM's centrepiece website where potential buyers can find 6,300 car and truck dealers and locate the exact vehicle they're shopping for. The GM move is also a fallout of a slump in showroom sales. Daimler Chrysler is also going in for incentives of up to $2,000 on almost all vehicles—but on showroom sales and not in the virtual world. Will it take GM's cue and drive on to the Net?

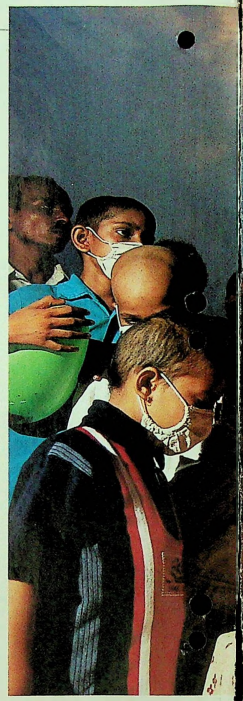
"In time, kids will learn French from Barbie dolls."

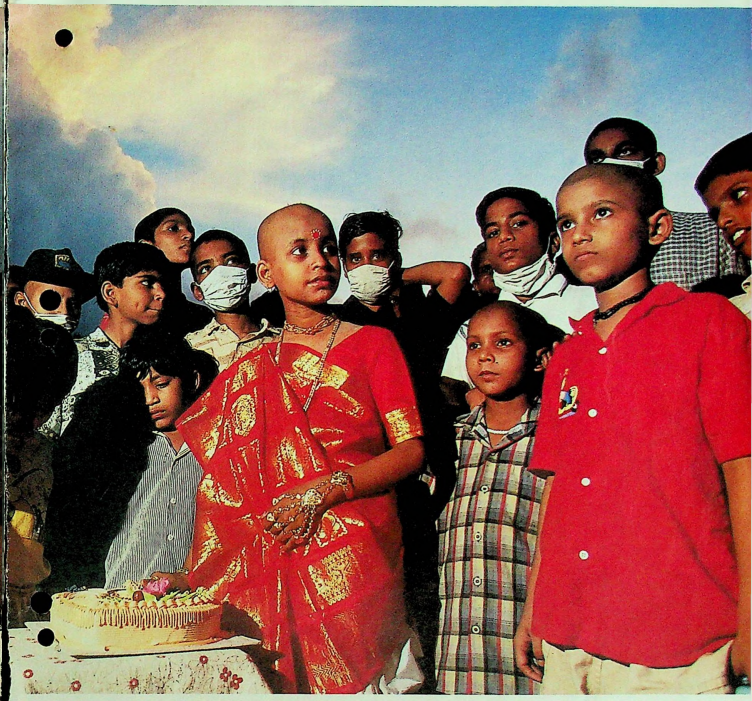
—Nicholas Negroponte, Director, MIT Media Labs, on the future of digital technology.

DUSK FALLS AT DAWN

They are but children. But stalked by premature death, it's a battle where hope is the only tenuous lifeline.







SHANE JUDE FERNANDES Seen here with his mother. This one-and-a-half month old baby from Goa had to undergo surgery at Mumbai because she developed respiratory trouble.

NAVANEETA GOSWAMI (Right) This nine-year-old girl suffers from cancer. She celebrates what may be her last birthday, with other kids who are victims of the same affliction.

By **PAYAL KAPADIA**

SHIVAM Shinde's life depends on the machines around him. Plastic tubes stick out like umbilical cords, connecting his fragile body to various modern-looking contraptions. A dialysis machine flushes out his system. A ventilator helps him breathe. Blood and plasma transfusions prop his flagging haemoglobin count. The last time he was in hospital was five months ago. That was the day he was born.

Shane Jude Fernandes is still to get home. Born one-and-a-half months ago, he developed respiratory problems soon after and was flown down from Goa on oxygen support. One heart surgery later, it looks like Shane is finally homebound.

Varun Nagaonkar bends over his colouring book. He chooses green for the doggie, like most four-year-olds would. His mother says he has a problem with his haemoglobin count; his eyes and tongue were white when he was brought in. What she doesn't know, or isn't telling, is that he's been diagnosed with leukaemia.

Prabhat (name changed) came to the children's home run by Delhi-based NGO Sahara, after his parents succumbed to AIDS. He thinks that his potent breakfast of four tablets and a spoonful of syrup is treating his tuberculosis. He will probably never grow up to understand that he also has HIV.

All these children are newcomers to this world. But sickness and pain are not new to them. While kids their age are warding off schoolyard bullies and chicken pox, these children are fighting a battle they can't afford to lose. The battle for life in a paediatric ICU where death is always around the corner and where life means chemotherapy, or regular hospital checks, or just looking over your shoulder every once in a while.

Says Shane's mother Elizabeth: "You have to be a strong mother and have a positive outlook." And though optimism is hard to come by in such circumstances, Shivam's parents, who have been camping outside the ICU for days, are determined not to crumble with despair. "We hope that he gets better," they say. But it's Varun's mother, Varsha Nagaonkar, who exhibits perhaps the highest degree of sang-froid. The abyss gapes at her and yet she musters the will to hope: "Of course he's in a hospital so I'm scared, but he'll be fine soon." Cryptic words shut out the dark.

ENTIRE families are waiting gracefully, with fortitude. By the bedside, until a sleeping child awakes. In the playroom, armed with paintbrushes and crayons. In the corridors, talking to others like them. With their doctors, measuring up their chances and haggling for a little more time. Courage for them, it seems, is hereditary. And faith too.

The terminally ill child gets by on wish-fulfilment. It is the parents, however, who are the real 'patients'.

Mina Goswami though is running out of faith. Her only child Navanita was diagnosed with cancer two months ago. The Goswamis made their first visit to Mumbai to find treatment for their daughter. "I thought she'd be a doctor," Mina's voice peters out.

Navanita has just turned nine. This birthday might be her last. So this year, the celebrations are very special. In more ways than one. There are more than 20 kids at the party. They all have cancer. Age, gender, all distinguishing features vanish; with their tonsured heads and their protective face-masks, only their eyes speak—they light up in unison with the candles on the birthday cake. The trappings of cancer can't hide the fact that they are just children, braving a disease that makes grown-up men cry.

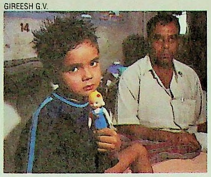
"If she is not here, our lives will be over." cries Navanita's father, Nishikanta. "We will never leave Bombay." The child is not the patient as much as the parents are, according to Dr Soonu Udani, head of the paediatrics department at Mumbai's Hinduja Hospital. "The child is on medication, or under sedation. But it's very hard for parents to accept

Photographs by **ABHIJIT BHATLEKAR**

KAWALJIT KAUR SINGH

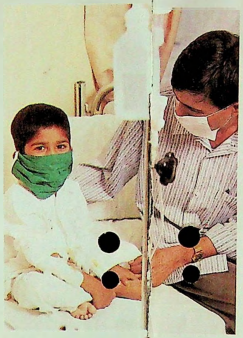
This 14-year-old suffers from thalassemia major (average life-span 21 years) and aspires to be a judge. She also met one besides filmstar Sunil Shetty.

GIREESH G.V.



ZUHI

This six-year-old girl (seen here with her adopted father) suffers from leukaemia. She is now at the Institute Rotary Cancer Hospital, a speciality wing of the All India Institute of Medical Sciences. She belongs to a village in Badayun, UP.



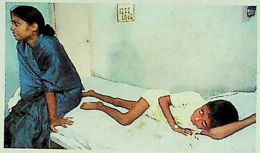
VARUN

He, like any other 4-year-old, loves his drawing book. His mother doesn't know or won't say that he has leukaemia.

SAMINUR

This 8-year-old boy in Calcutta has acute haemophilia. He suffers from internal bleeding in his stomach.

SATISH KUMAR



SWAPAN NAYAK

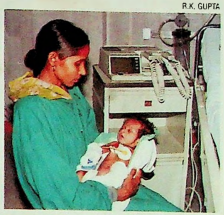
KARTHIK

He is eight years old, belongs to Bangalore and he dropped out of school when he was diagnosed with leukaemia. His father finds it tough to pay for his medication.

MANISH

This new-born baby, currently in SGPGIMS, Lucknow, had to undergo a heart surgery. His parents had lost hope as they didn't have money. Donations saved the day.

R.K. GUPTA



that the situation is unsalvageable." For doctors, communicating their helplessness is a heartless task. Parents want to believe that if their money can buy the best medical care, the road to recuperation will be a sure, if long, one.

It doesn't help when the money lasts shorter than the treatment, and a dying child becomes a drain on the family income. When Nataraj and Anudha were told that their 10-year-old daughter, Geetha, has Ewings Sarcoma and that the initial course of treatment would cost Rs 4 lakh, they first contemplated suicide. For Nataraj, a labourer, the cost was unimaginable, especially when there were two other children to look after.

KARTHIK'S parents had to walk the same tightrope between saving one child's life and ensuring a secure future for the others. Their eight-year-old son quit school after he was diagnosed with leukaemia 15 months ago. He has gone through chemotherapy and radiation; and the expenditure incurred so far has been Rs 2 lakh. "He needs treatment for another 16 to 18 months," cries Shivakumar, Karthik's father, who is employed in a power-loom unit. "It's very difficult to bear the expenses with my salary."

For Manish Yadav's parents too, financial constraints were proving to be a great hurdle in saving their son's life, but thanks to the publicity provided by the electronic medium and the local press, the situation was brought under control in the nick of time. "This is his (Manish's) second life," his surgeon Nirmal Gupta, at the Sanjay Gandhi Post Graduate Institute of Medical Sciences in Lucknow, proclaims proudly.

Manish smiles at his mother Meera as she holds him tightly. She had no idea what her son's ailment was. Avers she: "He used to turn blue sobbing and have irregular breathing, but now he seems fine." Manish had a hole in his heart.

For chronic cases, resignation often replaces initial panic and fear as medical bills mount and the sickness takes a turn for the worse. Doctors get blamed a lot by angry parents who feel shortchanged when a healthy child takes ill and dies. These are the parents who need counselling desperately, to understand why the medical fraternity failed and why they lost a child. Counselling also helps prepare the parents and maybe, even the child, for the bleak road ahead—whether parents should tell an older child that he might die. Or urge them to express their emotions to the child before it's too late. And to include other siblings who might be feeling left out.

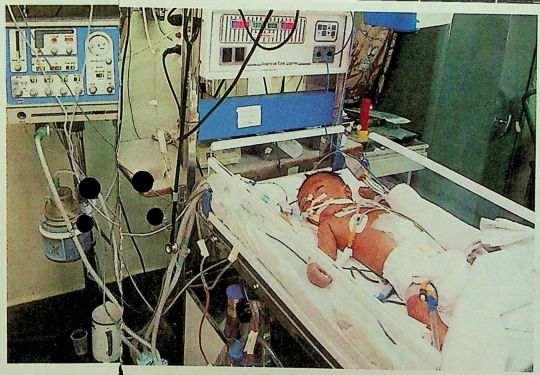
No wonder then that voluntary organisations are targeting the entire family. VCare, a non-profit emotional support group for cancer survivors, organises family outings to involve parents and siblings in the healing process. Cancer patients are introduced to two other cancer survivors to emphasise that cancer isn't another word for terminal. "People say you are dying with cancer—why don't they say that you are living with it?", asks Vandana Gupta, founder of VCare, herself a cancer survivor.

Emotional support, according to Gupta, means many things. To some, it means financial help; to others it means finding a place to stay; and there are also those for whom it means talking to somebody who isn't wearing a doctor's coat.

For younger children, death itself means very little. "They know that they are not feeling well, but what they fear most is that they'd wished they'd become someone great, or take part in some competition," says Gupta. "The interruption seems to upset them more than death itself."

Resignation often replaces initial panic as medical bills mount and the sickness takes a turn for the worse.

Udai Joshi, founder of Make-A-Wish Foundation of India, understands the value of a wish all too well. Especially for a sick child whose short existence doesn't give him enough time to fulfil the wish on his own. Joshi's son, Gandhar, went to the US to get treatment for leukaemia. He died at the age of 10, after the US based Make-A-Wish Foundation granted him his last wish. A family trip to Disneyworld.



Joshi set up the Indian foundation in 1996 to gift happiness to terminal kids. Make-A-Wish volunteers visit hospitals regularly and find children who have been certified as terminal cases. "We build rapport with the parents and the child," says Joshi. "We can fulfil any wish."

Fourteen-year-old Kawaljeet Kaur Singh made two wishes—to meet Sunil Shetty and to meet a judge. Kawaljeet suffers from thalassemia major; the average life-span for such patients is 21 years. Yet, she dreams of becoming a judge. "Even when I see the photographs, I feel so thankful," she says, her face aglow as she recalls the day and runs her fingers lovingly over the photographs.

SHIVAM SHINDE

This five-month-old in Mumbai is in an incubator with tubes coming out of his body like umbilical cords. They are attached to various life-saving gizmos.

For a kid who loves singing and dancing, Navanita's wish was predictable: to dance before a large audience. Make-A-Wish Foundation made the arrangements and Navanita danced. Not to one song, as planned, but to two. "We laughed more than we ever have," gushes Mina, overwhelmed. Now Navanita has only one more wish: to get well so that she can get her hair back.

These organisations provide the human touch. Not a small thing. Only dwarfed in the face of huge medical bills that need to be paid. Shivam's parents are borrowing money to keep him alive; concerns about repaying it have been deferred for now. And miracles do happen. Since *Outlook* did this story, Shivam has made a startling recovery. His cancer went into natural remission, his kidneys recovered and he has gone home. Shane has gone home too. For that half-a-chance that they would live, the cost was worth it. But for the majority of Indians, even that half-a-chance is unaffordable.

In Mumbai, Kawaljeet's treatment costs Rs 1,100 per month. Her father, a cabdriver, has to shell out only Rs 350, the rest is covered by the Mumbai Thalassemic Society. In Bangalore, the Shristi Special Academy runs a project called Drishti, to support terminally ill children like Karthik and Geetha with the help of donations.

If a parent weathers the financial crunch, there is the absence of formal bereavement counselling when a child dies. But in India, strong family support makes up where professional services are missing. And the role of good, old-fashioned fortitude can't be emphasised enough. Grief is followed by relief that the child isn't suffering anymore. And therapists say that parents even visit them after the counselling period has helped them tide over the sorrow. Some of them come to talk and share photographs. Yet others come with the good news that they are expecting children again. ■

With S.R. Srikanth, Ashis K. Biswas, Sutapa Mukerjee and Dhiraj Singh

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FEBRUARY 26, 2001

TIME

JAPAN'S OUTRAGE
The Submarine Incident

HUMAN CLONING IS CLOSER THAN YOU THINK

For couples who can't have a child—or who have lost one—the unthinkable may soon be possible. Here are the perils

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BABY, IT'S YOU! AND YOU, AND YOU ...

Digital illustration for TIME by Arthur Hochstein and Lon Tweeten. Photograph of baby by Penny Gentieu—Babystock

Renegade scientists say they are ready to start applying the technology of cloning to human beings. Can they really do it, and how scary would that be?

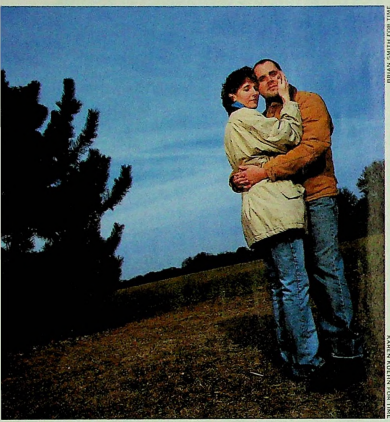
BY NANCY GIBBS

BEFORE WE ASSUME THAT THE MARKET FOR HUMAN CLONES CONSISTS MAINLY OF NARcissists who think the world deserves more of them or neo-Nazis who dream of cloning Hitler or crackpots and mavericks and mischief makers of all kinds, it is worth taking a tour of the marketplace. We might just meet ourselves there.

Imagine for a moment that your daughter needs a bone-marrow transplant and no one can provide a match; that your wife's early menopause has made her infertile; or that your five-year-old has drowned in a lake and your grief has made it impossible to get your mind around the fact that he is gone forever. Would the news then really be so easy to dismiss that around the world, there are scientists in labs pressing ahead with plans to duplicate a human being, deploying the same technology that allowed Scottish scientists to clone Dolly the sheep four years ago?

All it took was that first headline about the astonishing ewe, and fertility experts began to hear the questions every day. Our two-year-old daughter died in a car crash; we saved a lock of her hair in a baby book. Can you clone her? Why does the law allow people more freedom to destroy fetuses than to create them? My husband had cancer and is sterile. Can you help us?

The inquiries are pouring in because some scientists are ever more willing to say yes, perhaps we can. Last month a well-known infertility specialist, Panayiotis



CLONING TO CREATE LIFE ...

Infertile because of cancer therapy, Dorner, with wife Nancy, wants to make a baby through cloning. Lesbian partners DeShazo and Thomas, right, also find the idea enticing

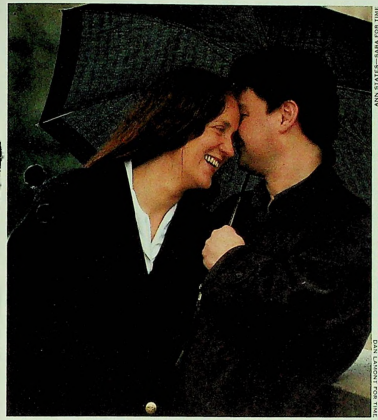
Zavos of the University of Kentucky, announced that he and Italian researcher Severino Antinori, the man who almost seven years ago helped a 62-year-old woman give birth using donor eggs, were forming a consortium to produce the first human clone. Researchers in South Korea claim they have already created a cloned human embryo, though they destroyed it rather than implanting it in a surrogate mother to develop. Recent cover stories in *Wired* and the New York *Times* Magazine tracked the efforts of the Raelians, a religious group committed to, among other things, welcoming the first extraterrestrials when they appear. They intend to clone the cells of a dead 10-month-old boy whose devastated parents hope, in effect, to bring him back to life as a newborn. The Raelians say they have the lab and the scientists, and—most important, considering the amount of trial and error involved—they say they have 50 women lined up to act as surrogates to carry a cloned baby to term.

Given what researchers have learned since Dolly, no one thinks the mechanics of cloning are very hard: take a donor egg, suck out the nucleus, and hence the DNA, and fuse it with, say, a skin cell from the human being copied. Then, with the help of an electrical current, the reconstituted cell should begin growing into a genetic duplicate. "It's inevitable that someone will try and someone will succeed," predicts Delores Lamb, an infertility expert at Baylor University in Texas. The consensus among biotechnology specialists is that within a few years—some scientists believe a few months—the news will break of the birth of the first human clone.

