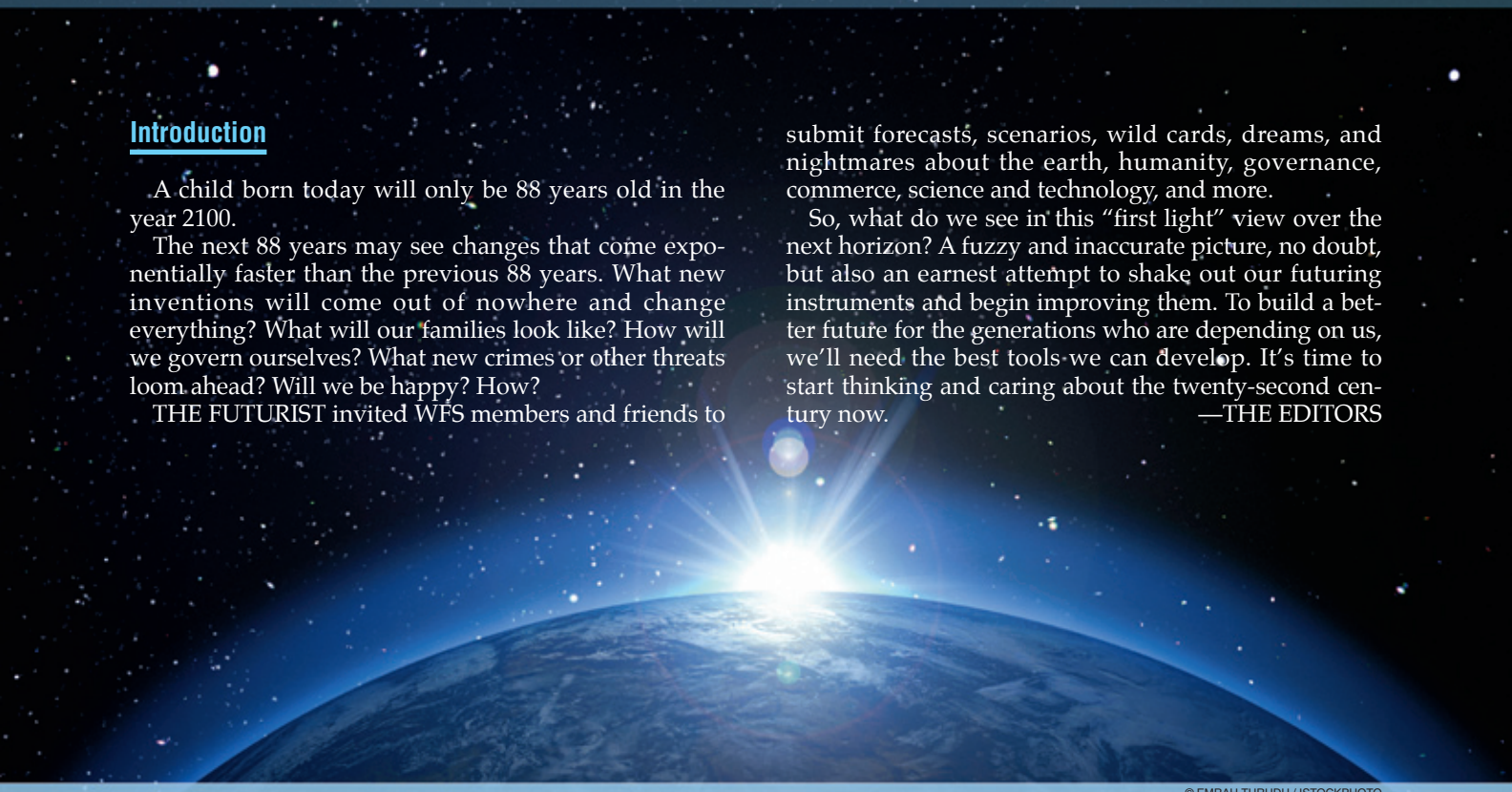
The 22nd Century at First Light:
Envisioning Life in the Year 2100

A special report by members and friends of the World Future Society



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Introduction

A child born today will only be 88 years old in the year 2100.

The next 88 years may see changes that come exponentially faster than the previous 88 years. What new inventions will come out of nowhere and change everything? What will our families look like? How will we govern ourselves? What new crimes or other threats loom ahead? Will we be happy? How?

THE FUTURIST invited WFS members and friends to submit forecasts, scenarios, wild cards, dreams, and nightmares about the earth, humanity, governance, commerce, science and technology, and more.

So, what do we see in this "first light" view over the next horizon? A fuzzy and inaccurate picture, no doubt, but also an earnest attempt to shake out our futuring instruments and begin improving them. To build a better future for the generations who are depending on us, we'll need the best tools we can develop. It's time to start thinking and caring about the twenty-second century now.

—THE EDITORS

Major Transformations to 2100: Highlights from the TechCast Project

By Laura B. Huhn and William Halal

Will the year 2100 bring disaster or salvation? A global population that exceeds food supply and exhausts planetary resources? Ecological collapse and severe climate change? Or will we experience a unified world heralding an unprecedented Age of Global Consciousness?

TechCast (www.TechCast.org) draws on its knowledge base of forecasts pooling empirical trend data and the knowledge of more than 100 experts to examine the big transformations ahead. Lifestyles, families, homes, and other aspects of life are likely to change because the forces of nature, technology, demographics, and economics are transforming the world dramatically.

Here is a macro-forecast that summarizes the 70 strategic breakthroughs that offer an outline of how the foundations of society are likely to evolve over the remainder of this century.

2015: Next Economic Upcycle

Our timeline begins around 2015, when the following technological advancements are expected to start the next 35-year economic upcycle:

- **E-Commerce.** Internet use explodes worldwide, producing trillions of dollars in revenue.
- **Global Access.** About 50% of the world population will have Internet access.
- **Globalization.** At today's growth rates, we'll halve poverty by 2015.
- **Green Business.** Thirty percent of corporations are likely to practice environmental management, leading to a $10 trillion–$20 trillion green industry at the end of the decade.
- **TeleMedicine.** Online records, videoconferences with your doctor, and other electronic practices will improve medical care and reduce escalating costs.
- **TeleWork.** Globally, 1 billion people were mobile workers in 2010. By 2015, that number should increase to 1.3 billion.
- **Space Commercialism/Tourism.** Space trips for tourists and visits to low-Earth orbit are likely to produce a boom in commercial space.

