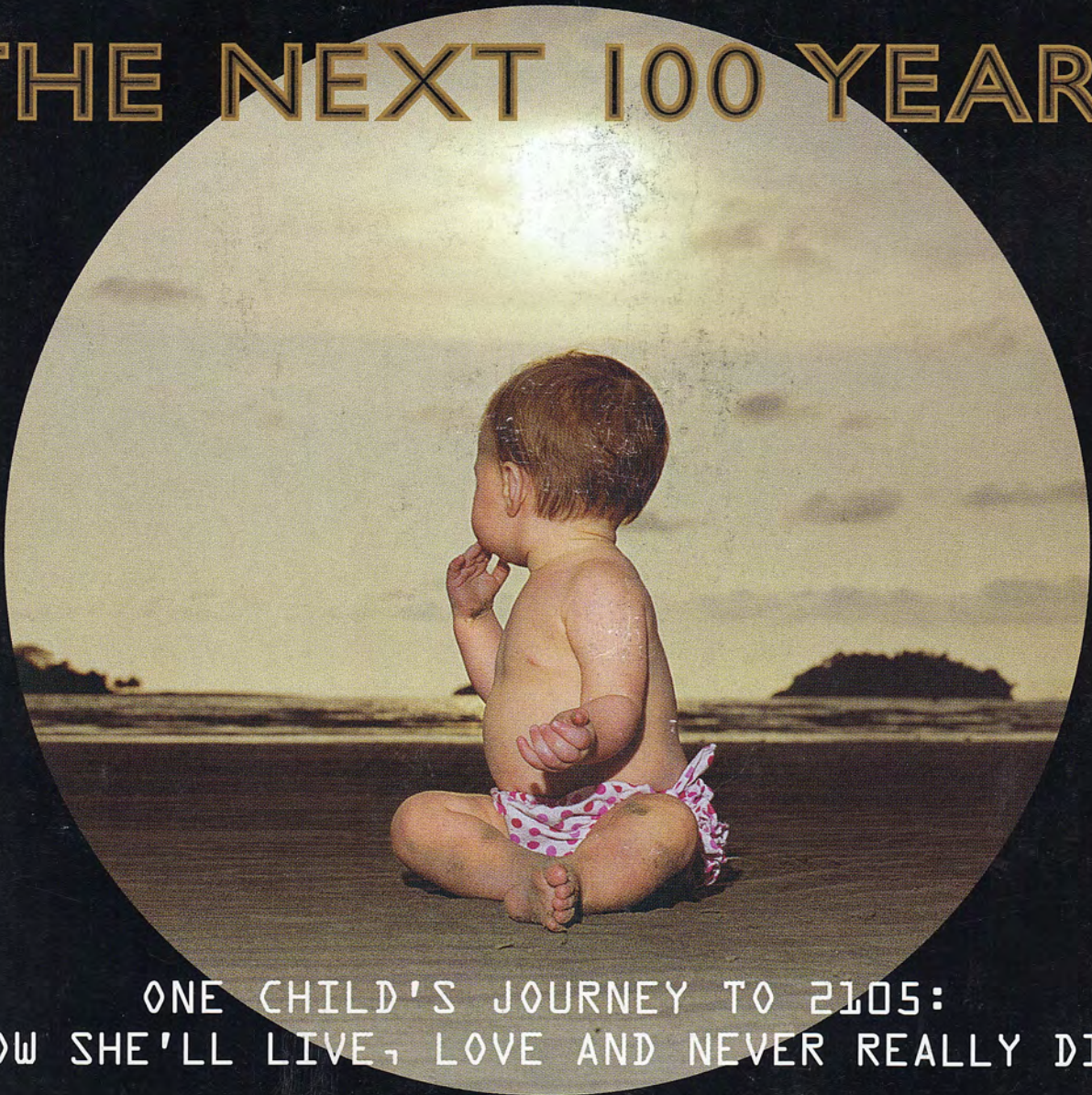


*In celebration of our centennial 1905-2005*

# MAGCLEAN'S

*presents*

## THE NEXT 100 YEARS



ONE CHILD'S JOURNEY TO 2105:  
HOW SHE'LL LIVE, LOVE AND NEVER REALLY DIE

REPORTED BY ALLEN ABEL

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# 2055

*Chapter five, age fifty*

## A CURE FOR EVERYTHING

Moms can be dads, every newborn is perfect and every child is adopted

*"But I don't want comfort. I want God, I want poetry, I want real danger, I want freedom, I want goodness. I want sin."*