At that moment, at least two things will happen—one private, one public. The meaning of what it is to be human—which until now has involved, at the very least, the mysterious melding of two different people's DNA—will shift forever, along with our understanding of the relationship between parents and children, means and ends, ends and beginnings. And as a result, the conversation that has occupied scientists and ethicists for years, about how much man should mess with nature when it comes to reproduction, will drop onto every kitchen table, every pulpit, every politician's desk. Fierce debate over issues like abortion and euthanasia will seem tame and transparent compared with the questions that human cloning raises.

That has many scientists scared to death. Because even if all these headlines are hype and we are actually far away from seeing the first human clone, the very fact that at this moment the research is proceeding underground, unaccountable, poses a real threat. The risk lies not just with potential babies born deformed, as many animal clones are; not just with desperate couples and cancer patients and other potential "clients" whose hopes may be raised and hearts broken and life savings wiped out. The immediate risk is that a backlash against renegade science might strike at responsible science as well.

The more scared people are of some of this research, scientists worry, the less likely they are to tolerate any of it. Yet variations on cloning technology are already used in biotechnology labs all across the country. It is these techniques that will allow, among other things, the creation of cloned herds of sheep and cows that produce medicines in their milk. Researchers also hope that one day, the ability to clone adult human cells will make it possible to "grow" new hearts and livers and nerve cells.



IN THE FAMILY: Sabine Saltic experienced menopause prematurely. She and husband Eyup prefer cloning to using a stranger's eggs

THIRD SHOT: Cloning is a fantasy of Matt Racquer and Desiree Boen; she had a hysterectomy after bearing two kids in a previous marriage

But some of the same techniques could also be used to grow a baby. Trying to block one line of research could impede another and so reduce the chances of finding cures for ailments such as Alzheimer's and Parkinson's, cancer and heart disease. Were some shocking breakthrough in human cloning to cause "an overcompensatory response by legislators," says cloning expert Tony Perry of New York City's Rockefeller University, "that could be disastrous. At some point, it will potentially cost lives." So we are left with choices and trade-offs and a need to think through whether it is this technology that alarms us or just certain ways of using it.

WHAT IF ... a child dies and one parent wants to clone but the other doesn't? Who owns the rights to a dead person's DNA?

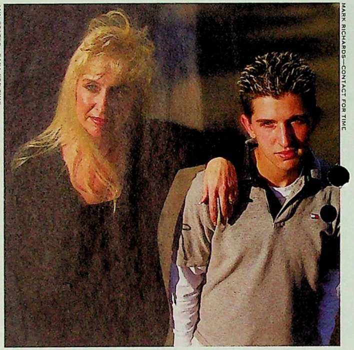
BY DAY, RANDOLFE WICKER, 63, RUNS A lighting shop in New York City. But in his spare time, as spokesman for the Human Cloning Foundation, he is the face of cloning fervor in the U.S. "I took one step in this adventure, and it took over me like quicksand," says Wicker. He is planning to have some of his skin cells stored for future cloning. "If I'm not cloned before I die, my estate will be set up so that I can be cloned after," he says, admitting, however, that he hasn't found a lawyer willing to help. "It's hard to write a will with all these uncertainties," he concedes. "A lot of lawyers will look at me crazy."

As a gay man, Wicker has long been frustrated that he cannot readily have children of his own; as he gets older, his desire to reproduce grows stronger. He knows that a clone would not be a photocopy of him but talks about the traits the boy might possess: "He will like the color blue. Middle Eastern food and romantic Spanish music that's out of fashion." And then he hints at the heart of his motive. "I can thumb my nose at Mr. Death and say, 'You might get me, but you're not going to get all of me,'" he says. "The special formula that is me will live on into another lifetime. It's a partial triumph over death. I would leave my imprint not in sand but in cement."

This kind of talk makes ethicists conclude that even people who think they know about cloning—let alone the rest of us—don't fully understand its implications. Cloning, notes ethicist Arthur Caplan of the University of Pennsylvania, "can't make you immortal because clearly the clone is a different person. If I take twins and shoot one of them, it will be faint consolation to the dead one that the other one is still running around, even though they are genetically identical. So the road to immortality is not through cloning."

Still, cloning is the kind of issue so confounding that you envy the purists at either end of the argument. For the Roman Catholic Church, the entire question is one of world view: whether life is a gift of love

ANN STATES—SABA FOR TIME



MARK RICHARDS—CONTACT FOR TIME

AND TO KEEP LOVE ALIVE ... Marion Vuchetich hopes tissue from her late son may be the source of future organ transplants for her family; Christie Silva wants cloning to produce new kidneys for her diabetic son Travis

or just one more industrial product, a little more valuable than most. Those who believe that the soul enters the body at the moment of conception think it is fine for God to make clones; he does it about 4,000 times a day, when a fertilized egg splits into identical twins. But when it comes to massaging a human life, for the scientist to do mechanically what God does naturally is to interfere with his work, and no possible benefit can justify that presumption.

On the other end of the argument are the libertarians who don't like politicians or clerics or ethics boards interfering with what they believe should be purely individual decisions. Reproduction is a most fateful lottery; in their view, cloning allows you to hedge your bet. While grieving parents may be confused about the technology—cloning, even if it works, is not resurrection—their motives are their own business. As for infertile couples, "we are interested in giving people the gift of life," Zavos, the aspiring cloner, tells TIME. "Ethics is a wonderful word, but we need to look beyond the ethical issues here. It's not an ethical issue. It's a medical issue. We have a duty here. Some people need this to complete the life cycle, to reproduce."

In the messy middle are the vast majority of people who view the prospect with a vague alarm, an uneasy sense that science is dragging us into dark woods with no paths and no easy way to turn back. Ian Wilmut, the scientist who cloned Dolly but has come out publicly against human cloning, was not trying to help sheep have genetically related children. "He was trying to help farmers produce genetically improved sheep," notes ethicist Erik Parens of the Hastings Center in New York state. "And surely that's how the technology will go with us too." Cloning, Parens says, "is not simply this isolated technique out there that a few deluded folks are going to avail themselves of, whether they think it is a key to immortality or a way to bring someone back from the dead. It's part of a much bigger project. Essentially the big-picture question is, To what extent do we want to go down the path of using reproductive technologies to genetically shape our children?"

[WHAT IF . . . people don't want to be cloned after they die? Will they be able to insert a do-not-clone clause in their will?]

AT THE MOMENT, THE AMERICAN PUBLIC IS plainly not ready to move quickly on cloning. In a TIME/CNN poll, 90% of respondents thought it was a bad idea to clone human beings. "Cloning right now looks like it's coming to us on a magic carpet, piloted by a cult leader, sold to whoever can afford it," says ethicist Caplan. "That makes people nervous."

And it helps explain why so much of the research is being done secretly. We may learn of the first human clone only months, even years, after he or she is born—if the event hasn't happened already, as some scientists speculate. The team that cloned Dolly waited until she was seven months old to announce her existence. Creating her took 277 tries, and right up until her birth, scientists around the world were saying that cloning a mammal from an adult cell was impossible. "There's a significant gap between what scientists are willing to talk about in public and their private aspirations," says British futurist Patrick Dixon. "The law of genetics is that the work is always significantly further ahead than the news. In the digital world, everything is hyped because there are no moral issues—there is just media excitement. Gene technology creates so many ethical issues that scientists are scared stiff of a public reaction if the end results of their research are known."

Of course, attitudes often change over time. In-vitro fertilization was effectively illegal in much of the U.S. 20 years ago, and the idea of transplanting a heart was once considered horrifying. Public opinion on cloning will evolve just as it did on these issues, advocates predict. But in the meantime, the crusaders are mostly driven underground. Princeton biologist Lee Silver says fertility specialists have told him that they have no problem with cloning and would be happy to provide it as a service to their clients who could afford it. But these same specialists would never tell inquiring reporters that, Silver says—it's too hot a topic right now. "I think what's happened is that all the mainstream doctors have taken a hands-off approach because of this huge public outcry. But I think what they are hoping is that some fringe group will pioneer it and that it will slowly come into the mainstream and then they will be able to provide it to their patients."

All it will take, some predict, is that first snapshot. "Once you have a picture of a normal baby with 10 fingers and 10 toes, that changes everything," says San Mateo, California, attorney and cloning advocate Mark Eibert, who gets inquiries from infertile couples every day. "Once they put a child in front of the cameras, they've won." On the other hand, notes Gregory Pence, a professor of philosophy at the University of Alabama at Birmingham and author of *Who's Afraid of Human Cloning?*, "if the first baby is defective, cloning will be banned for the next 100 years."

"I WOULDN'T MIND BEING THE FIRST PERSON cloned if it were free. I don't mind being a guinea pig," says Doug Dorner, 35. He and his wife Nancy both work in health care. "We're not afraid of technology," he says. Dorner has known since he was 16 that he would never be able to have children the old-fashioned way. A battle with lymphoma left him sterile, so when he and Nancy started thinking of having children, he began following the scientific developments in cloning more closely. The more he read, the more excited he got. "Technology saved my life when I was 16," he says, but at the cost of his fertility. "I think technology should help me have a kid. That's a fair trade."

Talk to the Dorners, and you get a glimpse of choices that most parents can scarcely imagine having to make. Which parent, for instance, would they want to clone? Nancy feels she would be bonded to

HUMAN CLONING

MY SISTER, MY CLONE

I have a clone. She lives in Pittsburgh, Pennsylvania, and her name is Diana. She's my body double: blond hair, hazel eyes and fair skin. She's 1 cm taller, but we have the same voices and the same mannerisms. We're both unmarried. We love to read, we relish Mexican food, and we get the same patches of dry skin in winter. We both play tennis and golf. O.K., she's funnier than I am—but just a little.

In the debate over the ethical, emotional and practical implications of human cloning, identical twins—distinct beings who share the same DNA—present the closest analogy. Identical twins are in fact more similar to each other than a clone would be to his or her original, since twins gestate simultaneously in the same womb and are raised in the same environment at the same time, usually by the same parents.

But even with our genes and backgrounds the same, my sister and I are very different people. Diana is a corporate lawyer; I'm a former magazine editor, now a literary agent. She studied classics at Bryn Mawr; I studied the history of religion at Vassar. She favors clothes that have actual colors in them; I opt for black. She's politically conservative; I'm more liberal. She's a pragmatist; I'm an optimist.

COURTESY SUSAN REED

BEING DOUBLE: Reed, left, and her twin are more alike than clones would be but are still different

We're not the only twins with differences in our family. My father, a writer and former diplomat, had an identical twin brother, Francis, who was a right-brained banker. Francis, who died in 1992, also had identical twin daughters. My cousin Rose is an intense adventurist while her sister Peg is softer and more traditional.

Of course, there are ways in which identical twins are bound together that are more profound than the usual sibling links. When I walk into a room, it takes no more than a glance before I can sense my twin's mood—if she's happy or tense or upset. I know what it's about and why. It's something I suspect few people, maybe not even all twins, experience. Would clones? I suspect not, since their life experiences would be so different.

Other connections between Diana and me may be more related to our matching DNA and thus more applicable to clones. My twin and I filter information in much the same way, and we think, perceive and interpret things similarly. When we're together, we often respond simultaneously with the same word or sentence. We have put on the same T shirt on the same day in different cities. We have friends who are twins, both doctors, who have similar experiences. They took a pharmacy class together in medical school but sat across the classroom from each other and took separate notes. They studied separately for the exam. When it was returned, they had missed the same questions, for the same reasons.

Despite these shared propensities, people who hope they can create a duplicate of, say, a lost child may be setting up that clone for heartbreak. Imagine the expectations that would be created for such a person. Comparisons are tough enough on identical twins. Between Diana and me, there were issues such as who got the better grade, who scored more points in a basketball game, who had more friends. But neither of us had to live with the idea that she was created to match up to the other's best features. A cloned child might not play the piano as well as the original. Or be as smart.

Identical twins are living proof that identical DNA doesn't mean identical people. My sister and I may have the same hardwiring—and a wire that connects us. We have fun with our similarities, but at the end of the day, there's no confusion about who is who. Just as the fingerprints of all individuals, even identical twins, are unique, so are their souls. And you can't clone a soul.

—*By Susan Reed*

the child just from carrying him, so why not let the child have Doug's genetic material? Does it bother her to know she would, in effect, be raising her husband as a little boy? "It wouldn't be that different. He already acts like a five-year-old sometimes," she says with a laugh.

How do they imagine raising a cloned child, given the knowledge they would have going in? "I'd know exactly what his basic drives were," says Doug. The boy's dreams and aspirations, however, would be his own, Doug insists. "I used to dream of being a fighter pilot," he recalls, a dream lost when he got cancer. While they are at it, why not clone Doug twice? "Hmm. Two of the same kid," Doug ponders. "We'll cross that bridge when we come to it. But I know we'd never clone our clone to have a second child. Once you start copying something, who knows what the next copies will be like?"

In fact, the risks involved with cloning mammals are so great that Wilmut, the premier cloner, calls it "criminally irresponsible" for scientists to be experimenting on humans today. Even after four years of practice with animal cloning, the failure rate is still overwhelming: 98% of embryos never implant or die off during gestation or soon after birth. Animals that survive can be nearly twice as big at birth as is normal, or have extra-large organs or heart trouble or poor immune systems. Dolly's "mother" was six years old when *she* was cloned. That may explain why Dolly's cells show signs of being older than they actually are—scientists joked that she was really a sheep in lamb's clothing. This deviation raises the possibility that beings created by cloning adults will age abnormally fast.

WHAT IF . . . it becomes acceptable to clone a person once. What about 10 times? One hundred?

"We had a cloned sheep born just before Christmas that was clearly not normal," says Wilmut. "We hoped for a few days it would improve and then, out of kindness, we euthanized it, because it obviously would never be healthy." Wilmut believes "it is almost a certainty" that cloned human children would be born with similar maladies. Of course, we don't euthanize babies. But these kids would probably die very prematurely anyway. Wilmut pauses to consider the genie he has released with Dolly and the hopes he has raised. "It seems such a profound irony," he says, "that in trying to make a copy of a child who has died tragically, one of the most likely outcomes is another dead child."

That does not seem to deter the scientists who work on the Clonaid project run by the Raelian sect. They say they are willing to try to clone a dead child. Though their outfit is easy to mock, they may be even further along than the competition, in part because they have an advantage over other teams. A formidable obstacle to human cloning is that donor eggs are a rare commodity, as are potential surrogate mothers, and the Raelians claim to have a supply of both.

Earlier this month, according to Brigitte Boisselier, Clonaid's scientific director, somewhere in North America a young woman walked into a Clonaid laboratory whose location is kept secret. Then, in a procedure that has been done thousands of times, a doctor inserted a probe, removed 15 eggs from the woman's ovaries and placed them in a chemical soup. Two weeks ago two other Clonaid scientists, according to the group, practiced the delicate art of removing the genetic material from each of the woman's eggs. Within the next few weeks, the Raelian scientific team plans to place another cell next to the enucleated egg.

This second cell, they say, comes from a 10-month-old boy who died during surgery. The two cells will be hit with an electrical charge, according to the scenario, and will fuse, forming a new hybrid cell that no longer has the genes of the young woman but now has the genes of the dead child. Once the single cell has developed into six to eight cells, the next step is to follow the existing, standard technology of assisted reproduction: gingerly insert the embryo into a woman's womb and hope it implants. Clonaid scientists expect to have implanted the first cloned human embryo in a surrogate mother by next month.

Even if the technology is basic, and even if it appeals to some infertile couples, should grieving parents really be pursuing this route? "It's a sign of our growing despotism over the next generation," argues University of Chicago bioethicist Leon Kass. Cloning introduces the possibility of parents' making choices for their children far more fundamental than whether to give them piano lessons or straighten their teeth. "It's not just that parents will have particular hopes for these children," says Kass. "They will have expectations based on a life that has already been lived. What a thing to do—to carry on the life of a person who has died."

The libertarians are ready with their answers. "I think we're hypercritical about people's reasons for having children," says Pence. "If they want to re-create their dead children, so what?" People have always had self-serving reasons for having children, he argues, whether to ensure there's someone to care for them in their old age or to relive their youth vicariously. Cloning is just another reproductive tool; the fact that it is not a perfect tool, in Pence's view, should not mean it should be outlawed altogether. "We know there are millions of girls who smoke and drink during pregnancy, and we know what the risks to the fetus are, but we don't do anything about it," he notes. "If we're going to regulate cloning, maybe we should regulate that too."

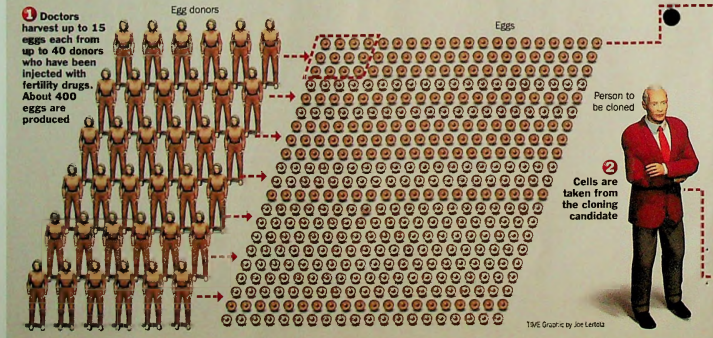
OLGA TOMUSYAK WAS TWO WEEKS SHY OF her seventh birthday when she fell out of the window of her family's apartment. Her parents could barely speak for a week after she died. "Life is empty without her," says her mother Tanya, a computer programmer in Sydney, Australia. "Other parents we have talked to who have lost children say it will never go away." Olga's parents cremated the child before thinking of the cloning option. All that remains are their memories, some strands of hair and three baby teeth, so they have begun investigating whether the teeth could yield the nuclei to clone her one day. While it is theoretically possible to extract DNA from the teeth, scientists say it is extremely unlikely.

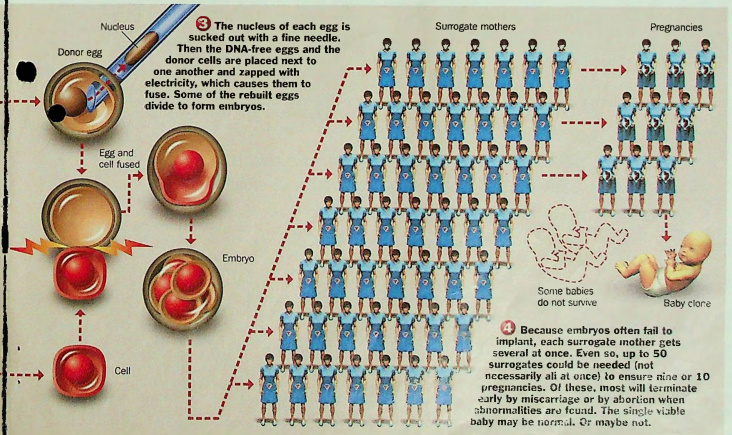
"You can't expect the new baby will be exactly like her. We know that is not possible," says Tanya. "We think of the clone as her twin or at least a baby who will look like her." The parents would consider the new little girl as much Olga's baby as

HOW TO CLONE A HUMAN

If it works in humans as it has in other mammals, cloning will be technically possible, but also terribly inefficient and risky.