2015–2020: Global MegaCrisis

From 2015 through 2020, a doubling of global GDP will cause the Global MegaCrisis to become intolerable, with the planet teetering on environmental collapse (see THE FUTURIST, May-June 2011). Here are TechCast's four scenarios:

- **Decline to Disaster** (25% probability): World fails to react, resulting in catastrophic natural and economic calamities. Possible loss of civilization.
- **Muddling Down** (35% probability): World reacts

It has been a wild ride of a century full of expected wonders. Molecular manufacturing became a reality well before 2050, turning all sorts of once-valuable materials into commodities, and yes, we even eventually got flying cars.

But the century also came with a rich harvest of utterly unexpected surprises and the stubborn persistence of some things we thought had been left behind in the twentieth century. Here are a few of the outcomes you never guessed back in 2012:

- **Ownership is so twentieth century.** My generation looks back with nostalgia on a time when we actually owned things. Compared to 2012, we have access to an astounding bounty of goods and services, but we don't really "buy" things anymore because everything comes with strings (and license agreements) attached. In much the same way that you subscribed to software and e-books, we now "subscribe" to physical objects.
- **Longevity arrived, but with limits and for a price.** Life extension remains a work in progress. Sure, 100 is the new 60, but 130-year-olds remain a curiosity. The debate still rages over whether or not there is a hard-wired limit in the human organism. In the meantime, longevity ain't cheap, and the cost of im-

only partially, so ecological damage, increased poverty, and conflict create major declines in life.

- **Muddling Up** (25% probability): World reacts in time out of need and high-tech capabilities; widespread disaster averted, although many problems remain.
- **Rise to Maturity** (15% probability): World transitions to a responsible global order.

2020: High-Tech Era

Assuming the world survives reasonably well (Muddling Up), major breakthroughs are likely to introduce a High-Tech Era:

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Looking Back: The Wonders We Didn't Expect

By Paul Saffo

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mortality rises exponentially as individuals enter their second century.

The result is a new societal divide between the chronological haves and have-nots: The wealthy "old turtles" move at a stately pace, making long-term plans, while the "may-fly" poor die out decades earlier. It has created vexing issues around the distribution of wealth and power.

- **Life everywhere, but where's ET?** A century's worth of space exploration has turned up all sorts of weird life forms. The extremophiles found in Earth's hellish niches back around 2000 are prosaic compared to the astounding range of what constitutes life on our nearby neighbors. Life has turned up everywhere we look, with the implication that life just wants to happen no matter how improbable the environment.

We also stopped counting Earthlike planet discoveries early in the twenty-first century, but astoundingly, we still have no clear evidence of ETs—extraterrestrial life forms that we can communicate with—despite a century of searching. Perhaps the answer to Fermi's question ("Where are they?") might be an existentially unnerving realization that we are terribly, profoundly alone. This could, of course, change tomorrow, but in the meantime, we can at least talk to our robots and the countless AIs haunting the global noosphere.

- **Discovery has deepened mystery.** I can't even begin to catalog all that has been discovered in the last century, but with our new knowledge has come a new appreciation of just how vast and mysterious the universe is. J. B. S. Haldane got it right way back in 1927 when he observed that "the Universe is not only queerer than we suppose, but queerer than we *can* suppose."

The astonishing consequence has been a religious resurgence. In 2020, science's relentless explanatory logic had believers on the run, but in the decades that followed, it became clear that an ever stranger, more capacious universe had ample room for the divine, the spiritual, the mystical, and the mysterious.

The result has been a repeat of Jasper's Axial Age on a smaller scale, as new belief systems have proliferated. Many of your late-twentieth-century cults are all respectable and spruced up, and Atheism itself has become a mainstream faith, complete with its own rituals. It all seems a bit less than rational, but like Bohr's horseshoe ("I am told that it will bring good luck whether or not I believe in it"), it gives us comfort as we look out over the giddying vastness that is the frontier of the twenty-second century.

- **Smart and Green Transportation:** e.g., intelligent cars, high-speed trains.
- **Climate Control, Alternative Energy.**
- **Mastery of Life:** e.g., personal medicine, organ replacement, cancer cure.
- **Second-Generation Information Technology,** e.g., "good" artificial intelligence, automated routine knowledge, robots, infinite computing power.

2030–2050: Mature World Order

A Mature World Order evolves beyond knowledge to an Age of Global Consciousness:

- **Space:** exploration and colonization of the Moon, Mars.
- **Advanced Energy:** Fusion energy becomes viable.
- **Life Extension:** Average human life span reaches 100 years.
- **Expanded Consciousness:** e.g., general AI, thought power, neurotechnology. Humans become almost godlike.

2070–2100: Beyond Earth

- **Deep Space:** Contact is made; star travel becomes possible.
- **Unified World Systems:** Humanity achieves Type I Civilization (mastery over most forms of planetary energy).

Forecasts

Where the Wild Things Are Not

By Brenda Cooper

In the Western creation story, the first man and woman are given a task: to care for a garden and the beasts and animals within it. By 2100, mankind will be living in a garden the size of the world. Species will

Scenario

When the Storms Came

By Richard David Hames

Hi. I'm Daeng, an emeritus biocultural ethicist. Each month I work my allocated 10 hours for the FinanceLab hubbed here in Moscow, a "resilient" city with a populace approaching 21 million.

FinanceLab has managed all non peer-to-peer transactions and flows for our region since the global banking meltdown mid-century. My job is cool, although I would love to meet more people and listen to their stories, rather than interact with them via my webscreen.

Because of the extreme heat, it's simply too dangerous to venture out much. My main companion is DAO. As a fifth-generation personalized clone, DAO is able to access the totality of documented human knowledge, answer any question I pose, and tend to all my requests. But she's not really into hugging or intimacy, which I miss.