*"In fact," said Mustapha Mond, "you're claiming the right to be unhappy."*

*"All right then," said the Savage defiantly. "I'm claiming the right to be unhappy."*

*"Not to mention the right to grow old and ugly and impotent; the right to have syphilis and cancer; the right to have too little to eat; the right to be lousy; the right to live in constant apprehension of what may happen tomorrow; the right to catch typhoid; the right to be tortured by unspeakable pains of every kind."*

*There was a long silence.*

*"I claim them all," said the Savage at last.*

—ALDOUS HUXLEY, *BRAVE NEW WORLD*, 1932



**IN SEPTEMBER 2005**, when Elizabeth Valerie Hannah Abel was 105 days old, she never had been sick a minute in her life. By the year 2055, alas, that may no longer be true.

Certainly, it will not

be the case for her father, who will be 105 years old. In our (currently) inescapable prison of senescence and morbidity, everyone, savage or civilized, has the right to grow old and ugly and impotent. But by 2055 I may be abusing the privilege.

The only remedy available to me at that point, other than the silence of the cold, dark tomb, may be decapitation and the even colder liquid-nitrogen deep-freeze. (Be patient—there will be more about cryonic immortality in our final chapter, set in the year 2105.) But at age 50, Lizzie still will be just a kitten. So let us consider whether anything is likely to happen to her that science will not be able to cure, conquer, re-engineer, exterminate, eliminate, prevent, intercept, or reverse.

Janet Rossant expects that there will be a remedy for almost every kind of unspeakable pain. She is a biologist and geneticist at the University of Toronto and one of the world's leading authorities on the chemical code of mammals like us. Rossant can rattle off the wonders of the future in less time than it takes Baby Lizzie to wonder at her rattle.

"By the time Lizzie is 20," she says, "she will have her personal genetic code recorded on a chip. She will know if she is predisposed to heart disease or Alzheimer's. Genetic screening will not be for only 20 diseases—it will be for everything. Soon, we will have babies born with the certainty of not having *any* single-gene defect. Heart disease and cancer? We are very, very close. Resistance to infectious disease? Probably—but the bugs have pretty good natural selection processes of their own. We were lucky with SARS. In the future, we will have to guess how to make vaccines against *any* disease that might evolve.

"We are going to have goats and cows producing human proteins in their blood. We will be able to take a muscle cell and put it back in an egg and reprogram its development. If she has a motorbike accident, a spinal cord injury, we will be able to regrow those cells."

It is a vision of the Death of Disease, decade by decade, and germ by germ. "In 50 years, if Lizzie gets heart disease and her heart muscle begins to break down, how are we going to fix it? By then, we will

be able to understand how to take living cells and say, 'Fix this heart for us!' We will have tissue engineering. We will be able to build new hearts in living people. We will have little robots cleaning out our arteries.

"If you look at the human species, we think of ourselves as the product of evolution, and it has been a slow process. But maybe in the next 100 years, we will drive evolution."

**SOME OF** these miracles are going to be accomplished by medicines that even a microscope can't see.

Raj Bawa is a biochem consultant and nanotechnology patent agent in Virginia—and, like me, a graduate of Rensselaer Polytechnic Institute in Troy, N.Y. (Unlike me, he understood what our professors were talking about.) Bawa revels in the realm of "quantum dots"—flecks of matter so minuscule that millions of them could fit on a red blood cell.