According to experts, producing a single viable clone will require scores of volunteers to donate eggs and carry embryos—most of which will have major abnormalities and never come to term. The clones that do survive could suffer more subtle problems that might show up well after birth. Here's how it might be done.





their own. "Anything that grows from her will remind us of her," says Tanya. Though she and her husband are young enough to have other children, for now, this is the child they want.

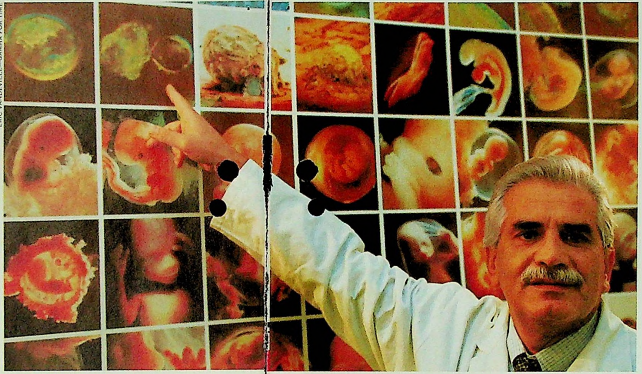
Once parents begin to entertain the option of holding on to some part of a child, why would the reverse not be true? "Bill" is a guidance counselor in Southern California, a fortysomething expectant father who has been learning everything he can about the process of cloning. But it is not a lost child he is looking to replicate. He is interested in cloning his mother, who is dying of pancreatic cancer. He has talked to her husband, his siblings, everyone except her doctor—and her, for fear that it will make her think they have given up hope on her. He confides, "We might end up making a decision without telling her."

His goal is to extract a tissue specimen from his mother while it's still possible and store it, to await the day when—if—cloning becomes technically safe and socially acceptable. Two weeks ago, as his mother's health weakened, the family began considering bringing up the subject with her because they need her cooperation to take the sample. Meanwhile, Bill has already contacted two labs about tissue storage, one as a backup. "I'm in touch with a couple of different people who might be doing that," he says, adding that both are in the U.S. "It seems like a little bit of an underground movement, you know—people are a little reluctant that if they announce it, they might be targeted, like the abortion clinics."

If Bill's hopes were to materialize and the clone were born, who would that person be? "It wouldn't be my mother but a person who would be very similar to my mother, with certain traits. She has a lot of great traits: compassion and intelligence and looks," he says. And yet, perhaps inevitably, he talks as though this is a way to rewind and replay the life of someone he loves. "She really didn't have the opportunities we had in the baby-boom generation, because her parents experienced the Depression and the war," he says. "So the feeling is that maybe we could give her some opportunities that she didn't have. It would be sort of like we're taking care of her now. You know how when your parents age and everything shifts, you start taking care of them?

DAVID A. BURNETT—CONTACT FOR TIME

ERIC VANDEVILLE—GAMMA FOR TIME



READY TO GO: Zavos, above, and Antinori, right, claim to have numerous infertile clients waiting to buy their cloning services

Well, this would be an extension of that."

A world in which cloning is commonplace confounds every human relationship, often in ways most potential clients haven't considered. For instance, if a woman gives birth to her own clone, is the child her daughter or her sister? Or, says bioethicist Kass, "let's say the child grows up to be the spitting image of its mother. What impact will that have on the relationship between the father and his child if that child looks exactly like the woman he fell in love with?" Or, he continues, "let's say the parents have a cloned son and then get divorced. How will the mother feel about seeing a copy of the person she hates most in the world every day? Everyone thinks about cloning from the point of view of the parents. No one looks at it from the point of view of the clone."

If infertile couples avoid the complications of choosing which of them to clone and instead look elsewhere for their DNA, what sorts of values govern that choice? Do they pick an uncle because he's musical, a willing neighbor because she's brilliant? Through that door lies the whole unsettling debate about designer babies, fueled already by the commercial sperm banks that promise genius DNA to prospective parents. Sperm banks give you a shot at passing along certain traits; cloning all but assures it.

Whatever the moral quandaries, the one-stop-shopping aspect of cloning is a plus to many gay couples. Lesbians would have the chance to give birth with no male involved at all; one woman could contribute the ovum, the other the DNA. Christine DeShazo and her partner Michele Thomas of Miramar, Florida, have been in touch with Zavos about producing a baby this way. Because they have already been ostracized as homosexuals, they aren't worried about the added social sting that would come with cloning. "Now [people] would say, 'Not only are you a lesbian, you are a cloning lesbian,'" says Thomas. As for potential health problems, "I would love our baby if its hand was attached to its head," she says. DeShazo adds, "If it came out green, I would love it. Our little alien ..."

[WHAT IF . . . cloning becomes popular and supplants natural selection? Will that skew the course of human evolution?]

Just as women have long been able to have children without a male sexual partner, through artificial insemination, men could potentially become dads alone: replace the DNA from a donor egg with one's own and then recruit a surrogate mother to carry the child. Some gay-rights advocates even argue that should sexual preference prove to have a biological basis, and should genetic screening lead to terminations of gay embryos, homosexuals would have an obligation to produce gay children through cloning.

All sorts of people might be attracted to the idea of the ultimate experiment in single parenthood. Jack Barker, a marketing specialist for a corporate-relocation company in Minneapolis, is 36 and happily unmarried. "I've come to the conclusion that I don't need a partner but can still have a child," he says. "And a clone would be the perfect child to have because I know exactly what I'm getting." He understands that the child would not be a copy of him. "We'd be genetically identical," says Barker. "But he wouldn't be raised by my parents—he'd be raised by me." Cloning, he hopes, might even let him improve on the original: "I have bad allergies and asthma. It would be nice to have a kid like you but with those improvements."

Cloning advocates view the possibilities as a kind of liberation from travails assumed to be part of life: the danger that your baby will be born with a disease that will kill him or her, the risk that you may one day need a replacement organ and die waiting for it, the helplessness you feel when confronted with unbearable loss. The challenge facing cloning pioneers is to make the case convincingly that the technology itself is not immoral, however immorally it could be used.

One obvious way is to point to the broader benefits. Thus cloning proponents like to attach themselves to the whole arena of stem-cell research, the brave new world of inquiry into how the wonderfully pliable cells of seven-day-old embryos behave. Embryonic stem cells eventually turn into every kind of tissue, including brain, muscle, nerve and blood. If scientists could harness their powers, these cells could serve as the body's self-repair kit, providing cures for Parkinson's, diabetes, Alzheimer's and paralysis. Actors Christopher Reeve, paralyzed by a fall from a horse, and Michael J. Fox, who suffers from Parkinson's, are among those who have pushed Congress to overturn the U.S. government's restrictions on federal funding of embryonic-stem-cell research.

But if the cloners want to climb on this train in hopes of riding it to a public relations victory, the mainstream scientists want to push them off. Because researchers see the potential benefits of understanding embryonic stem cells as immense, they are intent on avoiding controversy over their use. Being linked with the human-cloning activists is their nightmare. Says Michael West, president of Massachusetts-based Advanced Cell Technology, a biotech company that uses cloning technology to develop human medicines: "We're really concerned that if someone goes off and clones a Raelian, there could be an overreaction to this craziness—especially by regulators and Congress. We're desperately concerned—and it's a bad metaphor—about throwing the baby out with the bath water."

TIME/CNN POLL

Is it a good or bad idea to clone animals such as sheep?

Good idea	29%	Bad idea	67%

Is it a good idea to clone human beings?

Good idea	7%	Bad idea	90%

What is the main reason you are against cloning humans?*

Religious beliefs	34%
Interferes with human distinctiveness/individuality	22%
Used for questionable purposes like breeding a superior race	22%
The technology is dangerous	14%

*Asked of the 914 people who think human cloning is a bad idea

Is it against God's will to clone humans?

Yes	69%	No	23%

Do the following justify creating a human clone?

	YES	NO
To produce clones whose vital organs can be used to save others	28%	68%
To save the life of the person being cloned	21%	74%
To help infertile couples have children	20%	76%
To allow parents to have a twin child later	10%	88%
To allow parents to create clone of child they lost	10%	88%
To allow gay couples to have children	10%	86%
To create genetically superior human beings	6%	92%

Would a clone of a dead person have his or her same personality?

Yes	10%	No	74%

If you had a chance, would you clone yourself?

Yes	5%	No	93%

When will it be possible to create a human clone? In next:

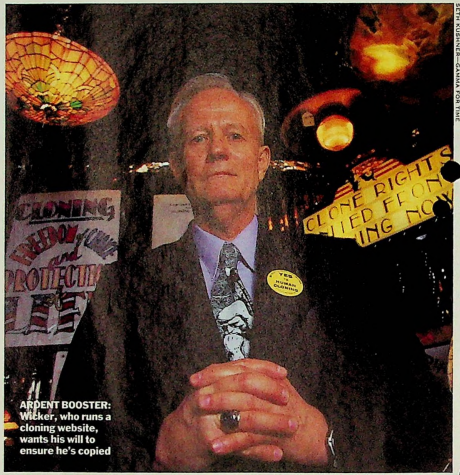
10 years	45%	50+ years	10%
20 years	23%	Never	15%

From a telephone poll of 1,015 adult Americans taken for TIME/CNN on Feb. 7-8 by Yankelovich Partners Inc. Sampling error is ±3.1%. "Not sures" omitted

Scientists at ACT are leery of revealing too much about their animal-cloning research, much less their work on human embryos. "What we're doing is the first step toward cloning a human being, but we're not cloning a human being," says West. "The miracle of cloning isn't what people think it is. Cloning allows you to make a genetically identical copy of an animal, yes, but in the eyes of a biologist, the real miracle is seeing a skin cell being put back into the egg cell, taking it back in time to when it was an undifferentiated cell, which then can turn into any cell in the body." Which means that new, pristine tissue could be grown in labs to replace damaged or diseased parts of the body. And since these replacement parts would be produced using skin or other cells from the suffering patient, there would be no risk of rejection. "That means you've solved the age-old problem of transplantation," says West. "It's huge."

So far, the main source of embryonic stem cells is "leftover" embryos from IVF clinics; cloning embryos could provide an almost unlimited source. Progress could come even faster if Congress were to lift the restrictions on federal funding—which might have the added safety benefit of the federal oversight that comes with federal dollars. "We're concerned about George W. Bush's position and whether he'll let existing guidelines stay in place," says West. "People are begging to work on those cells."

That impulse is enough to put the Roman Catholic Church in full revolt; the Vatican has long condemned any research that involves creating and experimenting with human embryos, the vast majority of which inevitably perish. The church believes that the soul is created at the moment of conception, and that the embryo is worthy of protection. It reportedly took 104 attempts before the first IVF baby, Louise Brown, was born; cloning Dolly took more than twice that. Imagine, say opponents, how many embryos would be lost in the effort to clone a human. This loss is mass murder, says David Byers, director of the National Conference of Catholic Bishops' commission on science and human values. "Each of the embryos is a human being simply by dint of its genetic makeup."



SETH KUGINER—GAMMA FOR TIME

ARDENT BOOSTER: Wicker, who runs a cloning website, wants his will to ensure he's copied

Two weeks ago 160 bishops and five Cardinals met for three days behind closed doors in Irving, Texas, to wrestle with the issues biotechnology presents. But the cloning debate does not break cleanly even along religious lines. "Rebecca," a thirty-something California resident, spent seven years trying to conceive a child with her husband. Having "been to hell and back" with IVF treatment, Rebecca is now as thoroughly committed to cloning as she is to Christianity. "It's in the Bible—be fruitful and multiply," she says. "People say, 'You're playing God.' But we're not. We're using the raw materials the good Lord gave us. What does the doctor do when the heart has stopped? They have to do direct massage of the heart. You could say the doctor is playing God. But we save a life. With human cloning, we're not so much saving a life as creating a new being by manipulation of the raw materials, DNA, the blueprint for life. You're simply using it in a more creative manner."

WHAT IF . . . a clone develops unforeseen abnormalities? Could he sue his parents—or the cloners—for wrongful birth?

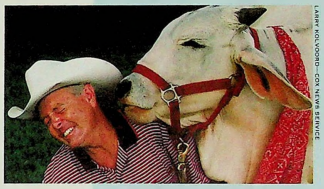
A field where emotions run so strong and hope runs so deep is fertile ground for profiteers and charlatans. In her effort to clone her daughter Olga, Tanya Tomusyak contacted an Australian firm, Southern Cross Genetics, which was founded three years ago by entrepreneur Graeme Sloan to preserve DNA for future cloning. In an e-mail, Sloan told the parents that Olga's teeth would provide more than enough DNA—even though that possibility is remote. "All DNA samples are placed in computer-controlled liquid-nitrogen tanks for long-term storage," he wrote. "The cost of doing a DNA fingerprint and genetic profile and placing the sample into storage would be $2,500. Please note that all of our fees are in U.S. dollars."

When contacted by TIME, Sloan admitted, "I don't have a scientific background. I'm pure business. I'd be lying if I said I wasn't here to make a dollar out of it. But I would like to see organ cloning become a reality." He was inspired to launch the business, he says, after a young cousin died of leukemia. "There are megadollars involved, and everyone is racing to be the first," he says. As for his own slice of the pie, Sloan says he just sold his firm to a French company, which he refuses to name, and that he is heading for Hawaii. The Southern Cross factory address turns out to be his mother's house, and his "office" phone is answered by a man claiming to be his brother David—although his mother says she has no son by that name.

The more such peddlers proliferate, the more politicians will be tempted to invoke prohibitions. Four U.S. states—California, Louisiana, Michigan and Rhode Island—have already banned human cloning, and soon Texas may become the fifth. Republican state senator Jane Nelson has introduced a bill in Austin that would impose a fine of as much as $1 million for researchers who use cloning technology to initiate pregnancy in humans. A proposed Texas law would permit embryonic-stem-cell research, but bills proposed in other states were so broadly written that they could have stopped those activities too.

"The short answer to the cloning question," says ethicist Caplan, "is that anybody who clones somebody today should be arrested. It would be barbaric human experimentation. It would be killing fetuses and embryos for no purpose, none, except for curiosity. But if you can't agree that that's wrong to do, and if the media can't agree to condemn rather than gawk, that's a condemnation of us all."

—*Reported by David Bjerklie and Andrea Dorfman/New York, Wendy Cole/Chicago, Jeanne DeQuine/Miami, Helen Gibson/London, David S. Jackson/Los Angeles, Leora Moldofsky/Sydney, Timothy Roche/Atlanta, Chris Taylor/San Francisco, Cathy Booth Thomas/Dallas and Dick Thompson/Washington, with other bureaus*


LARRY TOWELL—CORBIS SABA FOR TIME

SECOND CHANCE, a bull cloned from another called Chance, puzzles its owner

COPYDOG, COPYCAT

"I've never met a human worth cloning," says cloning expert Mark Westhusin from the cramped confines of his lab at Texas A&M University. "It's a stupid endeavor." That's an interesting choice of adjective, coming from a man who has spent millions of dollars trying to clone a 13-year-old dog named Missy. So far, he and his team have not succeeded, though they have cloned two calves and expect to clone a cat soon. They just might succeed in cloning Missy later this year—or perhaps not for another five years. It seems the reproductive system of man's best friend is one of the mysteries of modern science.

Westhusin's experience with cloning animals leaves him vexed by all this talk of human cloning. In three years of work on the Missyplicity project, using hundreds upon hundreds of canine eggs, the A&M team has produced only a dozen or so embryos carrying Missy's DNA. None have survived the transfer to a surrogate mom. The wastage of eggs and the many spontaneously aborted fetuses may be acceptable when you're dealing with cats or bulls, he argues, but not with humans. "Cloning is incredibly inefficient, and also dangerous," he says.

Even so, dog cloning is a commercial opportunity, with a nice research payoff. Ever since Dolly the sheep was cloned in 1997, Westhusin's phone at A&M's College of Veterinary Medicine has been ringing with people calling in hopes of duplicating their cats and dogs, cattle and horses. "A lot of people want to clone pets. A lot of people. Especially if the price is right," says Westhusin, raising his eyebrows. "A lot." Cost is no obstacle for Missy's mysterious West Coast billionaire owner; he's plopped down $3.7 million so far to fund A&M's research.

Contrary to some media reports, Missy is not deceased. The owner, who wishes to remain anonymous to protect his privacy, wants a twin to carry on Missy's fine qualities after she does die. The prototype is, by all accounts, athletic, good-natured and supersmart. She's not a show dog, as one might expect, but a mongrel—collie and husky—rescued from a pound. Missy's master does not expect an exact copy of her. He knows her clone may not have her temperament. In a statement of purpose, Missy's owners and the A&M team say they are "both looking forward to studying the ways that her clones differ from Missy."

Besides cloning a great mutt, in other words, the project may contribute insight into the old question of nature vs. nurture. It could also lead to the cloning of special rescue dogs and endangered canids like the Ethiopian wolf and African wild dog. At the A&M labs, a picture of Missy's cheerful mug hangs over the micromanipulator, where technicians inject her genetic code into eggs from donors whose own DNA is of no particular interest to anyone. The biggest problem is getting eggs. Because dogs randomly go into heat only every six months to a year, there's a lot of waiting for one of the lab's 50 dogs to enter estrus. Last week a bitch named Betsy caused a flurry of activity when she did just that, but no one knows whether she will actually ovulate—or if another female will go into heat and thus be ready as a surrogate.

Despite the lack of a canine breakthrough, dog owners are the biggest clients of Genetic Savings & Clone, a commercial spin-off of Missyplicity that offers to freeze pet DNA for future cloning for $895 plus $100 annual storage. A white canister—which looks like an Artoo Detoo unit—is already full of hundreds of trays containing genetic material from cats and dogs, with a few prized horses and cattle nestled in the whirling eddies of subzero liquid nitrogen.

The fate of the dog samples will depend on Westhusin's work. He knows that even if he gets a dog viably pregnant, the offspring, should they survive, will face the problems shown at birth by other cloned animals: abnormalities like immature lungs and cardiovascular and weight problems. "Why would you ever want to clone humans," Westhusin asks, "when we're not even close to getting it worked out in animals yet?"

—*By Cathy Booth Thomas/College Station*

INFORMATION & GUIDELINES

HEARINGS ON THE ACHR SPECIAL REPORT ON GENOMICS AND HEALTH

The ACHR Special Report

The Advisory Committee on Health Research (ACHR), the highest level scientific advisory body in the World Health Organization, reporting directly to the Director General, has been asked by her to prepare a Special Report on Genomics & Health. The Report will focus primarily on the scientific issues and the potential of genomics in improving health in developing countries. It is intended primarily as a **road map** (description & analysis) and **vision** (future scenarios) document on the *scientific* potential of the genomics revolution. The Report will also address the ethical, legal and social implications of genomics, especially in relation to developing countries. The Report will not attempt to define specific WHO policies or guidelines on the issues in question, rather it is a broad document outlining possible processes to reach the objective of equitable access to the benefits produced by the genomics revolution. The Report will target a very broad audience ranging from the Director General, the staff of WHO, the ministries of health in the member countries, inter-governmental organisations and the world community at large, and will thus be written in a manner which balances scientific rigor and readability. The Report will also support WHO's role as an advocate of international health, in ensuring that underprivileged, marginalised and disadvantaged peoples have access to scientific benefits resulting from the genomics revolution. The Report would be a success if it helps developing countries to share in the scientific benefits which genomics brings, and if it helps WHO's advocacy role for improving the health of the disadvantaged and underprivileged.