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I grow my own food using permaculture techniques that I learned from Mum after Dad died. At least I can be sure my diet doesn't contain unwanted additives, which is a luxury few people can afford these days. I value my health and my fitness. Besides, tending to my small wall bioshelter is very gratifying.

After all these years, I still occasionally yearn for some grilled chicken or a pork green curry—what Asian person would not? But after the great contagion of 2038, which killed over 2 billion people in a matter of weeks, most meat production in Greater Europe was banned. I really don't fancy the artificial equivalents, though they look and taste authentic enough.

Being born of a Thai mother and an Australian father, I grew up in what seemed to me at the time to be the most idyllic cosmopolitan city in the world. Bangkok is under water now, of course, and most of the tropics are just too hot to inhabit. Singapore still endures, but who would want to live in such a tightly gated, artificial enclave? I need to feel free, to breathe fresh air, even if my movements are somewhat constrained.

I often wonder what might have happened had the scientists' warnings about climate change been heeded. But when the storms came, it was far too late. It all happened so quickly. Wealthy

live or die by our hand and our choices, and, ultimately, so will we.

Some people might claim that we are already there. I disagree. There are many wild places today, but climate change and population growth are claiming them, changing them, and in some cases erasing them. With work, better use of information technology in the form of sensing, tracking, and artificial intelligence can help us create a sustainable path to a world full of garden.

One of the programs that my city is most proud of is called Green Kirkland, where people show up in droves to weed the parks, pulling invasive species and planting natives. Staff and volunteers manage the watersheds and the salmon habitat. We clean the stormwater.

On a bigger scale, dam releases are being used to manage the amount of silt in the Colorado River to protect the humpback chub.

Reprehensible industrial-level habitat destruction and laudable habitat restoration projects can be found from China to Australia to Canada.

By 2100, most of the developed world will be managed. We will know how many large mammals live in almost every open space. It is likely that tiny sensors will report out on moths and moss and microclimates, and then initiate or suggest action to humans caring for the complex dependencies of species.

As the twenty-second century begins, our 88-year-old may work as a caretaker for natural habitat. Perhaps she learned eco-care skills in the community-service portion of her education when she was 16 (in 2028), and continued to leverage these skills for low-paying temporary jobs that supported a year of travel through Asia or Australia. Maybe she returned to this work for summers until she had children, and then again in the first few years of retirement, and now she has become a senior volunteer in the community park.

In 2100, 88-year-olds may not have seen an unexpected waterfall or wolf for some time. They have hunted for birds they knew were in a specific managed ecosystem and competed to get the best pictures. They have helped release once-extinct species into newly prepared habitats. They can count on one hand the number of times they have been completely alone, unable to even see another human being.

While most people in 2100 may not have unexpected encounters with wildness daily or even often, the highly paid professionals working on ecosystem preservation could be plagued with such surprises. As humans try to tend a complex biosphere, unintended consequences will abound.

Even in 2100, humans are unlikely to be as capable as nature is when it comes to managing evolution. They will depend heavily on artificial intelligences to help, but the process still requires human intervention. Natural evolution will compete with human-induced evolution. All urban ecosystems will be managed, and most rural ones will at least be monitored.

One of the ethical discussions of the day will be about how to choose between the wild and the made, how to best tend the garden called Earth.

people simply moved. The poor suffered. So many people died from lack of water, disease, or starvation—although we are still refused access to the precise figures.

After many relationships, like many people of my generation, I now live alone—the result of us being encouraged not to parent children or to make too many friends on iWeb for fear of identity theft. Not that I mind. I feel no attachment or loyalty to this place.

And so today, as I record this message for Jez—my only child, whom I've never met—I celebrate my 88th birthday. It is Saturday, June 12. The year is 2100. My geneticist tells me to expect death 11 years from now. I am ready. I have seen and lived through so much.

Keys to Future Energy Prosperity

By Ozzie Zehner

By 2100, one aspect of our world will have become apparent: While populations and economies can grow exponentially, the planet's resources cannot. Nevertheless, as this simple realization unravels over coming decades, it will not be plainly visible. It will manifest in less-obvious ways.

The finitude of the Earth will present itself in terms of supply constraints, international conflict, disease, water shortages, unemployment, and most of all economic volatility.

As traditional fuels stretch thin, nations will shift to low-grade coal and shale oil to fuel their economic activity. As heating costs rise, the world's forests will understandably become an irresistible resource to exploit for fuel. The natural gas and petroleum-based fertiliz-

ers that cultivated the green revolution will become too expensive for many of the world's farmers at the same time that crops for biofuels will be in highest demand.

The world's poor and disenfranchised will bear the brunt of these transitional pains. Nations may institute food export bans as they did following the 2008 and 2011 food price shocks. Others may use food aid as a weapon, as Henry Kissinger once suggested the United States might do. As the costs to exhume fossil fuels rise, the invisible hand of the market will go right for our throats.

In 2100, people will still be traveling to and from work, celebrating birthdays, trying new restaurants, and going on vacations. They'll just be doing it all with a lot less energy.

Not only will the age of cheap fossil fuels have ended by 2100, few alive will have any recollection of such an era. Residents of 2100 will therefore find little utility in the brand of economic thinking that their elders bequeathed them.

Some alternative energy schemes will have failed to live up to the wide-eyed dreams that previous generations had envisioned. By 2100, it will have become apparent that early technologies were largely reliant on fossil fuels as well as the economic activity that accompanied cheap energy. Engineers will discover that, while wind and sunlight are renewable, turbines and solar cells are not.

Landfills will house millions of tons of defunct solar panel waste, leaking heavy metals into groundwater supplies. But a larger concern will reign: the enduring

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Energy and Living Well

By Paul Bristow

Life in the year 2100 is all about energy. No, that's no longer true. It's about living well.

We had to completely reinvent civilization in the face of fossil-fuel shortages and increasing climate change. Permaculture become the basis of our new sustainable civilization.