"Let's say the patient has cancer of the kidney," he says. "Rather than the method we currently use, which is an indiscriminate high dose that affects the entire body, a solution containing these quantum dots would be given intravenously and they would home in on the tumour. They would be carrying antibodies specific to the kidney cancer and nothing else. So you launch these nano-weapons. When they approach and recognize the tumour they dock with it, and they release their payload. This is coming in the near future—five to eight years."

"What is coming further out?" I ask him.

"In the way-out," Bawa replies, "we would take a disease like diabetes and we would have a nano-device that acts as sensor, reservoir and delivery system for pharmaceuticals. It would be a little computer that travels around the bloodstream, measures the sugar level, and releases the exact amount of insulin that is required. Probably, this would be delivered by a patch on the skin. It would be an artificial external pancreas."

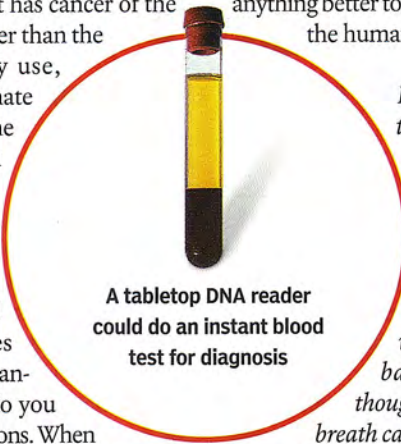
"What else?" I wonder.

"How about a bedside-tabletop DNA reader? It could instantly test the blood of an unconscious patient, so the doctor doesn't

have to take a sample and send it off to the lab and wait two or three days to find out what the infectious agent is. Think of how this could be used in cases of bioterrorism or the release of a toxic substance. The thing is, it has to be portable, it has to be reliable, and it has to be cheap."

The roster of nano-miracles seems limitless. Ted Sargent of the U of T and MIT predicts a kind of photo-biopsy—"materials that a doctor could inject into your bloodstream that would glow and be visible outside your body. That means no MRI, no X-ray. These molecules would be light-emitters that stick only to cancer cells. Turn on the light and the cancer becomes visible even when a tumour has only 10 cells."

Scientists around the world have been thinking big about nanotechnology. But so has Michael Crichton. Here's a glimpse of a happy future from his novel *Prey*, in which a swarm of nano-robots escapes from the lab, learns how to self-replicate, and, for lack of anything better to do, sets out to annihilate the human race:



A tabletop DNA reader could do an instant blood test for diagnosis

*David was now rolling on the ground, black from head to toe. The third swarm had enveloped him. It was difficult to see through the dancing particles. It looked as though David's mouth was a black hole, his eyeballs completely black. I thought he might be blind. His breath came in ragged gasps, with little choking sounds. The swarm was flowing into his mouth like a black river.*