The **process** for preparing the Report consists of three key components : **(1)** Assistance from a Team of Consultants (Professor Sir David Weatherall-Lead Writer, Professor Dan Brock, Professor Heng-Leng Chee) to help the ACHR in preparation of the Report; **(2)** Building on previous work within and outside of WHO, e.g. the Daar-Mattei Report in WHO (1998-99), the ongoing WHO ELSI Initiative *(see box below)*, reports from other organisations (e.g. UNESCO, the Nuffield Trust, National Bioethics Advisory Committee, etc); **(3)** Transparent, open and wide-ranging consultations which provide an opportunity for all interested parties to voice their opinions and concerns. This will consist of **regional consultations** and **hearings**. The participants of the regional consultation will consist of a diverse range of interested and informed individuals from WHO member states (especially from developing countries) including researchers/scientists, experts in ethical issues, policy makers, civil society, consumers and community leaders. They will be asked to emphasize regional (rather than general/global) perspectives on the key issues. In contrast, the participants of the **hearings** represent a spectrum of major international players who have contributed to the discourse and debate in this area. The participants for the hearings will come from public & private genome initiatives, industry/pharma, academia, international organisations and community/civil society. Both sets of participants will be asked to consider a common group of issues expressed as a list of questions for consideration.

Objective of Hearings

The objective of the hearings is to provide the ACHR with inputs on issues which will be addressed in the Report. There is thus a clear need to *focus* the hearings on issues which are of concern to the ACHR as they work to prepare the Report with the assistance of the Consultant Team. It is highly desirable that presenters and participants are clear *on what the Committee hopes to obtain* and that there is a common framework for these activities, that they address a common set of issues.

ELSI Initiative

The ELSI (ethical, legal and social implications) initiative within the Non-Communicable Diseases cluster of WHO was initiated in July, 2000. The aim of the initiative is to develop an ELSI Agenda for WHO and it is focused on developing an ELSI research program which specifically addresses the genomics-related concerns of developing countries, developing guidelines for genetic data banks and developing internal WHO expertise in these areas. The relationship between the ELSI initiative and the ACHR Special Report is clearly complementary and synergistic. The ELSI initiative is focused on developing specific 'products' in the form of projects and guidelines and will help WHO pursue a specific agenda strategy in the future. The ACHR Special Report, as 'one-off', primarily informational document of high visibility will help promote the ELSI initiative in the longer term: i.e. the ELSI initiative will build on the impact of the ACHR Special Report. The ACHR Report will also include the ELSI initiative as an example of a specific process which WHO has put in place to develop one area related to the genomics revolution.

Procedures

1. All participants for the hearings will be invited to prepare a brief statement/position paper before the hearing for circulation to other participants (to be sent to the Secretariat by June 1, 2001) *Please refer to the series of questions & issues outlined below.*
2. Selected participants will then be allocated 15-20 minutes to present the main points of their organisation's position. **Due to time contraints, it will not be possible for all participants to present their position papers-we seek your understanding on this matter.** See ANNEX 1 for outline of programme and ANNEX 2 for provisional participants list.
3. ACHR members and the Consultant Team will then have the opportunity to ask questions to the presenter (time allowing, questions from the floor may be allowed).
4. Time will be allocated for General Round Table discussion at the end of the proceedings to be moderated by Professor Sir David Weatherall.

Questions and Issues for Consideration

The issues which are of special concern to the Committee have been framed in the form of a series of general questions. Participants/presenters at the hearings are free to *select* from these questions, depending on their own organisational interests/experiences and personal perspectives. In addition they are free to express additional opinions they may have regarding other issues in genomics & health. The general questions are as follows :

- What are the potential benefits of genomics for developing countries ?. Which of the technologies arising from genomics are most relevant, useful, beneficial and sustainable?

- What will be needed to ensure that developing countries will truly benefit from these advances in an equitable and sustainable manner ?, i.e. What can we all do to make it happen, what are the enabling processes ?, What action is needed at both the national and international level ?. *What will be required* from the various parties (e.g. scientists, policy makers, health workers, community, consumers, etc) in order to fulfil this unprecedented scientific potential.

- What role is appropriate for WHO at the national and international level to facilitate these enabling processes ?

- How can we ensure that the perspectives of developing countries are taken into consideration in the international debate on these issues ?

- What are the ethical, legal, and social implications that developing countries should be aware of and get ready for, and how do they differ from those in developed countries ?. What steps can countries take to ensure that the rights and benefits of the populations contributing to genomic research are respected ?. Are there issues which are unique to a particular cultural/ethnic/religious setting ?

- What are the **risks** associated with genomics-based technologies and how can they be assessed ?. Are developing countries as a whole (or sub groups within them) more vulnerable to such risks ?. Are some of the risks specific to developing countries and can they be addressed at reasonable cost ?. How would developing countries go about doing so and what conditions are needed to make it possible for them to do so ?. Is there a role for the 'precautionary principle' with regard to all of the above ?.

- What are the gender implications and how can they be addressed ?

- What's the reality behind the hype of many of these new advances ? Are we creating false expectations ?

- Should developing countries strive to participate in cutting-edge research in genomics ?. If yes, *how* and in which areas ?

[Important note : although a broad spectrum of issues related to genomics should be considered, it has been decided that the issue of **GM (genetically modified) crops** should not be a major item for discussion as this is a highly controversial area in relation to biosafety and environmental impacts and has been widely covered by many other meetings and agencies such as FAO]

ANNEX 1

Programme Outline (Provisional)

Venue : Salle B, WHO Headquarters, Geneva, Switzerland
Chair : Professor Mahmoud Fathalla, Chair of the ACHR.
Moderator : Professor Sir David Weatherall, FRS.

0830-0900	Registration
	Opening by Dr. David Nabarro, Executive Director, DGO/WHO Welcoming remarks by Chair, ACHR, Prof. Mahmoud Fathalla
0900-1030	Presentations (3)
1030-1015	Coffee break
1015-1245	Presentations (continued) (5)
1245-1400	Lunch Break
1400-1600	Presentations (4)
1600-1615	Coffee break
1615-1730	Round Table discussion (Moderator : Professor Sir David Weatherall)
1730-1745	Concluding Remarks – Professor Sir John Sulston
1745	Closing remarks by Chair, Professor Mahmoud Fathalla

(A more detailed programme will be provided nearer the date of the meeting when the participants list is finalised)

ANNEX 2

PROVISIONAL LIST OF INVITED PARTICIPANTS

HEARING ON ACHR SPECIAL REPORT – JUNE 27, 2001

Name	Organisation
Professor Sir David Weatherall	Oxford University, UK
Professor Dan Brock	Brown University, USA
Assoc Prof. Heng-Leng Chee	Universiti Putra Malaysia, Malaysia
Dr Francis Collins	Director, NHGRI, USA
Prof Abdallah Daar	University of Toronto
Dr Michael Dexter	Director, Wellcome Trust, UK
Dr Sigurdur Gudmundsson	Surgeon General of Iceland, Iceland
Prof Ian Kennedy	Chair, Nuffield Council on Bioethics, UK
Dr Georges Kutukdjian	Director, Division of Human Sciences, UNESCO, Paris
Mme Noelle Lenoir (or nominee)	**European Commission/European Group on Ethics (EGE)**
Prof J-F Mattei	Member of Parliament, France
Prof Alex Mauron	University of Geneva
Dr Qasem Chowdhury	Coordinator, People's Health Assembly, Dhaka, Bangladesh
Dr Alex Capron	National Bioethics Advisory Committee, USA
Ms Sandrine Sabatier	Council of Europe
Dr Elettra Ronchi	Health & Biotechnology Coordinator, OECD, Paris
Professor Sir John Sulston	Former Director, Sanger Centre, UK
Dr Stephen Hoffman	Vice President, Celera Genomics
Dr Chan Chee Koon	Coordinator, Citizen's Health Initiative, Penang, Malaysia
Dr Robert Cook-Deegan	Chair, ELSI Planning Group
Dr George Poste	Smith Kline & Beecham Pharmaceuticals
Sir Richard Sykes	Chairman, Glaxo Wellcome
Dr Harold Varmus	President, Memorial Sloan Kettering Cancer Center
Dr Bernadette Modell	University College, London
Dr Delon Human	President, World Medical Association
Dr Harvey Bale	President, IFPMA
Dr Richard Feachem	Co-Chair, Working Group II, Commission on Macroeconomics & Health
Dr Ken Shine	President, Institute of Medicine
Dr Rita Colwell	President, National Science Foundation
Dr Bruce Alberts	President, National Academy of Sciences, USA

Other participants :

1. Members of the Advisory Committee on Health Research (ACHR)
2. WHO staff members
3. Observers from other organisations and the media

MP-13.

WHITE INDIA

■ by Supriya BEZBARUAH with Samrat CHOUDHURY

INDIA, 1901. THE GREATEST ever exercise in human nose-counting had just been undertaken. Her Majesty's Indian subjects were being counted, sifted and sorted. The Census of India was on. Census commissioner Sir Herbert Risley noticed that upper caste Hindus were fair and had sharp noses. Since these are among the distinguishing features of the "white man"—caucasoids—he figured there may be a relationship between the two. To make this scientific, he took a few measurements. The methodology: measure nose length, divide by nose breadth, and call the number arrived at the "nasal index". The conclusion, of course, was that upper caste Hindus are distant relatives of Englishmen who have been out in the sun a few centuries.

Much water has flowed down the Thames and Ganga since. Adolf Hitler has made infamous the theory of Aryan supremacy. Computers and genetic engineering have been invented. Accepted wisdom on the question of an Aryan invasion of India has veered from history book standard to disbelief after archaeologists found evidence that the Aryans did not ride into India, subjugate the native population and set themselves up at the top of the caste heirarchy.

And now, this happens.

Eighteen scientists from India and the US led by human geneticist Michael Bamshad of the University of Utah compared genetic signatures of modern-day Indians of various castes with those of today's Europeans and east Asians. Using genetic markers, they traced back the paternal lineage of the Indians through the Y-chromosome. Maternal lineage was traced through mitochondrial DNA (*see box*). The results of the study, published in an American journal called *Genome Research*, conclude that the upper castes are genetically closer to Europeans and the lower castes to Asians. Also, that we have a common maternal ancestry but different paternal stock.

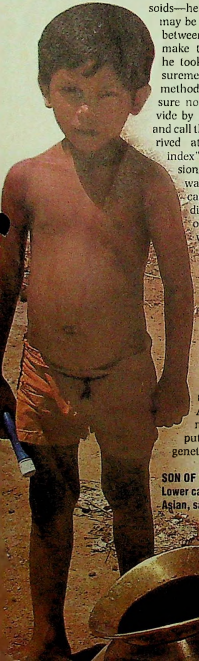
"This paper is clearly a landmark," says Partha Pratim Majumdar, head of anthropology and human genetics at the Indian Statistical Institute in Kolkata. "It uses a large battery of genomic markers to show that the observed trend among different castes matches expectations (about caste differences)." Dr Peter Forster of The McDonald Institute for Archaeological Research, University of Cambridge, says that "the conclusion that higher castes have greater genetic relatedness to west Eurasians is well founded on the basis of their data".

So then: are Brahmins and Kshatriyas really Europeans inside? They may be, but the final verdict on that is far from out yet. The paper has unleashed the academic equivalent of fistfights among historians and anthropologists across the country. Controversies once buried have returned from the grave and theories are being tossed about on all sides. How the European genes got here at all is among the most interesting points of the debate. The paper infers that caste Hindus are descendants of Aryans to explain the genetic data. The counter is quick. "Dravidian and Aryan are linguistic, not racial terms. There is no specific Aryan race," says social anthropologist V.N. Shrivastava. But the Aryan invasion theory was based, among other things, on linguistic grounds: the similarity between Sanskrit and European languages was taken as evidence of people from Europe having migrated to India. The Rig Veda is the oldest known Sanskrit text. It was dated to around 2000 B.C. which is about when the Indus Valley Civilisation is supposed to have ended. "But it was an oral genre—how can it be dated?" asks Nayanjot Lahiri, reader in history at Delhi University. Moreover there was no mention in the Rig Veda of migration or any other homeland, which would have been natural if a great journey had been undertaken or a war won. The people of Israel still talk with familiarity of their journey to the "Promised Land" 2,500 years ago.

"The observed trend among castes matches expectations."

PARTHA MAJUMDAR
Anthropologist

The Aryan invasion theory takes its hardest blow from the skeletons found at Indus sites. They show the same racial mix as any population of South Asia. There was no evidence of the carnage that would have accompanied an invasion. "Of the skeletons found, only three showed any signs of injury," says S.P. Gupte of the Archaeological Society of India. "And even those had wounds that had healed—the people did not die



SON OF THE SOIL: Lower castes are more Asian, says the study

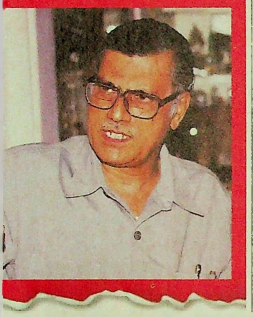
100000 BC The First Immigrants

India has long been a home for a stream of migrants. Among the first were Stone Age hunters from Africa.

10000 BC Builders of the Indus Civilisation

The next lot, possibly from the Mediterranean, spoke Dravidian dialects and built the rich Indus Civilisation.

The Central Bureau of Investigation is preparing to seek the extradition of M.V. Raja, an NRI businessman who cheated Indian Bank of Rs 468 crore



November 19, 1995 are those of criminal conspiracy (to defraud the Indian Bank), abetment of corruption and breach of trust. Between them, his companies (*see chart*) in India siphoned off about Rs 333 crore, and the balance through its front companies in Singapore—Mountamount, Nagova Exim Pvt Ltd and Sadeco Sarl Pvt Ltd.

Mountamount was the Singapore front company that MVR Exports—and Raja—used to purchase raw cashewnuts, primarily from Nigeria, for "export" to India. To do so, however, they needed to be financed against invoices by the bank. The CBI has repeatedly pointed out in its chargesheets that there was large-scale overinvoicing by the banks. Besides, the financing came only too easy: the Mountamount loan requests were processed rapidly and recommended by M.B.N. Rao, the bank's then deputy general manager at its Singapore branch, and sanctioned by its then chairman M. Gopalakrishnan, who was later arrested in the Rs 1,336-crore bank scam. The loans never met the RBI's strict guidelines. Often, loan limits were raised with impunity. As it turns out, almost 30 per cent of the money sanctioned to MVR has now been written off as non-performing asset.

The CBI's records also point out that Raja had five front firms in Rotterdam, the port which he used extensively to ship his cashew to destinations in Europe, Africa, North America. The firms—Hamilton Ventures Pvt Ltd, Nutworld Trading, Globenut, Richardson & Rogers Ltd, and Dutch Flag Ltd—received payments from Mountamount, but they were, say investigators, just a way of laundering the wealth. The CBI has dispatched letter rogatories to the Dutch Government to get details on the firms. "It's important for us to know the money trail at the Dutch end," says CBI spokesman, S.M. Khan. The request is still pending.

Raja, a 6-ft-tall graduate from Pachaiyappa College, Chennai, started the MVR Group of companies after winding up his father's textile business in 1962. His business involved importing raw cashew, processing it in India and exporting the finished stuff. His big break came in 1985, when he managed to get a substantial loan from the Indian Bank. Few saw the irony at the time: only the previous year Raja had defaulted on car loans taken from the same bank.

BY sending Mountamount's shipping documents (invoice, packing list, bill of lading) through Indian Bank, Singapore, to the Indian Bank accounts of MVR group companies in India, and making payments on a collection basis—bypassing the established, and RBI stipulated, letter of credit route, thanks largely to the collusion of the bank brass—he continued to mint money. Later, even when no shipments were due, shipping documents were sent for collection of money. These payments were sanctioned by Gopalakrishnan. The money collected in Singapore was then funnelled to the firms in Rotterdam.

Says Khan: "The arrest is a major gain for us. Raja is a major player in the Indian Bank case involving the biggest bank scam in the country." Raja's arrest has come at an opportune moment for the CBI. Recently the Madras High Court ordered the setting up of a special court to deal with the Indian Bank scam. With Raja in detention, Indian authorities will renew their request to Singapore to make available the details of his bank accounts. The CBI, on its part, will have to establish that Raja was indeed the protagonist who planned each move of his various front firms in which "sleeping directors" were appointed.

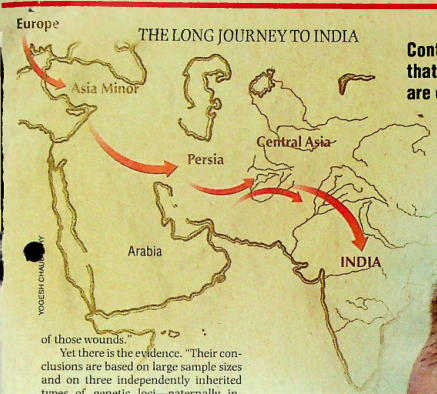
It certainly appears that Raja's plans of retiring in Paris may have been pushed back for quite a while.

—with Stephen David in Bangalore

SCAM COUNT

MVR Industries Ltd Case filed: 19 Nov, 1996 Amount: Rs 84.26 crore	**Enkay Foods Pvt Ltd** Case filed: 3 May, 1997 Amount: Rs 29.89 crore
Maxwell Exim Ltd Case filed: 19 Nov, 1996 Amount: Rs 147.65 crore	**Well Stores** Case filed: 12 Dec, 1996 Amount: Rs 6.48 crore
Arun Builders Ltd Case filed: 24 Dec, 1996 Amount: Rs 2 crore	**Sanjeevi Packaging** Case filed: 12 Dec, 1996 Amount: Rs 6.49 crore
Ramraj Trading Case filed: 15 Feb, 1996 Amount: Rs 6.49 crore	**Indica Builders** Case filed: 31 Dec, 1996 Amount: Rs 6.49 crore
Jaimatha Farms Case filed: 3 May, 1997 Amount: Rs 2.81 crore	**Abhinav Exim** Case filed: 31 Dec, 1996 Amount: Rs 6.49 crore
Anderson Industries Case filed: 3 May, 1997 Amount: Rs 2.81 crore	**Satyam Food Ltd** Case filed: 3 May, 1997 Amount: Rs 31.76 crore

** Three more Singapore firms and another Indian company are under investigation*



Controversy erupts over a study that says upper caste Indians are of European descent

of those wounds."

Yet there is the evidence. "Their conclusions are based on large sample sizes and on three independently inherited types of genetic loci—paternally inherited Y-chromosomes, maternally inherited mtDNA, and biparentally inherited Alu insertions," says Forster. Translation: the research team did their homework. Which means they are probably right about the European genes being there. "Our results clearly show that there are differences between upper and lower castes, and the upper castes are closer to Europeans," says B. Bhaskara Rao, an Andhra University anthropologist and one of the authors of the paper. And the fact that Sanskrit is close to European languages holds.