Housing looks familiar, if a little fatter with all the insulation that was added. The retrofit *passivhaus* concept went global as energy prices rose. These days, excess energy is very expensive, but for most people it just doesn't matter. Most communities are locally self-sufficient. Everyone grows food using permaculture principles. Agricultural monoculture became deeply unfashionable during the great GM disease outbreaks of the 2030s.

During the chaos, we were smart enough to keep the Internet going. Giving up broadcast television meant wireless broadband really took off. That, combined with holographic conferencing, meant that people finally could really live anywhere they liked while working somewhere else.

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With no need to travel for meetings, commuting vanished like a bad dream. Of course, the need for real human contact didn't. Most towns, villages, and districts have communal working areas, paid for out of local taxes in local currencies, which let you work together with your friends and neighbors. These mix/meet spaces are incredibly creative.

So business continues. Once the 99% movement really got going, the 1% left. These days, open-source cooperatives have mostly replaced capitalism, at least on-planet. In practice, most people run three or four very different jobs, both to increase personal resilience and because it's fun!

For example, manufacturing was relocalized. The advent of mass 3-D printing and cheap CNC (computer numerical control) meant that the difficulty of building something went away. At the same time, the increasing costs of transport forced the use of local materials. There are local solar-powered remanufacturing plants next to what used to be called waste dumps.

Now, the idea of big warehouses of finished goods—none of which quite does what you want—seems quaint. This is the case for all but the highest technology products, which are still

burdens of nuclear activities.

In 2100, energy firms will still be grappling with how best to store nuclear waste and clean up nuclear contamination. People will not identify nuclear contamination in terms of "accidents," as we do today. They will instead view nuclear activities as highly risky undertakings that are bound to expel radiation into human communities over time. Additionally, plenty of enriched fuel, radioactive waste, and nuclear byproducts will shift hands as nation-states crack apart and reconfigure into new political establishments.

Technological developments will influence the 2100 energy landscape, but they won't be the primary force. Future energy prosperity will actually hinge on social and political fundamentals: human rights, health care, transparency, citizen governance, walkable communities, strong civic organizations, and so on. These are important attributes for any era. But in an age of tight energy, they will become vital.

mass assembled and transported by sailing ship and cargo zeppelin. People are relaxed enough that, if something takes 10 weeks to arrive, they don't freak out.

Global populations are now divided 50/50 city and country dwellers. Regional government was the only scale that actually worked for fighting climate change; national governments became sources of embarrassment first, and then irrelevant. We still have conflicts, but mostly when some local politician promises a planet-harming shortsighted populist fix. The UN security force soon takes care of these. By the way, the UN is still called that, even though it's really the United "cities and regions."

We never did get fusion power working, but it doesn't matter anymore. Regional weather control by the power cooperatives ensures that the days are sunny for power and pleasure, with wind and rain overnight for power and plants. Life is good.

Bio Age 2100

By Olli Hietanen and Marko Ahvenainen

Technological change has progressed at a rapid pace. Within a few decades, the world has become virtual while we have started to apply biotechnology and nanotechnology.

Next, we will see how mobile technology is breaking out of computers and mobile phones, with the same technology being applied to all sorts of everyday objects: furniture, household appliances, buildings, clothing, packaging, cars, etc.

The Internet is thus evolving into "Ubinet"—an omnipresent cloud service—and we are entering a "hybrid economy" where customers are participating through social media in the design, manufacture, and crowd funding of products (co-production, crowdsourcing, cloud computing, and augmented reality).

At the same time, the focus of the world economy has shifted to Asia and to the emerging economies. In addition, we have experienced financial crises, which have become the rule rather than the exception.

The main phenomenon of the modern world is the accelerating speed of change.

However, above all, the current major concern of the future is the depletion of natural resources. This, combined with the pollution of the environment, put sustainability technologies (technologies of scarcity) at the heart of competitiveness to generate solutions to the major problems of mankind and to contribute to the well-being of all.

The challenge is not only in technology and business models, but there is also a need for a new kind of nonlinear innovation system, as well as a new philosophy of technology. The main reason to develop technology is no longer to conquer nature, but to protect nature against humans.

According to Nikolai Kondratieff, an economic upswing (long cycle) begins with a new technological innovation, whose effect eventually dies out (after 50–70 years), whereby the economy is plunged into recession. This continues until a new innovation in turn triggers a new wave of economic growth.

Significant breakthroughs to date have been, for example, the steam engine, railways, electricity, chemicals, radio, TV, computers, and mobile phones. Recent years have seen discussion of the Sixth Kondratieff Cycle (2010–2050), which differs from the Fifth because of the increasingly rising prices of raw materials and energy. It will no longer be possible with present-day technology to lower those prices.

One possible path of sustainable growth is the emergence of the Bio Age (similar to the Iron, Stone, and

Bronze ages), in which everything that can possibly be made from biomaterials will be.

The forest and agriculture sectors are developing into a bio-economy, which can use any bio raw material to manufacture anything: gas, fluid, fiber, mass, molecules, energy. Artificial meat will grow in the cow-byres of the future, mobile phones will be compostable, and many kinds of consumer goods (such as chairs, mobile phones, and clothes) will be printed from biomaterials and grown from seeds and stem cells.

All of these technologies and changes hold importance similar to the invention of the steam engine. They have brought and will continue to bring profound changes to our economy, our way of life, and even our cultural history.

Healthy Aging in the 22nd Century

By Marta M. Keane

What will the term *elder* mean in the future? And at what age will someone be considered an elder in 2100?

To be born in 2012 and only be 88 years old in 2100 will probably mean middle age rather than elderhood. Elders will be those who have lived triple-digit years and have been through several careers and cycles of education, career, and leisure. These elders will have exponentially more knowledge and experience, and they will continue to be contributing to society. Technology will be a key element allowing individuals to age with more independence and more choice.

Here, we examine each component of health (as defined by the World Health Organization) and how each will be manifested in 2100.