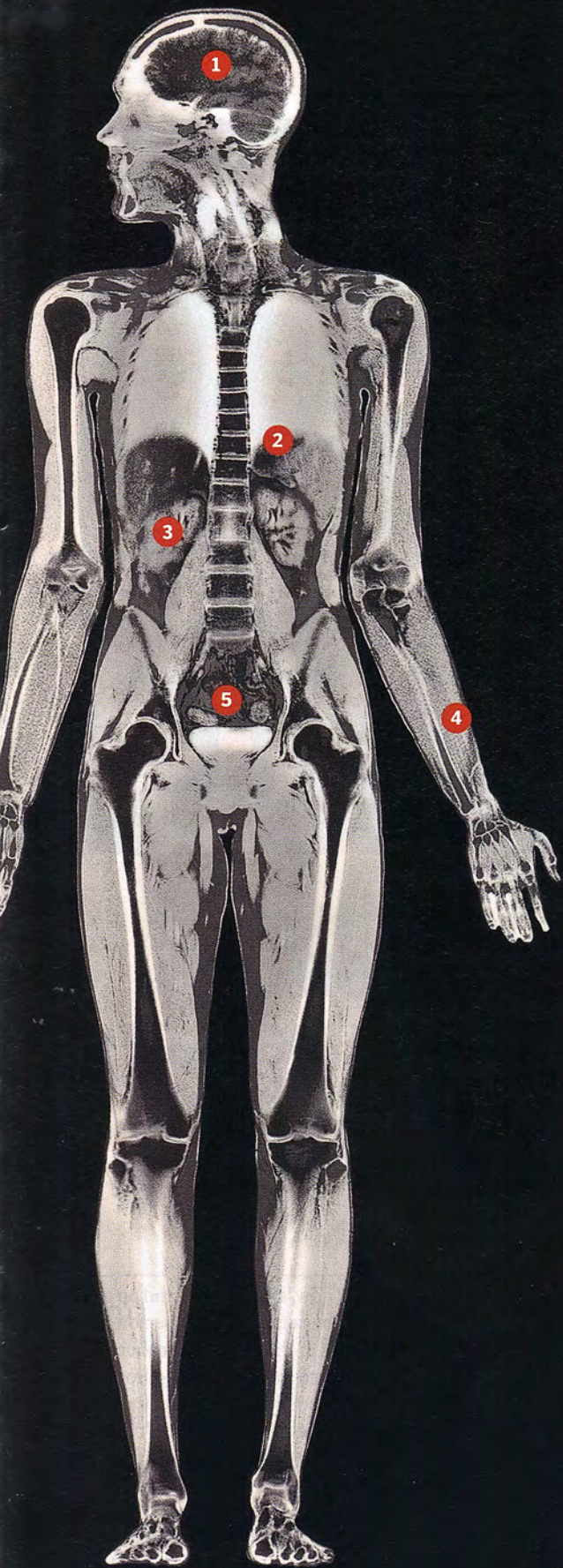
*His body began to shudder. He clutched at his neck. His feet drummed on the floor. I was sure he was dying.*

*"Come on, Jack," Charley said. "Let's get the f--- out of here."*

"I'm not scared," says Bawa. "I don't know how you could make a machine that could self-replicate. Imagine the mass-production. Imagine the cost! You're looking at 50 or a hundred years before anything like that could happen."

**WHILE WE WAIT** for Arma-nano-geddon, we concern ourselves with the self-replication of our kids.

"Where are we going in making babies?"



## A BETTER BODY

**1.** Brain implants will monitor a body's health and immediately notify a doctor at the onset of an illness.

**2.** When heart disease causes the heart muscle to begin breaking down, living cells will be instructed to fix it. Called tissue engineering, the process will build new hearts in living people. Meanwhile, little "robots" will travel through the bloodstream cleaning out arteries.

**3.** A patient with kidney cancer could be treated with a solution containing "quantum dots," flecks of matter so tiny that millions can fit on a red blood cell. They'd carry antibodies specifically for the kidney cancer, dock with the tumour and release their payload.

**4.** A patch on your skin could act as a delivery system for pharmaceuticals. It would release tiny nano-devices into your bloodstream. For a diabetic, they would measure the blood sugar level and release the exact amount of insulin required. Call it an artificial external pancreas.

**5.** Women will store their eggs when they are young, freeze them, and take them out when they are ready to be mothers. Scientists may even be able to take a woman's eggs and add a Y chromosome and make sperm. Because everyone will have their personal genetic code recorded on a chip, we will have babies born with the certainty of not having any single-gene defect.



# 'You will marry the person you love, but that won't be the person you have your children with'

—JANET ROSSANT, biologist and geneticist at the University of Toronto

asks Janet Rossant. "Where are those eggs and sperm going to come from in the future? We may be able to grow those cells in culture. We could take Lizzie's eggs and add a Y chromosome and make sperm—then she could be a father!"

"In North America," says Ted Sargent, "and in the First World generally, the power balance between the sexes is based on the time scale of female fecundity. In the academic world, the age at which women have children is the same age when the pressure to reach tenure is most intense. What if women could have children at any time in

their lives? Would it equalize the power of men and women?"