So, the plot thickens. If there was no Aryan invasion like the archaeologists say, and our upper castes are genetically closer to Europeans like the anthropologists say, what could possibly have happened?

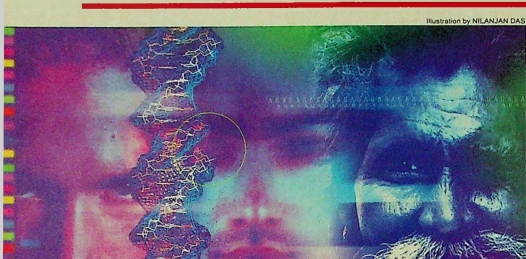
In their paper, Bamshad and colleagues conclude that it was a migration, mainly of males, that brought the west Eurasians here, not invasion. The white men didn't come in plundering and pillaging. They just drifted in and, it must follow, became sufficiently popular to begin cohabiting with the local women here. That there was migration to India is not disputed. "India was never an ethnic vacuum," says Shrivastava. "Palaeolithic hunters arrived in the Old Stone Age, there was a stream of migrants—

3000 BC **Fair Invaders: The Indo-Aryan Migrants**

They arrived with horses and chariots from Europe. They spoke Sanskrit. Their culture shaped India.

VASUDEVA KUTUMBAKAM: Brahmins and Kshatriyas may be of the caucasoid family

Illustration by NILANJAN DAS



UNBOTTLING THE GENE

THE GENETIC piece that makes a man, the Y chromosome, is transferred from father to son. So it reveals paternal lineage.

OUR ANCESTRAL mothers' secrets are revealed by a mother's genetic gift to her child—mitochondrial DNA (or MTDNA).

GENETIC SIGNATURES which identify racial groups were studied in Y chromosome and MTDNA of Indians, Europeans and Asians.

UPPER CASTES were found to be paternally closer to Europeans. Lower castes were closer to Asians.

builders of the Indus Valley—around 10,000 B.C., and the Indo-Aryans arrived around 3,000 B.C. ." And caste began? "There are more than 100 theories on how caste originated, but one can be sure it didn't emerge because Aryans subjugated the native population." So how did they then end up at the top of the caste hierarchy? And what, in any case, is caste?

EVERY answer leads to more questions. The *Manu Smriti* talks of caste as based on profession. Those who followed a particular vocation were classified as belonging to the corresponding caste. Bamshad holds that "caste may have been based on profession, but a particular profession was predominantly one race". Of course, race itself is not so easily defined when one is speaking of entire continents. Asian, African and European are geographical terms that do not indicate homogeneous populations, points out Dilip Chakravarti, a Cambridge University archaeologist. India alone now has people of all racial types, from the mongoloids of Northeast India to the tall, fair, sharp-featured people who are at the centre of the current controversy. "There's no question of the genetic diversity of the Indian population", says sociologist Andre Beteille, "but it is quite another thing to be divided into races."

Geneticists contest that. "There are discernible genomic signatures that are much more prevalent in groups such as caucasoids and mongoloids. These ancient signatures characterise these groups in the genomic sense and continue to be retained in spite of thousands of years of evolution." says Majumdar. So if someone has a caucasoid ancestor, the gene experts can find out.

That's for individuals. But a few Brahmins having caucasoid ancestors would hardly mean all of them do. Which is one more argument against the study. All the blood samples for the different castes were from a specific geographic area in Andhra Pradesh, and the sample size in some castes was as small as 10. "If more samples are studied, the results could be different," points out Shrivastava. Caste itself is also highly elastic. B.N. Chattopadhyaya, professor of ancient history at Jawaharlal Nehru University, Delhi, cites the example of the Boya tribe of Andhra Pradesh. They became warriors and claimed the status of Kshatriyas. Those among them who performed religious rituals even became Brahmins. In the 1960s anthropologists Karve and Malhotra compared four Brahmin sub-castes with four peasant sub-castes. They found that the variation within the Brahmin sub-castes was greater than the variations between Brahmin and peasant castes. Caste mobility happens even today, though post-Mandal the traffic is bidirectional.

So what's the bottom line? "Unlike other detective stories, with genetic evidence we can't say 'the butler did it'," points out anthropologist Shiv Vishwanathan. "but we shouldn't be afraid of truth or data. Evidence shrinks to shape with time." Perhaps it will. Right now time itself is a bone of contention. The study doesn't mention when the Europeans came to India. "Where does the genetic data show it was during the Vedic Age?" asks Gupte.

A hundred years ago, Risley's nose-based theory of the European origin of caste had met its match in B.N. Dutta's nose-based theory of caste. Dutta, Swami Vivekananda's brother, had then disproved the theory that higher castes have "European" noses merely by making more measurements. Times have changed, and tools too. Now it's genetic tests, and it may take many more of these to set to rest the controversy that has returned after a hundred years of quietitude. ■

"The Rig Veda was of an oral genre—how can it be dated?"

NAYANJOT LAHIRI
Historian

MP-13.

Cloning

Eve's second coming

Raelians, who believe life on earth was created by aliens, claim to have created the first human clone. Is it reality or a stunt?

By JERRY ADLER

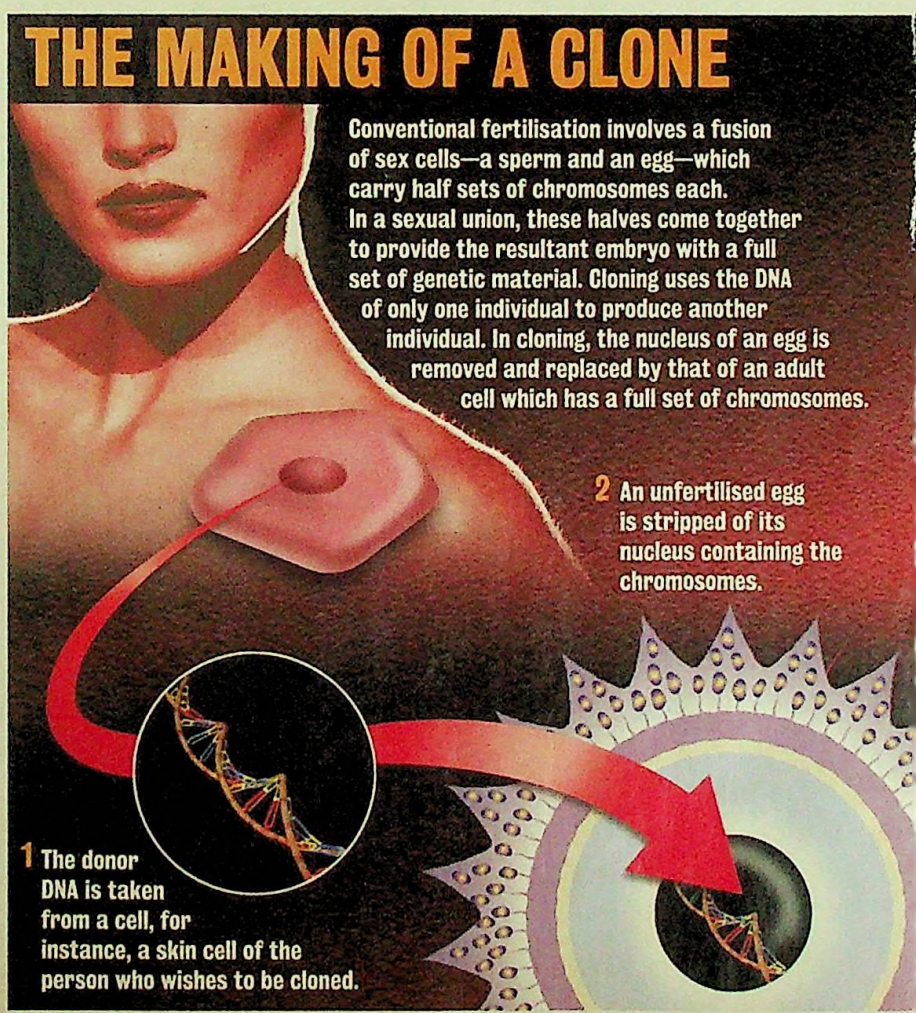
Two thousand years ago a Judean carpenter changed the course of history by offering humanity a path to eternal life. Two days after Christmas, last year, a French-born sometime journalist and race-car driver who calls himself Rael tried to do the same thing when his followers announced they had solved the mysteries of human cloning.

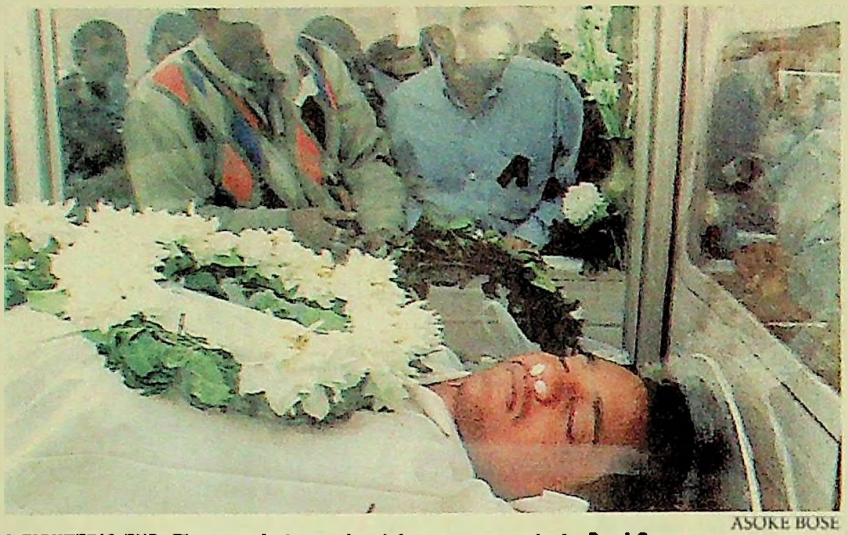
This was the high point of Rael's second career as a saviour, which began when he was taken aboard an alien spaceship and transported to a faraway planet whose inhabitants, the Elohim, had created all life on Earth. For most of the past three decades Rael has been on a mission to replace outmoded religious bunkum with modern, scientific bunkum. "Science is love!" he grandly proclaimed in an interview at his Canadian compound—UFOland—near the Vermont border. Soon, he promises, people will be able to make exact genetic copies of themselves, grow them instantaneously and then download all their accumulated memories and traits into the new bodies—the ideal solution for people who want to live forever but find Christianity so... unscientific.

In this contest of beliefs, the edge has to go to Christianity, and not just because it numbers 2 billion adherents against 55,000 Raelians. The claims of the former have never been verified by science, but they were meant to be taken on faith in any case. But Raelian Bishop Brigitte Boisselier, the director of the Raelian-backed company Clonaid (which sells cloning services to all comers), had promised to provide unambiguous scientific proof of an announcement otherwise conspicuously devoid of information: that unnamed researchers in an unidentified country had implanted a cloned embryo in an anonymous woman—who had delivered a baby girl "we call Eve, between us".

That claim could easily be checked by comparing the baby's DNA to the donor's. (In this case, the donor was the mother herself.) A science journalist, Michael Guillen, formerly of ABC News, had been enlisted to oversee the testing by independent researchers. But later, Rael himself implied the testing might be abandoned out of concern for the unnamed family's "privacy". Around the same time, a Raelian spokesman in the Netherlands announced the birth of a second cloned baby, to a lesbian couple. DNA testing wasn't mentioned.

If reporters suspended their accustomed scepticism towards people who believe in visits from aliens, it was because the possibility of human cloning long ago left the realm of science fiction. With varying degrees of hope and trepidation, scientists, theologians and other interested parties—like infertile couples and parents of children who had died in





ASOKE BOSE

A FIGHTER'S END: Thousands turned out to pay respects to Bapi Sen

that the assailants were constables of the reserve force of the Kolkata police and immediately arrested two of them. The other three surrendered before the chief metropolitan magistrate, who remanded all of them to police custody. One is still absconding.

Bapi, his wife and two sons were living with his parents and elder brothers. His wife Soma was inconsolable as his body was brought home and his father, Narayan Chandra Sen, a retired government official, collapsed.

Police found out that the six constables had left their barracks for New Year revelry without permission. They used a taxi owned and driven by Madhukant Jha, who was living illegally in the barracks. "I had to do what they told me to do," he said. The constables drank heavily and when they saw the girl on the motorcycle, they asked Jha to block the vehicle.

The chief minister has assured that all help would be given to the slain cop's family, but the citizens are worried. If a policeman gets killed for preventing molestation by lumpen elements in his own force, what about ordinary people?

A senior police officer said that the incident was an aberration and not the norm. According to him, the number of cases of eve-teasing had come down. In 2000, 57 persons had been arrested in 46 such cases and in 2001, 36 cases had been charged. Last year, 24 cases had been registered.

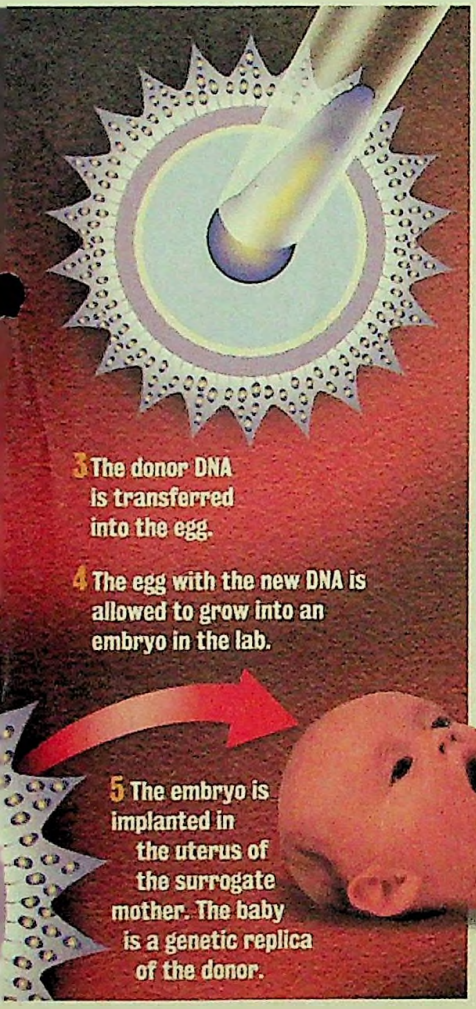
However, clinical psychologist Rajyashri Bandopadhyay felt it was not an isolated incident. "It is a fall-out of the media's glamorisation of the negative aspects of life. Impressionable minds fall for their allure. Policemen are no exception." ■

accidents—had been awaiting just such an announcement ever since the first mammal, Dolly the sheep, was cloned in 1996. The same technique, scientists say, could easily be applied to humans. Technicians remove the genetic material from an egg cell and replace it with DNA from a donor, then grow the embryo in a petri dish until its ready to be implanted, by the same process routinely used in fertilisation clinics.

Human cloning, says Rudolf Jaenisch, an MIT biologist, "is not a problem of technology, but principle." Only two other laboratories in the world have acknowledged pursuing reproductive cloning in humans. The head of one of them, the well-known Italian fertility expert Severino Antinori, has said he expects to have a baby born in January 2003—which sceptics suggested might have had something to do with the timing of Clonaid's announcement.

AFP

Sweeping away the quibbling over 'Eve's' actual existence, Rael (above) declares that cloning of a human baby "is just a step" towards his ultimate goal, of giving humanity eternal life.



Graphics/MUKESH M.

Thus, the Raelians remarkably managed to unite both theologians and scientists in outrage. Whether true or not, "the very attempt to clone a human being is evil", pronounced Stanley M. Hauerwas, a professor of theological ethics at Duke University, North Carolina. "That the allegedly cloned child is to be called Eve confirms the God-like stature these people so desperately seek." On a less exalted level of concern, researchers cautioned that the rate of serious birth defects in cloned animals, is as high as one in four or five, a grossly unacceptable risk to take with human beings.

Scientists' biggest concern was that the Clonaid extravaganza would give impetus to the demand by some in the US Congress for a sweeping ban on research involving any cloning of human embryos. By employing the same techniques of nuclear transfer, but stopping the process short of implantation, researchers can produce embryonic stem cells that can develop into any of the 200-odd kinds of tissue found in the human body. This technique has been used in animals to repair damaged nerves, hearts and kidneys, and could hold the key to treatments for conditions as diverse as heart disease, Parkinson's and crippling spinal-cord injuries.

Raelians also claim to want to alleviate suffering through science. Early on, they managed to strike the

Rate of birth defects in cloned animals is one in four or five, an unacceptable risk to take with humans, say researchers; (left) Dolly the sheep.

deepest vein of pain known to humankind, the grief of a parent for a dead child. Clonaid, founded in 1997, was funded to the tune of several hundred thousand dollars by a West Virginia couple, whose 10-month-old son had died during heart surgery. The couple pulled out in 2001, telling reporters that Boisselier appeared more interested in getting Raelism into the newspapers than setting up an actual laboratory. Since then, information on the company's operations has been almost impossible to come by.

Rael's self-proclaimed mission is to tear down "the myth of God", which is the major obstacle to world peace. "Telling people to fly planes into buildings—this is God at work," he said, referring to the September 11, 2001, terrorist attacks. His other major goal is to construct a $10 million 'embassy' to receive the aliens when they return to Earth in the near future. He would like it to be in Israel, he says, but the Israelis haven't shown much interest.

AFP

WITH NO PROOF IN HAND: Brigitte Boisselier, director of Clonaid

Rael stands in a crowded tradition of prophets who saw salvation in a flying saucer, a phenomenon observed by Carl Jung as far back as the 1940s. University of Southern California professor emeritus Robert S. Ellwood, an authority on UFO religions, says Jung called aliens "technological angels", a way for people to put their comforting belief in higher beings into a scientific context.

But unlike strange things done by people attracted to fringe beliefs—like the 39 followers of the Heaven's Gate cult who committed suicide in 1997, preparing for an ascent in an alien spacecraft—ordinary Raelians seem generally happy. They don't live in communes, says Susan Palmer, a professor at Dawson College in Montreal and the author of a forthcoming book on the Raelians, they don't collect weapons and they are taught to abstain from drugs. Their apocalyptic vision is uncommonly benign, and involves training a cadre of attractive young women (Rael's 'Order of Angels') to welcome the aliens when they return, sometime before 2035.

And His Holiness Rael, as journalists are required to address him, relaxes in UFOland in his gleaming space suit, appearing to enjoy the onslaught of media attention. Sweeping away the epistemological quibbling over 'Eve's' actual existence—"I told [Boisselier], keeping the baby with the mother is more important than proving to the world that you did it"—Rael declares that the cloning of a human baby "is just a step" towards his ultimate goal. "I am here to give humanity eternal life," he proclaims. It is a promise, history reveals, that humanity could never resist.

Mp-13.

The future of gene therapy

Interview with Dr. Nick Wood, Professor of Clinical Neurology and Neurogenetics.