• **Physical health.** People's physical health will be monitored daily in their homes. The smart home will be outfitted with readers to take vital signs and send them directly to a medical professional to review, and provide feedback on any medications or supplements that need to be altered that day. Rather than prescriptions as we have known them, medications will all be personalized to individuals' DNA, keeping all healthier for longer.

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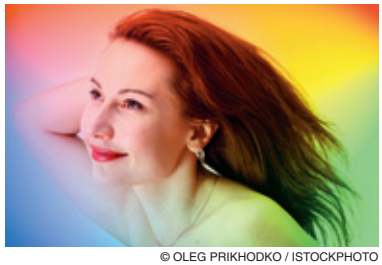
Paradise Found: No Aging, No Pensions

By Jouni J. Särkijärvi

I'm now 88, but it is something completely different from what it used to be in your days. This is probably the biggest change: We don't have to get old and die.

Already when I was born, the concept of rejuvenation was understood in theory: We knew what needs to be done at the cell level. It took some time to make it happen also in practice. Now, to stay young is actually cheaper than to get old.

Accidents do still happen, but regrowing organs was perfected already in the 2050s. It's a self-service society up to the finish line. It is up to you to shuffle off your own mortal coil.



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You may have considered the population explosion of your time intolerable, so what happens when people stop both dying and losing their fertility?

The problem used to be that people squandered resources and there was not enough food. Actually, there would have been enough food if people had had money for it. Both these problems were expressions of primitive technology. The Sun provides us with more energy than we can ever think of using, and the Earth is practically a closed system. We only have to reorganize these 15-billion-year-old atoms to suit whatever we need.

We have no "pension age," nor do we have pensions. On the other hand, there are no 9-to-5 jobs, either. You do not need human labor for what can be programmed. All our contributions have something to do with creativity. There are still scientists, artists, architects, and chefs.

Professional sports, alas, lost their appeal when the enhanced athletes conquered the field.

The politicians also welcomed longevity with open arms. You can tax it.

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Scenario

Beyond Transhumanism

By Gene Stephens

5, 4, 3, 2, 1, Happy 2100!

Now it's really time to reflect and try to decide what's next for me. I'm young—88 in a few months—but still it never hurts to take stock, especially in this "Brave New World." I've heard that phrase somewhere before. Anyway, it's really true today. Who would have thought I'd be one of the few predominantly humans left on Earth?

Old Ray Kurzweil may have sounded like a prophet a century ago, but he was so far off. He believed there'd be only 20,000 years of progress in the twenty-first century. It's been more like a million years of progress. It sure floored me; in fact, it left me so far behind, my kind is pretty much irrelevant.

All my friends have become chimeras or cyborgs or even robots. Most have actually opted for transhumanism, or that new term, *universalist*—getting all traces of human out of the equation. If I'm going to exist another thousand years or so, I've got to get with the program. I've wasted way too much time fighting the inevitable. What good are civil liberties and species pride if your species is extinct?

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I'm still in good standing with the underground, but there are only a few hundred of us left worldwide. Since many in the group have turned down the latest life-prolonging technology, humanity is truly a dying breed. We were warned that the smart machines would inherit the Earth, but we didn't realize it would be our choice to hasten the day by implanting every hot new neurochip into our bodies until we became more robot than human.

I rue the day I took that first step—acquiring 20 languages instantly in just one cheap nanochip. From there, it was a slippery slope to adding chips that increased lower body strength, chips that stored quadrillions of data bits with nanospeed retrieval; a chip here, a chip there, everywhere a new chip.

Now I've got to make some deci-

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Elders will be able to live in their own homes longer. With driverless cars, limitations on transportation will be a thing of the past. And the smart home will adapt to people's changing needs so that they will not need to move from their current home to maintain a safe environment.

• **Social-emotional health.** As elders continue to work longer and cycle through more periods of leisure during their lifetimes, they will have more friends and engage in more activities that will allow them to stay involved. Twenty-second-century elders will see their generation continue to be involved in social-action projects, coming together for the specific project and meeting new people, and continuing some relationships and letting others end with the project.

As with work, there will be cycles with marriage and family dynamics. It will be unlikely that there will be marriages that will last 100 years, so there will be multiple groupings of families that will have a fresh approach to embracing each addition to the family and expanding the definition of the extended family.

• **Spiritual health.** Views of a "divine power" will be transformed by advances in science and technological power. As scientific breakthroughs increase longevity, the fear of mortality and what follows will disappear. Spiritual practices and beliefs will become more individualized; many elders, for instance, will continue to be concerned for the environment, and in so doing, get back in touch with nature and the Earth.

• **Intellectual health.** Elders will be honored for their knowledge and experience. The many cycles of work and relationships will enrich their lives and be an inspiration to others. The ability to live

sions and make them fast. I may only have minutes, even seconds, to decide about these life-altering changes, to choose who (or what) I want to be next, how long, and what's after that.

To have any chance of keeping up, I'm going to have to leapfrog over a further-enhanced cyborg, transhuman, or even universalist and go directly to *cloud master.* Even if I don't have it all figured out, I'll get additional time to think once I'm a cloud dweller.

With my total memory reduced to a powerful nanochip and my environment-polluting organic body discarded, I can reside in the wireless cloud as long as I need. If I choose, I can be implanted in a robot or virtual body to give me some mobility and sensing experiences.

Who knows? I may like it enough to spend eternity in this utopian dream. Maybe, but.…

longer will focus importance on lifelong learning and continuing to experience the world through all the senses.

The year 2100 will be an exciting time to be "old." Technology and societal views will encourage a new attitude about aging. Elderhood will be viewed as the period in one's life with the most opportunity for independence and quality choices about one's own life.

Will We Still Have Money In 2100?

By Stephen Aguilar-Millan

Money has been around since the dawn of history. A future without money would suggest that we would be moving toward a barter economy rather than an exchange economy in 2100.

It is entirely possible that this could happen at the individual level. The Internet could allow peer-to-peer exchange, much in the way that eBay accommodates this at present. However, a barter system is unlikely to be of use at the societal level. The supply of public services like defense or justice is best facilitated through a monetary contribution, such as taxes.