"We will have women storing their eggs when they are young, freezing them and taking them out when they are ready to be mothers," Rossant predicts. "If they carry the gene for something like cystic fibrosis, they will examine their partner's genes to make sure the other half doesn't carry the same mutation.

"At the end of the day, people put out all

A human genome, digitized: the right genes would be worth plenty on the open market

these criteria now, and they still end up getting married because the other person just *feels* right. But in the future, reproduction may be separated from partnering. You will marry the person you love and want to spend your life with, but that won't be the person you have your children with. You will select your children from a marketplace of desirable genes."

It is a future in which moms can be dads, every newborn is perfect, and every child is adopted.

"The goal of research right now is the thousand-dollar genome," says Rossant. "When

we get there, your Lizzie will be putting her entire DNA profile in her personal ad."

**IF MY PRECIOUS** daughter does auction her genome on gBay, it should fetch a pretty good price.

Seven of Elizabeth's eight great-grandparents are or were Ashkenazi (Eastern European) Jews. And according to an article published this spring in the *Journal of Biosocial Science* by researchers from the University of Utah, Ashkenazi Jews have been naturally selected for unusually high intelligence.

"Ashkenazi Jews have the highest average IQ of any ethnic group for which there are reliable data," the authors wrote. "This fact has social significance because IQ (as measured by IQ tests) is the best predictor we have of success in academic subjects and most jobs. Ashkenazi Jews are just as successful as their tested IQ would predict, and they are hugely overrepresented in occupations and fields with the highest cognitive demands. During the 20th century, they made up about three per cent of the U.S. popula-

Harpending, one of the authors of the study, tells me from Salt Lake City. "The bad news is that potentially those genes can make you ill."

He's talking about Tay-Sachs disease—a dreadful degeneration of the central nervous system that blinds and paralyzes and kills by the age of five—and a cluster of other genetic defects that seems to be as intimately linked to Ashkenazi descent as is thinking that Adam Sandler's *Hanukkah Song* is funny.

"Now, the pharmaceutical industry will try to modify this so that the genes only have a good side, and they will extract them and then we are going to have Smart Pills. This probably won't be hard to do. There will probably be a lot of agonizing over it in North America, but the Chinese military will embrace it. They don't indulge in any of the moralizing hand-wringing that we enjoy so much.



Anyone's DNA profile could be recorded on a chip and be part of a personal ad

apply to a new school, or try to buy a car, or go for a job interview, the first thing the android across the desk will be programmed to say is, "Okay, let's see your genome."

"Certainly, we'll want it for medical reasons," he says. "Insurance companies are going to want it, and they are not going to allow medical privacy to keep them from getting it. This is an issue in public ethics that your daughter will have to face. Sure, they're in business to make money, but it grates on me to deny insurance on the basis of someone's genome. That kind of thing makes my teeth itch."

You may be wondering two things: how much of a firestorm of controversy did this research paper ignite; and how did evolution, normally so glacially slow, fast-forward in just a few centuries so that my people got the long end of the shtick?

# Every time our children apply for a job, the android across the desk will say, 'Let's see your genome'

tion but won 27 per cent of the U.S. Nobel science prizes. . . . They account for more than half of world chess champions."

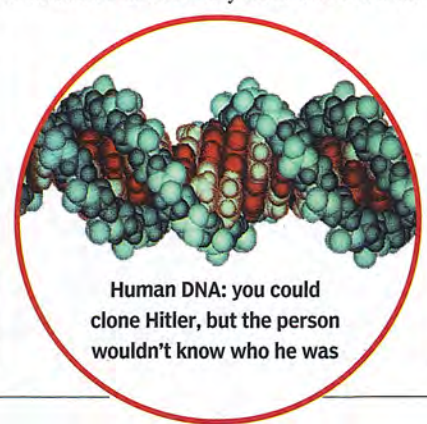
In fact, Baby Lizzie's cousin Ari Milner in Vancouver is playing chess at the national championship level—at the age of nine—and every time the phone rings at Cornell University, nano-physicist cousin Kirill Bolotin assumes that it must be Stockholm calling.