Dr. Nicholas William Wood, Professor of Clinical Neurology and Neurogenetics, National Hospital, Queens Square, London, is a world-renowned expert in neurosciences. He has received a number of prestigious awards, including the Charles Symmonds Memorial Award in 1993, the Duroshiler Award of the British Medical Association in 1996, and the Linacre Medal in 1999 from the Royal College of Physicians, London. Co-editor of two books on neurology, Dr. Wood is on the review board of several international journals. Dr. Wood has a doctorate in neurogenetics and training in clinical neurology, which form a rare combination.

Dr. Wood is the European coordinator of a study on the genetic basis of Parkinson's disease. He recently mapped an autosomal recessive locus for the disease. He has done genome-wide search and homozygosity mapping in a consanguineous Italian family. Over the past three years, the group has mapped successfully four other inherited movement disorders, including autosomal dominant ataxia, dystonia gene, geniospasm and paroxysmal kinesiogenic choreathetosis. Cloning projects are under way for each of these. He collaborated with three groups investigating the genetic basis of epilepsy. He is also a member of an international interdisciplinary group to study cellular physiology.

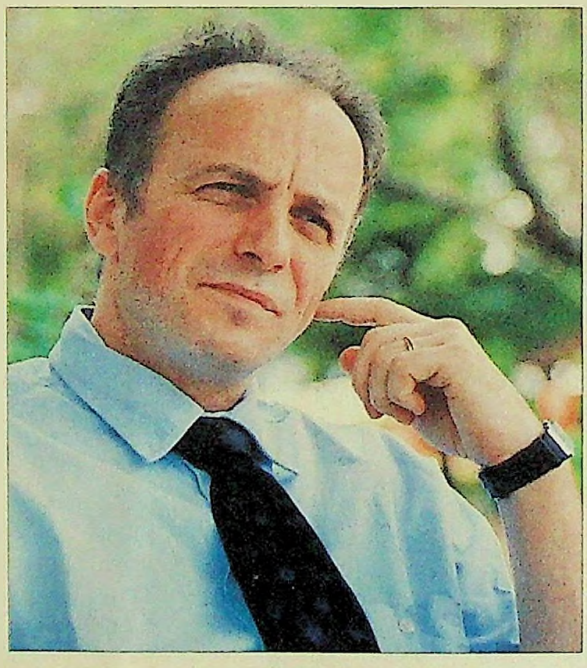
When he was in Chennai to deliver the 17th Gopalakrishna Oration conducted by the K. Gopalakrishna Department of Neurology at the Voluntary Health Services, Dr. Wood spoke to **Asha Krishnakumar** on the status of the Human Genome Project, the genetic basis of neurology, the future of gene therapy and state-of-the-art research in neurogenetics. Excerpts from the interview:

► *What is the Human Genome Project? How will it help our understanding of biology?*

The Human Genome Project was an international consortium that set out to sequence the whole genome. Everyone's genome varies, but only very slightly. You and I, despite coming from different parts of the world, are mostly alike. Most of our base-pass or code is identical. We probably vary in about 1 per cent of our genome. So, if you sequence just one person, you get 99 per cent of the information about the human genome. A small part of the basic human genome is yet to be decoded. But once done, you have something like the periodic table for chemistry. It is like how it was 100 years ago in the case of chemistry. According to me, biology is 100 years behind the physical sciences in terms of its basic understanding. The genome project is one of the major developments that would help bring rapid progress.

► *According to reports on the genome project, only mono-gene disorders have been sorted out. How will this help in our understanding of the causes and treatment of disorders arising from a single gene?*

You are right. Only simple, mono-gene disorders have been sorted out. But even that is a major development. Such genes act in the family — either you have it or you don't. If you don't, you will not get the disease and if you have the gene, you will get it. Huntington Disease, for instance, comes under this category. It is a dominant disorder coming through the generations. The genome project helps find these diseases very quickly.



S. THANTHONI

In the case of complex disorders it is just not the relative abnormality in the genes that causes the disease. By itself the gene does not tell you anything. It is a combination of genes and environmental factors that causes complex disorders such as epilepsy.

► *From the genome project results, how does one go about finding out the existence of the gene that causes a mono-gene disorder?*

You take a family with, say, 20 affected individuals and have markers scattered throughout the genome. You then apply the markers to the family and look for the marker that segregates the disease. Everyone in the family who could get the disease will have one type of marker and those who would not get it, another type of marker. Suppose you apply the markers and those who would not get the disease have the 200th marker and those who could get the disease have the 201st marker, then you know that wherever the 201st marker is must be close to the diseased gene. You then go to the database provided by the genome project, in the computer, and find out what genes are from the region where the 201st marker is. And let us say that you get a list of 20 genes. You then find out which ones of those are expressed

they are wide-ranging and multi-sectoral in their sweep, the implementation of these recommendations would require a high-level, yet fully representative, coordination body that must function, in the words of the Report, "like a symphony orchestra". The Commission has therefore recommended the constitution of a Standing Committee on Agricultural Trade, which is to be chaired by the Chief Minister, with the Minister for Agriculture as the co-chair. The Committee must represent the principal stakeholders within agricultural trade. It must coordinate programmes, provide policy direction, monitor trade, initiate pro-active action, promote trade and Intellectual Property Rights (IPR) literacy, and generate ideas and action to promote agricultural trade.

As a response to the extreme distress faced by plantation labour owing to the crisis in the plantation economy, the Commission, in one of its first interim recommendations, asked the Government of India to initiate a "Food for Wage and Employment Stabilisation in Plantation Crops Programme" under the Sampoorn Gramin Rozgar Yojana. The Kerala government acted on this recommendation. The Commission has proposed that a range of domestic support measures be created to offer income support to small and marginal farmers. These include:

★ Statutory Minimum Support Price (MSP) to field and plantation crops, a measure that is fully WTO-compatible.

★ The use of variable tariffs to protect cultivators against sharp fluctuations in international prices and import surges.

★ Re-imposing quantitative restrictions within the framework of a Livelihood Security Box.

★ Introducing policy measures like crop insurance, imaginative rural credit services, new forms of agricultural extension; providing facilities for marketing, storage and processing, and so on.

★ Initiating multi-disciplinary policy research on various forms of domestic support and their feasibility.

★ Initiating a massive programme of replanting and rehabilitation of all perennial crops such as coconut, cashewnut, rubber, tea, coffee and cardamom.

The Commission has drawn special attention to the revitalisation of fisheries, where it has called, among other changes, for

★ A movement to enhance the quality of domestically consumed fish.

★ A multi-stakeholder study of the current subsidies in the fisheries sector so that support that is non-actionable under the relevant WTO agreements can be provided to the sector.

★ Aquarian reform that will restrict the rights to own fishing vessels to those who actually fish.

★ New measures for environmental protection and sustainable management of fishing grounds.

While the Commission has made a blanket recommendation to the Government of India to review periodically issues such as Quantitative Restrictions (QRs), variable tariffs and statutory MSP in respect of all cash and plantation crops, it has also made specific recommendations in respect of each of these crops which have experienced sharp price declines in recent years. It has recommended that the government make efforts to have rubber re-categorised as an agricultural crop so that it can be brought within the AoA. To avoid distress sales and price manipulation in plantation crops, it has called for participatory buffer stocking through a modification of the Rural Godown Scheme of the Government of India. Such a system is best maintained by farmers' unions/cooperatives.

Herbal medicine and ayurveda, along with tourism, are potential high-growth areas which the Commission has identified as deserving of special attention. The growing global demand for traditional systems of healthcare presents great opportunities for Kerala but it also puts enormous pressure on the resource base of medicinal plants, which must be safeguarded by the groups concerned. The Commission has called for quality control and certification for ayurvedic medicines and the formation of medicinal plants growers associations, each covering about 100 hectares, for the cultivation and marketing of medicinal herbs. Areas rich in herbal plants can be developed into herbal sanctuaries. The Commission has recommended that the region from the Silent Valley Biosphere Reserve up to Wayanad be denoted a Herbal Biovalley. "The Herbal Biovalley should provide the biological software essential for a dynamic medicinal plant industry," the Commission has noted. The tourism sector must be reoriented to cater to health (ayurveda), spirituality, and nature tourism.

Unique to this Commission is its recognition of the media as playing an important role in meeting the challenges of the new trade dispensation. This is particularly so in a State where newspaper readership and media consumption are so widespread and the media so sensitised to livelihood concerns. The Commission has recommended the setting up of a WTO Media Cell that could perform the function of a clearing house of information pertaining to the WTO and Kerala. The Media Cell should work closely with yet another body that the Commission has recommended that the State government set up, namely, a Virtual University for Agricultural Trade. This is vital if Kerala is to become competitive in trade, knowledge and information empowerment for farm families, traders, consumers and exporters. "A computer-aided and Internet-connected Virtual University can be established on a hub and spokes model. The hub can be located at an appropriate location like the Kerala Agricultural University, with the spokes located in every district. The hub and spokes can be linked to television channels and community radio stations, so that relevant information reaches every farm family every morning," the Report notes. The Commission has called for a meeting of data generators and providers (the Indian Space Research Organisation, the India Meteorological Department, the Kerala Agricultural University, the National Dairy Development Board, the many Commodity Boards, Ministries and departments of the State and Central governments, and so on); data seekers (farm families, traders, consumers, exporters); and information managers (information technology or IT specialists, media representatives, extensions specialists, and so on) to work out a plan for the proposed university.

Writing 60 years ago, E.M.S. Namboodiripad had this to say in an essay entitled "From Militarist to Colonial Economy": "It is thus clear that agriculture in Kerala is directed towards the production of cash crops to be sold in the world market and that only the barest minimum of goods are produced for the purpose of local consumption. Every peasant is today dependent on the condition of the world market in a two-fold way: he has to buy commodities produced abroad; he has to sell his own produce abroad." Although the economy and society of Kerala have seen radical transformation since then, EMS' observations on the predicament of the peasantry appears almost prescient. If the peasant's dependence on the world market during colonial times was dictated by the requirements of British colonialism, the Kerala peasantry is today caught in a modern-day global trade regime that is unfavourably weighed against it. The impact of this has been particularly hard on producers in Kerala and it will perhaps require a nationalist movement of a different kind to set right the iniquities of the new global trade regime. ■

in the central nervous system. Say, 10 of them are, and suppose you already know that five of them cause some other disease, then you are left with only five genes, which you then sequence to find out which one of those causes the disease. This is the process by which you identify very rapidly a single gene responsible for a particular disease.

► *How was this done prior to the genome project?*

It was done by a method called 'linkage'. Once you know which chromosome the gene causing the disease was on and the marker associated with it, then you had to sequence the DNA [deoxyribonucleic acid] yourself. To do that you had to [illegible] one it all and it was a huge task. Now it has been done for you. You just have to find the mutation.

► *So, do we now have the facility to sort out all single-gene disorders?*

In the next five to 10 years almost all disorders caused by a single gene will be sorted out. This is no mean achievement.

► *What are the dominant mono-gene disorders that are to be sorted out by the genome project?*

Huntington, some forms of Alzheimer's, epilepsy and Parkinson's disease and a lot of muscle diseases including muscular dystrophy. There is a long list of rare diseases.

We make up about 30,000 genes; over half of them are expected to be in the central nervous system. Random mutations go on across those genes. So, over half of the diseases that may occur are going to be neurological. It is thus not surprising that the long list of genetic diseases would express itself on the nervous system.

► *What are poly-gene or complex disorders? Is there a possibility that they will be sorted out in the near future?*

For a single-gene disorder, everyone within a family who has a particular genetic disease is likely to have the same genetic abnormality as there is a very strong genetic factor that is causing the disease. This is easy to find out as it stands out.

But take, for example, epilepsy, which is mostly not transmitted through generations. You may just have one or two people in a family with epilepsy and that does not give you enough information. The disease may be a result of a complex interplay of genetic and environmental factors. Thus in the case of complex disorders it is just not the relative abnormality in the genes that causes the disease. By itself the gene does not tell you anything. It is a combination of genes and environmental factors that causes complex disorders such as epilepsy.

To find out the cause of such diseases it is not enough to study one person or a few families, you need to study hundreds of people as you cannot separate them to start with as you do not know what comparisons to make. It is thus best to start the study with a large population and do the mapping. Then go back and say that this type of epilepsy is mostly because of these factors and so on. Even in this case we are only guessing. But, surely, a homogenous approach where one lumps them to start with and splits them later is good. In the past, what was done was to split patients into disease categories and then say you have got this or that type of epilepsy. There is some basis in that but I think one should not get too fixed on that.

With the emergence of TB in the West due to AIDS or lower resistance levels, people have turned attention to why certain people are more susceptible to TB than some others. They have found out that it is genetically driven.

► *Are there genetic differences across ethnic groups? And would that make the identification of genetic disorders easier?*

Yes, undoubtedly there are ethnic variations in the genetic make-up. Some common diseases vary in a particular frequency throughout the world. For example, in Singapore, brain haemorrhage, a common cause for stroke, is more common than in the West. The reason for that is not very clear as yet. It may be because of differences in diet, environment and so on. But, as is being increasingly found out, it is to a large extent genetically driven. You will have to take into account what the frequencies of the disease are in different populations. Alzheimer's is a big problem in the United Kingdom. But in some other parts of the world, where the life expectancy at birth is low, people die before they can even get it. Thus, there are diseases such as Alzheimer's, Parkinson's and stroke, as also cancer, that are becoming major problems because people are living longer now.

► *How can genetic studies give clues to environmental factors that cause diseases?*

For example, in the case of Parkinson's disease, an idea that has arisen over the years (though not proved as yet) is that probably some environmental poison or toxin causes it. In such a case if a person is exposed to such an environment it may be useful to study how his genetic basis would react to the exposure in order to find out whether he is going to get the disease or not. There is a biological possibility to it. For instance, if you are a slow metaboliser at a number of different genes, then, it would be only modestly harmful and you know you can cope with it.

So, the idea is that if we study those genetic factors and find them to react to toxins that cause such diseases, then we can probably identify the environmental factors. But this is painting a rosy picture of the future. There are obviously more complex and difficult problems. I am sure in another five to 10 years' time, we shall still be left with a lot of questions about the common diseases. But we shall surely be at least a bit further along in understanding them.

► *How does one determine the inheritability of diseases?*

We can measure inheritability by twin studies. For example, the chance of identical twins being epileptic is quite high. Even a disease like TB [tuberculosis], which is infectious, has a genetic basis. It is quite clear from studies that not everyone who was exposed to TB in a family got the disease. The chance of identical twins getting TB is more than non-identical twins exposed to the same environment. With the emergence of TB in the West due to AIDS [Acquired Immune Deficiency Syndrome] or lower resistance levels, people have turned attention to why certain people are more susceptible to TB than some others. They have found out that it is genetically driven.

Probably, the only problem that is not genetically driven is trauma – being knocked over by a bus or a train. That is plain bad luck.

► *How can gene defects be corrected? Is gene therapy a possibility in the near future?*

Gene therapy is definitely something for the future. I am sure something useful will come out of gene therapy. But there are several problems. Suppose you detect a genetic defect and have to correct it,

there are ways of doing it. One way is getting a new gene into the cell. Most cells are receptive of new genetic material when they are dividing. So it is relatively easy to introduce new genes when the cells are dividing. Since liver, lungs and blood cells keep dividing all the time, it is easy to introduce new cells to correct diseases connected with these organs. But this is not possible with the nervous system as its cells keep dying, becoming fewer over the years as in the case of muscles. So a vector system needs to be developed that can transfer genetic material into non-dividing tissues. That is a technological issue and is being worked out. There are some good vectors now. That is one problem.

The other problem is getting the genes in the appropriate place. It need not be in the same place but should be capable of regulating the defect. Often you have to put into the gene something that will listen to the other messages around and gets switched on and off at the appropriate times. That is not trivial, particularly because you do not want the gene and protein to be expressed all the time; only when it is meant to. That is not straightforward. The vector might be very good. But you may want to send in 25 copies. But that would be very difficult to control. So, you may want to send in one copy to the right cell at the right time. That would lead to significant technological problems.

The therapy also depends on the nature of the defect. For some defects such as tetanus disorder, which is autosomal recessive — that is, both parents are well but carry the mutation and the two mutations come together in the offspring giving rise to the disease — if you can put in the right gene you can correct it. And since the parents are well with 50 per cent activity, all you have to do is get 50 per cent of the level. You will probably be fine even with 5 or 10 per cent levels.

But many dominant diseases such as Huntington are not owing to loss of function; it is the gain of function that leads to the problem. So what you have got is a new mutant gene that has a toxic new function — poisoning the nerve cells. Putting in a new copy of the gene would not help in this case. You have got to put in genes that stop the mutant copy. You have to go to another level of sophistication there. This will come in the future, but is not yet around the corner.

By understanding the genetic processes you will think of ways of either modifying the genes or persuading them to turn themselves on or off, as the case may be. In the case of, say, a nasty disease such as muscular dystrophy, people are now looking for small molecules that can cross the barrier into the muscle and switch on new trophyn to do the same job. Rather than trying to correct what is wrong, people are working at persuading the body to mimic in correcting the problem in some other way. I think this kind of approach has a greater chance of correcting gene defects than genetic therapy.

Among the therapies that are to be found, only some would be based on genetics; more would be molecular based.

► *Is there any relation between drug response and the genetic base?*

The main issue is drug response. Not everyone responds to drugs the same way. And not all drugs work on everybody. Now it is done in a hit-and-miss manner. In future, the responsiveness to a drug will be genetically determined.

Our group has found the first genetically determined drug responsiveness in epilepsy. We found that we can label a gene called 'multiple drug resistance gene' (which has been thought of in cancer genes for a while). If you have a certain form of this gene you have a high expression of the protein that stops foreign substances from getting into the cells. It is good if you do not want foreign substances to get in. But it is bad if you want drugs to get in. This leads to low level of drug inside the cell. We know the genetic make-up of that and we have shown that if you have a high expression of the protein there is a high epileptic drug resistance. Epilepsy, for instance, is difficult to treat in such cases. With such studies we shall be able to design drug trials better in the future. Instead of conducting trials in, say, 10,000 people, it can be done with just 500 people who do not get side-effects and respond better to drugs. This will bring down trial costs tremendously.

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That is the real potence of drug responsiveness and the genetic applications to it. The drug companies are very interested in this as they can save a lot of money.

► *There are some ethical issues involved in this, particularly when people are genetically resistant to drugs and are kept out of drug trials. How does one tackle such issues?*

That is a real problem as results of drug trials will not be applicable to this group of people. There is a significant ethical dimension to some of this work. It is complex.

► *What are the state-of-the-art research efforts in pharmacology for neurological disorders?*

As I mentioned earlier, pharmacogenetics is one — the genetic basis for drug responsiveness. And the other is geneticular molecular technology. In this, they take one element of protein known to be good at binding neurons or getting into neural cells and so on. You can design a friendlier compound using molecular technology. That is going to get a lot more sophisticated.

We know the periodic table (from the genome project) but know very little about the protein structures. There is going to be layers and layers of sophistication in this.