This reason alone is likely to keep money with us in 2100. But in what form? Who is likely to issue it? More interestingly, does cash have a future? Money has become largely digital over the past few decades. This is unlikely to change unless there is a major disruption to the way in which accounting records are kept.

Despite the predictions of its demise, cash has proven to be very resilient. Cash is the lifeblood of the black-market economy because it leaves no audit trail, and, as long as people want to avoid paying taxes, it will continue to serve that function. We can speculate that, even if notes and coins were abolished, a parallel form of "cash" would develop. For this reason, cash is still likely to be with us in 2100.

What may change are the issuers of money. At present, governments reserve for themselves the right to issue legal tender. Yet, systems of parallel currency have emerged. For example, we are accustomed to spending air miles (or points) for travel. Companies could harness the function of money as a store of value and a standard for deferred payments by issuing purchase tokens for future use. Most supermarket loyalty schemes operate along these lines. It could well happen that this trend, enabled by the Internet, could explode over the course of this century.

The trend will be enhanced if companies can tap into the trust that their customers have in their brands. Many companies do so already through loyalty credit cards, and even a form of private banking. This is one way in which the remainder of the twenty-first century could change.

If it is true that there is a growing distrust in the nation-state as a vehicle for expressing our collective aspirations, then, as our trust is transferred to the institutions that come to replace the nation-state, so those institutions will come to control the issuance of money.

It is quite likely that we will still have money in 2100, but it may not be issued by governments any longer.

Slums: A Catalyst Bed for Poverty Eradication

By Eric Meade

In 2100, more than 70% of the Earth's 10 billion people will live in cities. In dynamic regional hubs like Lagos, Nigeria (population 41 million), an infrastructure of renewable energy, sustainable local manufacturing, socially augmented reality, and anticipatory community governance will have produced economically vibrant neighborhoods that are microcosms of collaborative resident engagement.

But city life is more complex than village life. When-

ever people have moved from rural to urban environments, they have had to develop more complex attitudes and behaviors—for example, internalizing rules, cooperating beyond their own families, and learning to navigate complex institutions. The "complexity gap" between urban and rural living will widen as cities grow from millions to tens of millions of residents. Throughout the twenty-first century, people migrating to the city will close this gap, undergoing a psychosocial transition that could provide the foundation for twenty-second-century urban success.

Much of this transition will have occurred in the catalyst bed of the "slum." Sure, the slums of the twenty-first century have had their share of problems, with criminality and corruption occasionally spiraling out of control. But global leaders will have come to understand that allowing the undesirable elements of slum life to fester at reasonable levels is important for fostering slum dwellers' adoption of the more complex attitudes and behaviors required for successful citizenship at the municipal and global levels.

With this understanding, the century's most-effective NGOs will be those who do not try to "solve the problems" of the slums, but rather try to set the conditions in which the psychosocial transition from rural to urban could occur quickly and without reaching unproductive levels of human suffering. This will include providing slum residents with wireless service, ubiquitous educational programming, and "off-grid" solutions for power, water, health care, and sanitation. Interestingly, these "off-grid" solutions also will yield benefits for those who remain in rural areas.

Throughout the twenty-first century, urbanization will have provided new migrants from rural areas

Scenario

Meaning for Miranda

By Robert Moran

In her conversations with friends and family, Miranda—a remarkably fit, thrice updated, 88-year-old freelance infominer—notes that the discussion always bounces between the four corners of humanity's hollow valley:

1. Remarkable physical wealth.
2. Craving for authenticity.
3. Decline of traditional religious belief.
4. Redefinition of the age-old concept of "Free Will."

Twenty-Second-Century Plenty: As any history app will tell you, an explosion in living standards triggered by the exponential growth of GRIN tech (genetics, robotics, information, and nanotech) meant that nearly every human inhabitant of the planet, excepting the feral and the warrior cults, had their basic needs met by the 2080s. And with home-based 3-D printers the norm for almost 70 years, nearly any product goes from idea to form in a flash.

With our basic needs anticipated and met, robots doing the hard work, and virtually free energy, the survival struggle that has defined humanity is now the twinkling of a fading star. Goodbye, resource wars. The question now is how a species adapted to scarcity responds to abundance. Miranda is disturbed by the answer set.

Authenticity: Is it "real"? Is it "craft"? These are invariably the queries Miranda hears about new clothing or home goods. Algorithmically nano-targeted experiences, "news" filtered by digital advisory agents and displayed on augmented reality (AR), and rapidly printed consumer goods all make authenticity a scarce commodity. No wonder "U-Build" kits, Route 66 "driving vacations," tattoo artists, piano clubs, and farming are so popular with Miranda's children.

Belief: Miranda remembers Sunday school as a child. Although she has heard of emerging religious groups meeting in parks, she hasn't been to an actual church building in years. Miranda doesn't believe in the God that her parents believed in, but there are days that she misses Him, the certainty, the rituals, the authority. Like her friends, when she was young she downloaded and tried the Christo-Confucian behavior-prompting avatars on her AR, and they did make her a better person. But she grew to resent the life-logging, and so she unsubscribed.

"Free Will": By the time Miranda was 50, advances in neuroscience, predictive analytics, and response priming made her PhD in behavioral economics as quaint as all those "Silicon Valley"

with more complex environments that challenge them to become more complex themselves. And they will. This psychosocial transition, effected largely in the slums, will have lifted virtually all human communities out of poverty and create a global citizenry with its eye on the future.

From Communication to Transmission

By Manjul Rathee

We are already familiar with the idea of seamlessness in our world of constant communication. In the twenty-second century, as all living creatures evolve and adapt at a pace never known before, *communication* will evolve into *transmission.*

Transmission will allow us to maintain customizable interfaces in our minds. This will enable not just interpersonal communications, but interspecies transmission, as well.

We will be able to share information with the help of hybrid languages that may even go back to ancient pictograms: visuals rather than letters. Numerical systems would change, the era of computers would conclude, and the boundary between Man and Man-Made would become diluted.

museums. Although some insisted that the noble lie of pure "free will" be maintained, that idea died with her parents. Now the memes on volition proliferate daily, but all posit a circumscribed will. We were always the muddled captains of our soul, but now we know it. Now we are less so. Now we grope for the meaning we have lost in the information.