So my daughter's genes should be worth plenty on the open market, even after factoring in her mother's looks, and discounting mine. Or so it seems at first glance.

"Well, there is good news and bad news in those genes," anthropologist Henry

If they see a military advantage or an economic advantage, they just go for it."

I venture to Harpending that we are facing a future in which every time our children



Human DNA: you could clone Hitler, but the person wouldn't know who he was

Harpending and his co-authors conclude that the social strictures that forced Jews to work only as money-lenders, and never to marry outside their community, meant that "for the most part they had jobs in which increased IQ strongly favoured economic success, in contrast with other populations, who were mostly peasant farmers. They lived in circumstances in which economic success led to increased reproductive success."

It took barely a millennium for natural selection to work on this inbred population, chaining disease and intelligence together on the same tiny genes. Sephardic Jews from the Mediterranean basin show

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being the  
best thing.

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no such spike in IQ.

As for reaction to the paper, well, says Harpending, there wasn't any. "In fact," he says, "the most interesting reaction we got came at a conference in Cambridge. The British told us, 'We would never have *dared* publish that.' When we told them we had no reaction, they were abashed, red-faced, chagrined, that they hadn't published their own work. So I hope our paper breaks a little ice."

In the 1970s, molecular biology was already under way, yet we were very conservative about the future. Did I ever expect to know what we know today about the genome? No way!" But cracking the genetic code—for my daughter, for everyone—solves only a part of the puzzle. As Rossant says, "Part of us is DNA, and part of us is higher-order behaviour."

"If something terrible happens to Lizzie

## 'I don't want to live forever. I just want to be healthy when I die.'

—JANET ROSSANT

"Doesn't it make you wish you weren't a goy?" I tease Harpending.

"There is a downside to those genes," he replies. "I'm also not convinced that having a higher IQ is an unreserved good thing. We have this cult of IQ in our society, but I have a lot of family members on the other side of the bell curve, and I've always been jealous of *them*. They don't take their work home with them. When their workday is over, they go fishing."

"Do you think there will be a demand for Smart Pills and Happy Pills?"

"Of course there will be. Of course there will be. We've got Happy Pills now—anti-depressants, Viagra. But you don't have to think about it for very long to shudder at the potential for using Happy Pills for political manipulation."

"Wouldn't you feed *your* kids Smart Pills?" I persist. "Wouldn't you take them yourself?"

"If I had it to do over again," says Harpending, "I'd be a veterinarian in a small town in Appalachia, with an office near a good trout stream."

"IS ANYTHING we've said *so* different?" asks Janet Rossant. "When we look back to the 1960s and we were asked to predict the future, there were many fantastic visions, but nobody predicted the Internet.

while she is still young," I ask her, "could we take her genes and her cells and make another one?"

"Human cloning could be done now," Rossant says. "As a technology, it is here to stay. Is everybody going to be cloned? Probably not. Rich people? Maybe."

"Could you clone Lizzie?" I ask.

"Yes," says Rossant. "But it won't look like her. She and her clone would be the way twins are—they would think differently, and they would act differently."

"Could you clone Hitler?"

"Yes, but that person would not *know* he was Hitler, unless someone told him."

That squeaking sound you hear in the distance is the door to eternity opening.

"It does start to introduce the concept of mortality and immortality," Rossant says. But a cure for all diseases does not put an end to endings.

"Am I going to live to be 140?" I wonder. At that point Lizzie will be 85, and probably ready to thaw her eggs and start having children of her own.

"No," Rossant says. "Aging is programmed intrinsically into our cells. Things will wear out and you will die, the way people are dying now. At 102, you'll just fade away. And I'll go with you. I don't want to live forever. I just want to be healthy when I die." M