► *What is going to happen in the post-genomic sequencing era?*

First is population genetics and what is called 'linkage' or equilibrium or haphazard mapping. The NIH [National Institutes of Health] in the United States has put in several millions of dollars in what is called the 'Hap Map Project'. The other thing is to understand what regulates genes because we only produce 30,000 genes, far fewer than what we expected. The explanation for this is that we probably had one gene to make several proteins by splicing itself in different ways. It is probably regulated at different times and so forth. Understanding all those subtleties of the genetic structure can be very complex. That is called genomics.

On top of that is to understand what proteins the genes make. We know the very basic structure from the Human Genome Project. But how they are folded, how are proteins made, how they get modified and so on are issues that have to be worked out. So it is going to be layers of structures of work — genetic, genomic, proteomic and so on. ■

DECCAN HERALD

SUNDAY HERALD

JANUARY 4, 2004

Setting tongues loose

Ply them with wine, or better still, stuff them with biryani and deny them sleep. Or watch the fun as a lizard is slipped up the pants. One step ahead would be to temporarily snuff out all senses! RAKESH P throws light on some changes in police interrogation of crime suspects

STRIPPED down to his undergarments, Raja sat in a corner of the cell trembling with fear. "Will they continue to torture me if I confess to having committed the robbery or will they stop the thrashing now?" was the question that was running through his mind when a constable yelled at him, "You son of a b@#$#, we will show you hell if you do not tell us where the stolen jewellery is." And for more than a week, Raja was illegally detained and subjected to the worst forms of police torture - his nails were plucked and his private parts bruised.

"Sir, that was seven years ago. Now things have changed. We are packed off to the jail after three or four rounds of caning as the policemen do not keep us in the cell for more than a day," says 31-year-old Raja, a habitual offender and a resident of Banashankari.

It is true. The Bangalore City Police is undergoing a change in its mindset on the use of third degree methods (extremely violent forms) for extracting information from crime suspects. In the last five years, third degree methods have turned out to be a risky proposition for the police due to increased awareness about human rights among criminals, the poor physical conditions of suspects and a pro-active judiciary.

Things have reached such a passé that criminals have today started quoting the National Human Rights Commission (NHRC) guidelines on arrest. In fact, a few members of rowdy Tanveer's gang and extortionist Praveen alias Malayali Praveen have written to the NHRC stating that there was a threat to their lives from about ten police officers.

Weak physique of the criminals is another reason that prevents police from employing third degree methods. A police inspector who has served more than ten years in the City says, "Earlier, rowdies were strong-hearted and had a great physique. When hit, lathis not only rebounded but used to break. However, the physical build of criminals are poor these days with as many as 95 per cent of them addicted to drugs and suffering from various ailments. No officer would like to get suspended by thrashing a weakling who is in his custody."

Well, even criminals have started pressing the panic button for the police. Recently, one of the suspects bit his tongue when a constable raised his lathi on him at Banaswadi police station. "On seeing the suspect bleeding profusely, the police personnel panicked and let him go. Even the other suspects were set free with a warning that they should not speak about the incident," a police officer said while pointing out how the lathi was being relegated to the background. In fact, the City that used to witness at least three lock-up death cases a year has not seen a single one in the last two years.

Changing scenario

While some old-hands in the police department crib that criminal cases cannot be detected unless laws are bent, a majority of the officers are turning is used on hardcore criminals and rowdy-sheeters. Here, the police create an atmosphere that makes the criminals feel that they will be bumped off if they do not speak out. "The style of threat is different. A constable constantly narrates to the suspect the extents to which his superior will go. Fearing repercussions, the man confesses," an officer said. It was this technique that made rowdy Tanveer surrender before the Anti Rowdy Squad chief two years back.

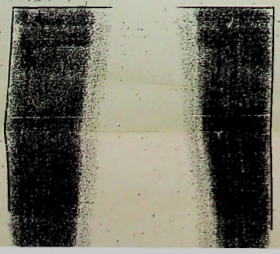
Injecting: This is another technique reserved for extracting information from robbery/dacoity gangs. Before the accused are brought to the police station, one of the latter's informants would have been housed in the cell. Once the accused are behind bars, the informant gains their confidence and collects information about their activities. Subsequently the information is passed on to the investigating officer. "Once the suspects know that the police have some information about their criminal antecedents, they just open up," said a police officer.

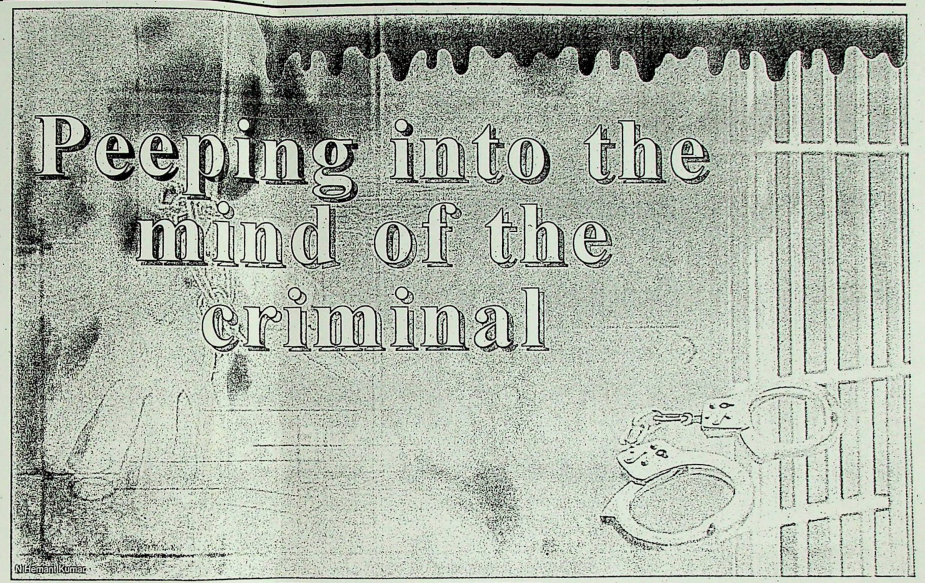
Irritating: Though a bit primitive, this technique works on people who fear insects and lizards. The suspect is made to wear a loose pair of trousers, which is tied at the bottom after a garden lizard is slipped in. While the lizard moves all over his legs in panic, the suspect screams out the truth. This technique is rarely used as policemen are not adept in catching lizards!

Insecurity: White-collared criminals and first-time offenders are subjected to this form of interrogation. Here, the suspect's eyes are tied with a piece of cloth, his ears are stuffed with cotton and he is put in a cell. No one will respond to the suspect's call. After some time, a sense of insecurity prevails and fearing the worst, the suspect speaks voluntarily.

With human rights organizations such as Sichrem, Vimochana and the People's Union for Civil Liberties (Karnataka) constantly warning the police against the use strong-arm tactics, the emphasis today is more on scientific methods of investigation. While the Finger Prints squad of the City Police continues to track down offenders, cellular technology is increasingly becoming the most sought-after tool for the policemen to catch criminals. Though no formal training has been given with regard to cellular technology, a few police officers have become experts in nabbing the criminals with the help of mobile phones. In fact, none of the accused in the multi-crore stamp paper racket have been subjected to third degree methods by Stamp it, the investigation team. All the arrests have been effected on the basis of interception of telephonic conversation the accused had with the kingpin, Abdul Karim Telgi alias Lala.

Obviously, with white collared and cyber criminals being more shrewd, it is high time the police honed their investigative skills and came out with innovative non-coercive methods of interrogation, instead of rolling up shirt sleeves for that thrashing spree!





From a simple lie detector test to DNA analysis and brain mapping, forensic science has gone ahead. VEENA BHARATHI highlights some of the behind-the-scene action in crime detection

IN 1991, when Deputy Conservator of Forests Srinivas's headless dead body was found in the BR-MM hills range, the body showed three types of grievous injuries. Gun shot wound, decapitation and extensive burns. The CoD had requested the expertise of Forensic Science Specialist of Karnataka State Laboratory Dr B M Mohan in restructuring the sequence of events, which further aided their investigations.

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The alleged kingpin of the stamp paper racket, Abdul Karim Lala alias Telgi, was on December 22 subjected to narco-analysis test, also known as the 'truth serum test'.

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The Forensic Science Laboratory, Bangalore adopted latest techniques such as the Newtron Activation Analysis and accurate ballistic methods which led to the conviction of Ponnappa, the man who shot his brother Chengappa dead in front of their mother following a property dispute in Coorg, three years ago. Ponnappa's counsel argued that the accidental gun shot was triggered in a scuffle, but the ballistic tests pointed out that the shot was on purpose.

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The Forensic scientists managed to unravel the truth in the sensational Halikhed B human sacrifice case, that rocked Gulbarga district two years back, by

Origins

The word 'Forensic' is derived from the Latin word 'Forensis' which means 'of the Forum'. In Rome, 'Forum' was the meeting place where civic and legal matters were discussed by those vested with public responsibility.

Forensic medicine was earlier known as 'Medical jurisprudence'. In 1858 Sir William Herschel of the Indian Civil Service first used 'Modern dactylography' or application of finger prints for personal identification. In fact, it was the Government of India which first adopted 'identification of persons by finger print comparison methods'. Thus, a finger print bureau was established in 1897 in Bengal. Only later on was this method introduced in Scotland Yard in 1901.

Now, for the last two decades with the changing crime scenario and the high professionalism and integrity shown by forensic scientists, there have been more interactive and productive analytical sessions takers, traces of the drug could get deposited at the hair roots. In this case no deposits of any drugs was found. It was an obvious conclusion that the lady was administered an overdose of sedatives and was buried alive in a state of semi-coma. Our findings corroborated the details between the mind and the body. When a deceptive examinee is subjected to this test, his or her intrinsic pattern of reacting to stressful situation will elicit certain body responses. These responses are recorded by the three components or the sensors of a polygraph machine, which are attached to the subject (or the suspect). The pneumograph records respiratory variations such as a subject's rhythm, depth and rate of breathing, a Galvanometer records the skin responses to electrical stimulation and a cardio-spygmograph records a subject's blood volume, pulse rate and blood pressure.

"Polygraph test is conducted in three phases. A pretest interview, chart recording and diagof inducing hypnosis in the subject. Due to lack of inhibition produced by the drug, the accused talks freely and responds truthfully to verbal questions. We make sure that all the emergency medical measures are available to the person while undergoing the test, including the presence of an anaesthetist to monitor the vital body functions," says Dr Malini, stressing that a neuro-psychology background of the examiner is very essential.

"Narcoanalysis is a very scientific and a humane approach in dealing with an accused's psychological expressions, definitely better than third degree treatment to extract truth from an accused," affirms Dr Malini.

The present day Sherlock Holmes

THE Andhra Pradesh Forensic Science Laboratory at Hyderabad is equipped with state-of-art technology to find answers to questions that beat detectives of the highest order. So when CBI wanted an answer to the question if Dilip Singh Judeo claimed correctly that the video in which he is seen accepting cash to help an Australian mining company corner a lease in India was a ploy, it sent the video cassette to APFSL. The lab is the only one in the country that has sophisticated state of the art digital enhancement systems equipment to carry out such tests. And the Judeo tape was the first one it tested. Two years ago the Tehelka cassettes had to be sent abroad for similar tests.

After putting it through various tests concerned with video forensics, the APSFL declared the Judeo cassette as genuine.

recording. Authenticity analysis is used to determine if a recording has simultaneous origins as the acoustic events it represents or if it has been altered or edited.

To help the forensic expert in the detection process the instrumental tools used a cross-pulse monitor, frequency generators, video signal generators, oscilloscopes, waveform monitors/vectorscopes, alignment tapes, and magnetic developing solutions.

Lastly, magnetic development of the original videotape can often yield important audio and control track timing and misalignment information. For example if an 8 mm original tape was subsequently subjected to the full-width erase head action of a VCR, the resultant erase head signature could be visualized on the video microscope and documented to establish the authenticity.

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Things have reached such a passé that criminals have today started quoting the National Human Rights Commission (NHRC) guidelines on arrest. In fact, a few members of rowdy Tanveer's gang and extortionist Praveen alias Malayali Praveen have written to the NHRC stating that there was a threat to their lives from about ten police officers.

Weak physique of the criminals is another reason that prevents police from employing third degree methods. A police inspector who has served more than ten years in the City says, "Earlier, rowdies were strong-hearted and had a great physique. When hit, lathis not only rebounded but used to break. However, the physical build of criminals are poor these days with as many as 95 per cent of them addicted to drugs and suffering from various ailments. No officer would like to get suspended by thrashing a weakling who is in his custody."

Well, even criminals have started pressing the panic button for the police. Recently, one of the suspects bit his tongue when a constable raised his lathi on him at Banaswadi police station. "On seeing the suspect bleeding profusely, the police personnel panicked and let him go. Even the other suspects were set free with a warning that they should not speak about the incident," a police officer said while pointing out how the lathi was being relegated to the background. In fact, the City that used to witness at least three lock-up death cases a year has not seen a single one in the last two years.

Changing scenario

While some old-hands in the police department crib that criminal cases cannot be detected unless laws are bent, a majority of the officers are turning out to be dynamic dissenters. Sandwiched between human rights activists and output-demanding superiors, police officers in Bangalore City are coming out with indigenous methods of interrogation, besides taking advantage of the strides being made in forensic sciences.

The interrogation technique to be adopted depends on the officer who is investigating the case. Some of the non-lathi techniques used by the City Police in recent times are given below.

Boozing : Here, the investigating officer will speak to the suspect in such a way that the latter begins to feel that the officer is not serious in pursuing the case. Next, the officer offers him the liquor of his choice. Under the influence of alcohol, the narration starts. In fact, using this technique, the police managed to recover a service revolver stolen from a City Armed Reserve constable who was attached to a High Court judge. "The suspect was subjected to interrogation for two days but he maintained that he knew nothing. It was only after he was offered his favorite drink, McDowell Whisky, that he admitted that he was in possession of the weapon," said an investigator.

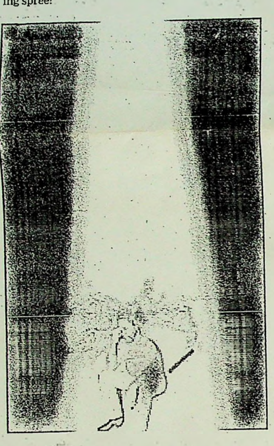
Sleeping: This is a technique used on criminals with a strong appetite. The suspect is served with biriyani and other food from time to time, but will not be allowed either to sit on the floor or to sleep for two days. Lack of proper sleep leads to indigestion and subsequently body ache, besides causing sweating and irritation in the eyes. As the suspect suffers he is asked to reveal the truth if he has to be allowed to sleep. This worked in the case of Kumar Yeriyur, from whom the police managed to recover 50 stolen two-wheelers.

Probing: One of the most effective methods, here the suspect is questioned non-stop for about eight to ten hours. All the minute details given by him are written down. The lengthy question-answer session will usually frustrate the suspect and chances of him making contradictory statements or trying to fix his associates are quite high. Following this, the investigating officer checks the veracity of statements made by the suspect. This is a laborious job, but it pays. Secondly, the officer can not only ascertain the truth but also trap others involved in the crime. This technique was used in the Vineet Vachani kidnap case that rocked the City in the year 2000. The mastermind of the kidnap, Sanjay Saighal spilled the beans after he was subjected to intense grilling.

Assuring: This technique is used on criminal gangs. The officer identifies a weak-minded member of the gang, picks him and coaxes him to become an approver. But this does not work with organized gangs that operate in the City's Shivajinagar and adjoining areas as a majority of them do not trust the police.

Browbeating: When assurances do not work, intimidation works, police believe. This technique [illegible] Civil Liberties (Karnataka) constantly warning the police against the use strong-arm tactics, the emphasis today is more on scientific methods of investigation. While the Finger Prints squad of the City Police continues to track down offenders, cellular technology is increasingly becoming the most sought-after tool for the policemen to catch criminals. Though no formal training has been given with regard to cellular technology, a few police officers have become experts in nabbing the criminals with the help of mobile phones. In fact, none of the accused in the multi-crore stamp paper racket have been subjected to third degree methods by Stampit, the investigation team. All the arrests have been effected on the basis of interception of telephonic conversation the accused had with the kingpin, Abdul Karim Telgi alias Lala.

Obviously, with white collared and cyber criminals being more shrewd, it is high time the police honed their investigative skills and came out with innovative non-coercive methods of interrogation, instead of rolling up shirt sleeves for that thrashing spree!



The third degree!

Third degree methods used by Bangalore Police

A crime suspect, on being brought to the police station, could either be subjected to a question-answer session or to third-degree methods. It all depends on the heinousness of the crime and the psyche of the investigator. If the suspect is a hard nut to crack, the methods employed to bring out the truth will also be harsh.

Some of the common third degree methods used by the City police are;

Basunde: Also called *lathi*, this is the first step. The suspect is made to keep both his hands on the table and his fingers are hit with a lathi (a stick).

Lala: The suspect is beaten with a lathi on the soles of his feet.

Ulta: The accused is hung upside down and tortured. (A lean person cannot withstand this treatment)

Aeroplane: The hands of the suspect are tied tightly behind his back and he is lifted in the air with a pulley. The suspect will not be able to bear the pain in the shoulder as the entire body weight is passed on to the shoulder

Bombay Cut: Hands of the suspect are tied behind his back, a pipe is placed under his knees and he is elevated just above the ground level. The entire body weight is on his knees causing enormous pain.

Burmappa: A small leather belt is used to hit the suspect on his posterior and back after pouring water all over his body.

Ruler: The suspect is made to lie down with his hands tied behind his back and two constables rub his body with a huge wooden ruler. (This is dangerous as it can rupture the veins and cause haemorrhage.)

Bellary Gundu: Also known as *Hyderabad Gundu*, chilli powder is put into the anus of the suspect. (This is not tried on suspects who have piles).

I[illegible] 1991, when Deputy Conservator of Forests Srinivas's headless dead body was found in the BR-MM hills range, the body showed three types of grievous injuries. Gun shot wound, decapitation and extensive burns. The CoD had requested the expertise of Forensic Science Specialist of Karnataka State Laboratory Dr B M Mohan in restructuring the sequence of events, which further aided their investigations.

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The alleged kingpin of the stamp paper racket, Abdul Karim Lala alias Telgi, was on December 22 subjected to narco-analysis test, also known as the 'truth serum test'.

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The Forensic Science Laboratory, Bangalore adopted latest techniques such as the Newtron Activation Analysis and accurate ballistic methods which led to the conviction of Ponnappa, the man who shot his brother Chengappa dead in front of their mother following a property dispute in Coorg, three years ago. Ponnappa's counsel argued that the accidental gun shot was triggered in a scuffle, but the ballistic tests pointed out that the shot was on purpose.

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The Forensic scientists managed to unravel the truth in the sensational Halikhed B human sacrifice case, that rocked Gulbarga district two years back, by subjecting the suspects to polygraph test. The police, who suspected the handiwork of black magicians behind the death of the ten-year-old boy, were surprised when forensic investigations revealed that it was a case of murder for vengeance.