Miranda and her friends are healthier and wealthier than her baby-boomer grandparents could have ever imagined, but with Hikikomori (social withdrawal) increasing despite the health chips and government-mandated AR messages, she wonders if they are any more fulfilled.

Everyone talks about the "Alexander problem" of having no more lands to conquer and wanting to achieve "hard things," but that's just talk between the idea and the reality.

Religious Belief in 2100

By Gina A. Bellofatto

Projecting religious populations around the globe to 2100 first requires a nod to trends over the previous 200 years. In 1910, those imagining the future of religion generally had a positive outlook, with many believing that religion was an unchallenged fact of life that would continue on for generations to come.

In one sense, this conviction was incorrect, as the world was, by percentage, less religious in 2012 than in 1900. In 1900, 99.8% of the world's population belonged to a religious tradition and 0.2% were unaffiliated (agnostic or atheist). The year 2012 marked a drop in the world's religious population to 88.2% and a rise of unaffiliated populations to 11.8%.

In 2100, however, the world will likely be only 9% unaffiliated—*more* religious than in 2012. The peak of the unaffiliated was in 1970 at around 20%, largely due to the influence of European communism. Since communism's collapse, religion has been experiencing resurgence that will likely continue beyond 2100.

All the world's religions are poised to have enormous numeric growth (with the exceptions of tribal religions and Chinese folk religion), as well as geographic spread with the continuation of migration trends. Adherents of the world's religions—perhaps particularly Muslims, Hindus, and Buddhists—will continue to settle in the formerly Christian and ever-expanding cities of Europe and North America, causing increases of religious pluralism in these areas.

Christians and Muslims together will encompass two-thirds of the global population—more than 7 billion individuals. In 2100, the majority of the world's 11.6 billion residents will be adherents of religious traditions.

A child born in 2012 begins his life in a religious world, and when he reaches 88 years of age in 2100, that reality will be even more intensified. No matter what religious tradition he belongs to, if any, he will be immersed in a world populated by the religious and defined by an increasing plurality of theologies, spiritualities, and worldviews, all living at his doorstep.

While this kind of crowded ideological marketplace has the potential for cultural clashes and conflict, it could alternatively serve as an impetus for a new spirit of tolerance and community: Living in a shared, increasingly global society compels people to realize their commonalities and shared interests even in the face of differences in creed.

Scenario

Southern Africa Takes Center Stage

By Michael Lee

It is five minutes to midnight on New Year's Eve at the end of the last day of the twenty-first century. In Dar es Salaam, one of the wealthiest cities in the United States of Southern Africa (USSA), revelers from across the region have traveled on the Trans-Africa high-speed train network to witness the arrival of the new century at a massive fireworks display and international gathering in East Africa's "harbor of peace."

Wearing a variety of light, thermoregulated fabrics in bright, fashionable colors, party-goers and families mill around in droves at the city's popular waterfront overlooking the Indian Ocean, its warm waters an ancient conduit of intercontinental trade.

Dignitaries include the prime minister of China; diplomats from IndiaStan, the European Federation, and Amerinada; and the UN Secretary-General. The reason for their high-profile visit, hosted by the aging president of USSA, Nelson Bandigwa, is that the city has been chosen as a UN Beacon of Progress for the first year of the twenty-second century. As the fireworks leap suddenly into the sky at the stroke of midnight, President Bandigwa smiles to himself and then quietly sheds a tear.

Nelson Bandigwa was born in 2012; by the time he turned 10, in 2022, the Southern African Development Community (SADC) became a confederation to govern the blossoming regional common market spearheaded by South Africa and its neighbors.

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In his youth, Bandigwa watched his region gradually unite, as many of its nations benefited from increased intra-African trade and infrastructure development. These vital projects included construction of extensive rail networks and large-scale hydroelectric schemes in Zambia near the famed Victoria Falls and on the banks of the mighty Congo River.

While the world passed from the Industrial Era to a new eco-scientific era after Peak Oil, Africa became a hotbed of solar-energy technology. The shift from a fossil fuel–based economy to a lower energy order based on renewables suited Africa well. The transition gradually reduced violent conflicts over dwindling resources. Nevertheless, periodic struggles over water broke out, as well as ongoing conflicts with radical Islamic and environmental groups using terror. In the wake of the new energy order, an epoch of greater general peace evolved in Africa.

President Bandigwa looked into the sky and continued to watch the fireworks through glazed eyes. Tonight, his heart felt full of years and memories of a century that had witnessed the creation of USSA and the rise of three new global superpowers: China, Brazil, and India (later called IndiaStan after the unification with Pakistan following a tragic nuclear confrontation in 2028).

Africa's time to take the center of the world stage had arrived by mid-century. The continent's progress had taken a long and painful journey characterized by waves of development, such as the Consumer Revolution and Youth Bulge of 2000-2015, followed by the era of big infrastructure building, urbanization, and regional integration (2005-2035) and Africa's own Green Revolution (2015-2030).

Periods of migrations to Southern Africa occurred as northern peoples sought warmer climes, escaping harsh winters when energy prices were escalating and fuel supplies were diminishing.

In addition, there had been immigrations of peoples from the overpopulated East, especially from demographically skewed China. This resulted in millions of Asian settlers on the continent, a significant portion of whom intermarried with local Africans to produce a new race of Sino-Africans. This created an African urban melting pot, leading to increased diversity and cultural dynamism. Yet, the tight-knit extended family traditions of Africa were preserved throughout this time of accelerating growth and cultural diversification.

As a former professor of history, Bandigwa believed the biggest catalyst for his region's rise to power had been its science-inspired Knowledge Renaissance of 2020-2050. In this time, the number of universities, colleges, and technical schools in the territory had

more than tripled. The USSA's leadership grew in such fields as solar energy, hydroelectricity, agriculture, food science, astronomy, and archaeology.