FOR the HOD of Forensic medicine at the Victoria Hospital, Bangalore, Dr P K Devdas, 'each day is a challenge'. Since it is not only the 'autopsy or the post mortem procedures' which keep him busy, Dr Devdas is used to facing day-to-day medico legal dilemmas and solving them by accurate decision making, as in the case of an FIR filed by the parents against their daughter who had eloped and married her lover against her parents' wishes.

"The girl claimed that she was four months pregnant. The police officer brought her to us to ascertain her age. I could not advise her to undergo an X-ray examination for determining the bone maturity (and thus her age), because a pregnant woman should not be exposed to X-rays especially in the initial months. Hence I referred her to a lady obstetrician at Vanivilas hospital to know her medical condition and then decide the further steps of evaluation," says Dr Devdas.

The girl in question seemed well above 18 years of age, though her parents had claimed that she wass not yet a major and thus had registered a case of kidnap against their son-in-law.

Forensic medicine and forensic science experts, clinical-criminal psychologists are truly the "behind the scene heroes/heroines" who have been working day and night to conduct and give autopsy reports, to aid the law in reconstruction of crime scenario, in substantiating the investigating officers' findings and in preventing the innocent victims or suspects from getting convicted.

From a simple lie detector test to DNA analysis and brain mapping, forensic science has gone ahead. VEENA BHARATHI highlights some of the behind-the-scene action in crime detection

Origins

The word 'Forensic' is derived from the Latin word 'Forensis' which means 'of the Forum'. In Rome, 'Forum' was the meeting place where civic and legal matters were discussed by those vested with public responsibility.

Forensic medicine was earlier known as 'Medical jurisprudence'. In 1858 Sir William Herschel of the Indian Civil Service first used 'Modern dactylography' or application of finger prints for personal identification. In fact, it was the Government of India which first adopted 'identification of persons by finger print comparison methods'. Thus, a finger print bureau was established in 1897 in Bengal. Only later on was this method introduced in Scotland Yard in 1901.

Now, for the last two decades with the changing crime scenario and the high professionalism and integrity shown by forensic scientists, there have been more interactive and productive analytical sessions taking place between police officials, forensic science experts, investigating agencies and forensic medicine specialists.

Says Dr B M Mohan, Director of Forensic Sciences Laboratory of Karnataka Government, Department of Police, Bangalore "hen deputy conservator of forests Srinivas was brutally murdered by Veerappan and his gang, the CoD asked us to reconstruct the sequence of events. The victim had suffered gunshot wounds and his beheaded body had been burnt. The bullet injuries indicated two entry wounds, though only one exit wound was seen at the victim's back. We found out that one bullet was lodged in the left ventricle of the heart, which happened to be the first bullet shot at Srinivas and the other bullet had gone 'through and through' the chest thus indicating an exit wound also.

"We also came to a conclusion that petrol had been used to burn the body to make it unrecognisable. The sequence of injuries were recorded as two gun shot wounds from a distance of 20-25 feet and from a height of 10-15 feet, followed by decapitation or 'beheading' and burning of the victim's body by using petrol. The victim's blood level estimation of carboxyhaemoglobin also provided us with clues about duration and stage of exposure to fire."

Says Dr B M Mohan narrating another on-going case in which a lady was drugged and buried alive on the Richmond Road in Bangalore more than five years ago, "In order to establish the victim's identity and the cause of death, superimposition technique of the recovered skull with the victim's photograph (taken when she was alive), DNA-analysis and hair root analysis were carried out. We ruled out the lady's habitual addiction to sedatives as claimed by the accused by her 'hair root analysis' test, since in persons who habitually take tranquillisers, traces of the drug could get deposited at the hair roots. In this case no deposits of any drugs was found. It was an obvious conclusion that the lady was administered an overdose of sedatives and was buried alive in a state of semi-coma. Our findings corroborated the details provided by the victim's daughter and other eye witness accounts."

According to Dr Mohan in cases of sexual assault, the assailant usually inflicts multiple injuries on the victim. During the tussle the assailant may also suffer bite marks and other injuries inflicted upon him by the victim. "Trace evidence materials on the victim of the assault, on the weapon, on the person of the suspect and at the scene of crime are analysed by sophisticated laboratory methods. We examine the blood stain patterns, edges of the dried-up stain both at the place of the offence and at the place of disposal of the body. From the scene where crime may have taken place, if the victim's body has been shifted, we inspect the clothing for stains of semen and blood. The clothing may also have carried soil, hair samples of both the victims and the offenders and other residues. All these trace evidence materials will be scientifically examined."

Criminal psychology

Forensic scientists are further helped in their marathon task of interpretation of the crime by clinical or criminal psychologists. Dr Malini, who works at the State Forensic Sciences Laboratory as the Clinical-Criminal Psychologist has a rich experience as a psychologist at NIMHANS, Bangalore.

Says Dr Malini, "In order to interpret the behaviour of the criminal (or the suspect) and corroborate the investigating officers' observation and the saying of the suspect, we carry out psycho analytical tests such as a polygraph test, Narco analysis and Brain-mapping."

A lie-detector or a polygraph test depends on the assumption that there is an interaction *When a deceptive examinee is subjected to this test, his or her intrinsic pattern of reacting to stressful situation will elicit certain body responses.* These responses are recorded by the three components or the sensors of a polygraph machine, which are attached to the subject (or the suspect). The pneumograph records respiratory variations such as a subject's rhythm, depth and rate of breathing, a Galvanometer records the skin responses to electrical stimulation and a cardio-spygmograph records a subject's blood volume, pulse rate and blood pressure.

"Polygraph test is conducted in three phases. A pretest interview, chart recording and diagnosis. During the pretest interview, we clarify the purpose of the test with the suspect. The examiner (a clinical or a criminal psychologist) would have prepared a set of test questions depending upon the relevant information about the case provided by the investigating officer, such as the criminal charges against the person and statements made by the suspect."

Lying by a suspect is accompanied by specific, perceptible physiological and behavioural changes and the "guilt consciousness" in a suspect is exposed by the 'sensors' which record various parameters such as the blood pressure level, respiratory rate, pulse rate and a wave pattern in the graph. The findings of a polygraph test are open for a judicial scrutiny.

"The Karnataka high court has accepted polygraph test findings as evidence in a murder case. In fact, a Calcutta Court convicted a few police officers (who were also the suspects along with the accused based on the circumstantial evidence) when they refused to take the polygraph test, treating their refusal to take the test as yet another ground for their culpability and involvement in the offence," says Dr Malini, citing a documented news report.

Narco-analysis

Another 'Criminal – assessment' scientific test is the 'Narco analysis'.

"This procedure is conducted in government hospitals after a court order is passed instructing us to conduct the test. The accused person's detailed medical examination is carried out. Only if the accused is medically fit to undergo the procedure, small doses of intravenous infusion of sodium pentothal is administered. This is an effective and non-hazardous method *ject. Due to lack of inhibition produced by the drug, the accused talks freely and responds truthfully to verbal questions. We make sure that all* the emergency medical measures are available to the person while undergoing the test, including the presence of an anaesthetist to monitor the vital body functions," says Dr Malini, stressing that a neuro-psychology background of the examiner is very essential.

"Narcoanalysis is a very scientific and a humane approach in dealing with an accused's psychological expressions, definitely better than third degree treatment to extract truth from an accused," affirms Dr Malini.

Recent research has shown that electrical brain responses can be a reliable indicator of information processing activities in the brain. This method called the 'Brain-wave finger printing' was researched and patented by neuroscientist Dr Lawrence Farwell (Director and Chief Scientist "Brain wave Science" IOWA).

Dr Farwell has published that a MERMER (Memory and Encoding Related Multifaceted Electro Encephalographic Response) is initiated in the accused when his brain recognises noteworthy information pertaining to the crime. These stimuli are called the 'target stimuli'. In a nutshell, Brain finger printing test matches information stored in the brain with information from the crime scene.

Brain mapping

The Forensic science Laboratory in Bangalore is the first and the only centre in India, which is conducting the Brain-mapping or Brain-finger printing test. "We use an equipment called the 'neuroscan' and obtain an EEG (Electro Encephalogram) and ERP (Event Related Potential) both of which are studied to analyse the case. There is an in-built programme, which automatically removes responses obtained due to 'tensions' unrelated to the crime. The accuracy rate is 99.99 per cent and in USA, the FBI have been making use of 'Brain-mapping technique' to convict criminals," says Dr Malini.

Studies have shown that an innocent suspect's brain would not have stored or recorded certain information, which an actual perpetrator's brain would have stored.

Indee, from fingerprinting and DNA analysis to brain mapping, forensic science has made rapid strides.

The present day Sherlock Holmes

THE Andhra Pradesh Forensic Science Laboratory at Hyderabad is equipped with state-of-art technology to find answers to questions that beat detectives of the highest order. So when CBI wanted an answer to the question if Dilip Singh Judeo claimed correctly that the video in which he is seen accepting cash to help an Australian mining company corner a lease in India was a ploy, it sent the video cassette to APFSL. The lab is the only one in the country that has sophisticated state of the art digital enhancement systems equipment to carry out such tests. And the Judeo tape was the first one it tested. Two years ago the Tehelka cassettes had to be sent abroad for similar tests.

After putting it through various tests concerned with video forensics, the APSFL declared the Judeo cassette as genuine.

Explaining the intricacies of the authenticity analysis, APFSL director K P C Gandhi said it is a very time intensive task requiring a millisecond-by-millisecond detailed examination of the recording. Authenticity analysis is used to determine if a recording has simultaneous origins as the acoustic events it represents or if it has been altered or edited.

To help the forensic expert in the detection process the instrumental tools used a cross-pulse monitor, frequency generators, video signal generators, oscilloscopes, waveform monitors/vectorscopes, alignment tapes, and magnetic developing solutions.

Lastly, magnetic development of the original videotape can often yield important audio and control track timing and misalignment information. For example if an 8 mm original tape was subsequently subjected to the full-width erase head action of a VCR, the resultant erase head signature could be visualized on the video microscope and documented to establish the authenticity.

Technology is today's Sherlock Holmes.

R Akhileshwari

MP-13.

MessageThis gives links to a number of reports and commentaries on the announcement by Korean scientists that they have cloned a human embryo.

Sandhya Srinivasan

Genetic Crossroads #37

The Newsletter of the Center for Genetics and Society

Special Issue on the Korean Cloning Announcement

February 17, 2004

I. In the Wake of the Korean Cloning Announcement: An Analysis

II. Key Links and Commentary

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III. Newsletter Subscription and Formats

I. IN THE WAKE OF THE KOREAN CLONING ANNOUNCEMENT: AN ANALYSIS

CGS has prepared an analysis of the state of the science, policy and politics concerning research cloning in the wake of the Korean cloning announcement. Key excerpts.

"The announcement that Korean scientists have created clonal human embryos puts new urgency behind the need for effective public oversight and control of new human genetic and reproductive technologies. While cloning techniques may someday have legitimate therapeutic applications, in the short term they make it far easier for rogue scientists to attempt to clone a child, and set the stage for other abuses. Given the absence of effective controls and regulations over these technologies in the great majority of countries, the Korean experiments are ill-considered and irresponsible.

"If real progress is to be made towards breaking the current stalemate on cloning

to re-examine their continued opposition to legislation that bans reproductive cloning but does not also ban research cloning. The Bush Administration needs to reconsider its strictures on funding for embryo research. Liberals and progressives need to realize that cloning and other new genetic technologies open the door to potentially horrific new forms of eugenics and social exclusion, and should be viewed with the utmost concern. Scientists need to realize that society as a whole has the right and responsibility to set guidelines for profoundly consequential technologies. Scientists also need to hold each other accountable for raising false hopes among vulnerable constituencies and lay publics."

The full text is at: http://www.genetics-and-society.org/newsletter/index.html#T

II. KEY LINKS AND COMMENTARY

1. Critical comments in news coverage

Initial news coverage of the Korean announcement significantly overstated the near-term prospects for therapeutic applications of cloning technology, and downplayed the risks. Some articles included comments giving more balanced assessments:

Rick Weiss, "S. Korean Scientists Describe Cloning," Washington Post (February 13)

"The South Korean team also provided previously undisclosed details about their experiments, revealing that their technique had not worked when they tried to clone male cells-a fact that calls into question its therapeutic potential for men. In the ethics arena, some experts raised questions about the way female volunteers were recruited for the study, which carried modest medical risks and offered them no benefits."
http://www.genetics-and-society.org/resources/items/20040213_washpost_weiss.html

Rosie Mestel, "Clone Is One Step in Extended Process," Los Angeles Times (February 13)

"The report of a successfully cloned human embryo was a milestone in the field of stem cell research, but the medical promise of such endeavors still lies years in the future, scientists said Thursday."
http://www.genetics-and- society.org/resources/items/20040213_latimes_mestel.html

"Cloning surprise sparks raging controversy," Singapore Straits Times (February 14)

"Even among those pursuing cell replacement treatments, many say that therapeutic cloning would be too inefficient and expensive, and that using stem cells from adults was more practical."
http://www.genetics-and-society.org/resources/items/20040214_straitstimes.html

Gina Kolata, "Despite Advance in Cloning, Scientists Are Tempering Hope With Reality," New York Times (February 15)

"'We are mindful that this field has been overhyped,' said Dr. Irving Weissman,

who directs the stem cell institute at Stanford University."
http://www.genetics-and-society.org/resources/items/20040215_nytimes_kolata.html

2. CGS commentary

Two recent articles featuring Center for Genetics and Society staff also addressed cloning issues.

CGS Director Richard Hayes, "Selective Science," TomPaine.com (February 12)
"The birth of the first genetically modified child would be a watershed moment in human history. It would set off a chain of events that would feed back upon themselves in ways impossible to control."
http://www.tompaine.com/feature2.cfm/ID/9937

Pedro F. Trisneda, "La clonación, más allá de una novella (Cloning beyond fiction)" Tiempos del Mundo (February 12), featuring CGS Associate for International Affairs Rosario Isasi
"According to Dr. Isasi, [H]umanity is facing a policy deficit, both national and international, concerning control of the new technologies of human genetic modification."
http://www.idm.com/hemisferio/investigacion.htm

3. Other critical commentary

Judy Norsigian, "Road to Cloning: Caution Ahead," New York Times (February 17)
"To the Editor: Therapeutic applications of embryo cloning - still a distant promise - cannot be developed without first overcoming significant research hurdles with embryo stem cells derived from non-clonal embryos. Sadly, abortion politics have impeded much of this stem cell research. Moreover, many scientific companies involved in commercializing embryonic stem cell research have acknowledged repeatedly how impractical it would be to develop therapies from stem cells derived from clonal embryos. The news from South Korea underscores once again the critical need for both an effective global ban on human reproductive cloning and better information about fertility drugs used during egg extraction. It is a myth that these drugs have been adequately studied and that reasonable informed consent is possible. Finally, because embryo cloning is the gateway to genetic modifications that go far beyond medical treatment into the realm of designer babies, we need a much broader discussion of this contentious issue."
http://www.genetics-and-society.org/resources/items/20040217_nytimes_norsigian.html

"Human Genetics Alert UK criticises cloning researchers' irresponsibility" (February 12)
"Responding to today's news of the cloning of human embryos, HGA's Director, Dr David King said: 'So-called therapeutic cloning will never be possible in medical

practice, because it requires hundreds of eggs per patient, which are not available. Serious scientists, and the companies involved in commercialising embryonic stem cell research, have repeatedly acknowledged this.' But by publishing this technique, what the Korean researchers have done is to give a big boost to those who want to make cloned babies. Before there is a global ban on reproductive cloning, people like Professor Zavos and the Raelians will be able to copy the technique to clone babies. The Koreans have been irresponsible in the extreme. The international community must now act immediately to ban reproductive cloning. There should be an international moratorium on any further embryo cloning research until this is in place."'

For further information, email info@ngaiert.org

Hilary Rose, "Beware the Cowboy Cloners," The Guardian (February 16)

"What is clear is that the rush to experiment with human embryos is, to say the least, premature, driven more by the lust for scientific glory than a clear sense of the medical imperatives. As the procedures involved in therapeutic cloning are almost identical to those needed for reproductive cloning, the Korean achievement brings that closer, too. This inexorably opens the doors to those whom Suzi Leather, the chairwoman of the Human Embryology and Fertilisation Authority, calls 'cowboy cloners'. It is this weakness in the medical case for human therapeutic cloning that throws the moral issues into such sharp relief."

http://www.genetics-and-society.org/resources/items/20040216_guardian_rose.html

4. Earlier critical assessments

Critical assessments of research cloning have been made for some time, but are rarely featured in major press outlets. Exceptions include:

Peter Aldhous, "Can They Rebuild Us?" Nature (April 5, 2001)

"The idea of therapeutic cloning, which offers the potential of growing replacement tissues perfectly matched to their recipients, is falling from favour.[M]any experts do not now expect therapeutic cloning to have a large clinical impact."

http://www.genetics-and-society.org/resources/items/20010405_nature_aldhous.html

Denise Gellene, "Clone Profit? Unlikely: The Technology's Commercial Viability Faces Many Hurdles," Los Angeles Times (May 10, 2002)

"As chief executive of Geron Corporation, [Thomas Okarma] has no interest in using cloned embryos to produce customized treatments for disease. 'The odds favoring success' are vanishingly small,' he said, and the costs are daunting. Okarma said it would take 'thousands of [human] eggs on an assembly line' to produce a custom therapy for a single person. 'The process is a nonstarter, commercially,' he said.

"'Where do you source that many eggs? Sourcing human eggs is a contentious issue in itself,' said Alan Robins, chief scientific officer of BresaGen Ltd., a cell therapy company in Australia and Athens, Ga. 'It is not something we want to get involved in.'

"According to Lutz Giebel, CEO of CyThera, a cell therapy company in San

Diego, '[Therapeutic cloning] is not commercially viable. Quality control is difficult; the FDA can't regulate it, [and] no one can afford the treatment.' He said that a complete ban on human cloning would have only 'a limited impact on corporate product development.'"
http://www.genetics-and-society.org/resources/items/20020510_latimes_geilene.html

Andrew Pollack, "Use of Cloning to Tailor Treatment Has Big Hurdles, Including Cost, " New York Times (December 18, 2001)

"'It's too laborious and costly to employ as a routine therapeutic procedure,' says Dr. Alan Colman, the research director at PPL Therapeutics, the Scottish company which helped to clone Dolly the sheep. 'They're never going to have enough women's eggs available to do it,' said Dr. Alan Trounson, director of the Monash Institute of Reproduction and Development in Australia and an adviser to ES Cell International, a company based in Singapore and Australia."
http://www.genetics-and-society.org/resources/items/20011218_nytimes_pollack.html

III. NEWSLETTER SUBSCRIPTION AND FORMATS

For information on subscribing and unsubscribing to the CGS email newsletter Genetic Crossroads, and on changing between enhanced HTML and plain text formats, go to http://www.genetics-and-society.org/newsletter.

For information about the Center for Genetics and Society go to http://www.genetics-and-society.org/about.

[Non-text portions of this message have been removed]