The nation had also developed new systems of long-term underground disposal of low-level nuclear waste in wildernesses created by climate-change-induced drought, paving the way for safer deployment of nuclear power. The Southern African Space Agency (SASA) had produced several astronauts who had worked on international space stations. One was chosen for a mission of the Global Space Agency (GSA) to test the viability of establishing a human settlement in caves on Mars where water had been discovered.

Throughout Bandigwa's lifetime, the United States of Southern Africa had been a leader in one of the world's biggest businesses: tourism. Particularly successful were eco-tourism, archaeo-tourism, and the wildly popular sport of nonlethal hunting using sedation darts instead of live ammunition.

And finally, building on the work of Nelson Mandela and Desmond Tutu, and on peoples' innate spirit of *Ubuntu* (humaneness), USSA had become widely respected around the world for its expertise in conflict resolution and the practice of racial and religious harmony.

President Bandigwa's tear at midnight had been an expression, more than anything else, of pride for how Africa had overcome the historic humiliations that once haunted the continent.

Lanes in the Sky

By Davidson Barlett

In hindsight, one can easily identify the advantages of jet-powered aircraft over propeller-driven ones, and appreciate the quantum leap forward that jet aircraft represented.

Now, try to imagine a new generation of low-ceiling, ground-hugging aircraft designed to bring aviation to the masses. These will be built to glide on the ground effect (that cushion of air that hugs the surface of the earth up to an altitude of 15 feet) for increased safety and efficiency.

Imagine these new craft using aerodynamic design, ultralight materials, and a totally new system of propulsion that utilizes neither fixed nor rotating wings to allow it to float gently over the ground. They will move in the desired direction with the grace and speed of an arrow, cruising just 15 feet above the ground.

To put the practical applications of such a propulsion system in perspective, imagine cars and buses that don't need roads. Imagine trains, trams, and barges that don't need tracks, waterways, or bridges. Imagine transportation vehicles with the flight characteristics of low-flying helicopters, without the danger and disruption of rotors. And imagine for a moment the obsolescence of the wheel for powered motion: George Jetson's flying car in every garage.

Only one technological logjam—inertial thrust—is stopping this fantasy from becoming a reality. Research on inertial thrust represents a little-known but fascinating quest on the part of many an amateur inventor. Perhaps someday another name will be added to the list of immortals like Galileo, Edison, the Wright brothers, and Einstein when the riddle of inertial thrust will be solved, adding yet another dimension to the universe of human knowledge and achievement.

Let us hope we live to see it—along with a controlled fusion reactor, interstellar space flight, and other marvels of science fiction. And when you doubt that this type of breakthrough will ever take place, look back at the works of Jules Verne, and marvel at the relative accuracy of his nineteenth-century visions of the future, which were the subject of much ridicule in his time. And remember the concept that human achievement is limited only by human imagination.

The Local-Global Duality

By Joshua Loughman

The growth of cities into suburbs, and then exurbs, could see communities of the twenty-second century collide into megalopolises covering entire regions of the countries we recognize today. This growth of local communities, and the flattening of the world through connectivity, would polarize people's engagement into

local and global, steering away from the sense of nationalism seen throughout the twentieth and early twenty-first centuries.

The new local-global social dichotomy would have several effects, from the personal to the macro scale. The nature of employment would change from the static employee-employer model to a more fluid arrangement: Workers' skills grant them more flexibility and enable them to work efficiently for multiple employers and utilize their full productive capacity.

This productivity and flexibility would be aided by advancements in interconnectivity through mobile devices and human–machine interfaces. Enhanced connectivity would allow people to live anywhere in the world. They will work with local productive enterprises in areas that must be local, such as manufacturing and farming, but also engage in the global knowledge industry. The continued blending of public-private partnerships could work to utilize these more fluid parts of the economic system.

Another result of this changing social dichotomy is the way in which governments would function. Governments would polarize along with society into large super-cities and into continental and global alliances chartered along geopolitical and strategic global-resource prerogatives.

These large geopolitical forces would develop to secure increasingly scarce resources of fuel, food, water, timber, and minerals. Most of the previous century would have been spent in securing these resources, and technological advancement will likely be too late to prevent conflicts before the global resources problems are solved. Technologies such as new sources of power, solar, geothermal, fuel cell energy storage, and fusion could feed the growing global demand.

The growth of these energy and mitigation technologies would also come too late to respond to the

Scenario

Life and Love in the Pod

By Bart Main

Timmy stirred beneath the blanket as the dawn filled his room. Stretching deliciously, he opened one eye to look at the clock.

"Temp?" he asked.

"18," replied Margo.

"Good. Perfect for my run," thought Timmy.

The lights came on as he rolled out of bed, the covers shook themselves into place as the Murphy bed ascended, the wall opened to reveal the bathroom, and Timmy stumbled into the shower.

"Tell Mom I'll have a Spanish frittata," he told Margo.

"Got it," she replied.

As the faint smell of endorphins tingled him awake, Timmy slipped on some shorts and a T-shirt and walked out the door into the sweet smell of spring. The path beckoned him along as his bare feet kissed the mossy grass. The air filled him with joy. He picked up his pace when he saw a familiar bouncing ponytail flash through the trees ahead.

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"Genevieve!" he called through his wrist band. The girl waved her left arm in response, but she seemed to pick up speed. Timmy wondered for a moment whether his ear stud was dead until the realization struck him that she wasn't interested in his company. He turned down the short trail and was home, took another quick shower, and plunked down across from his mom at the breakfast table. The frittata was delicious, and he told her so.

"So what's wrong?" asked Mom.

"Genevieve snubbed me just now."

"She's involved. You'll have to find somebody else to fall for."

"Yeah, I know. But she is really cute."

"Yes, she is, and so are you, honey. What about Rebecca? I was talking to her grandmother yesterday, and she said that Rebecca was checking you out."

"Yeah, Margo told me. She's nice, but I'm not sure that I can get into that synkinetic surround she's making. It's really important to her. You know I'm much more into my epigenetic manipulation."

changing global climate. Governments and other social organizations have already predicted the coming consequences, but not having to feel the full impact at present will cause these organizations to delay an adequate response. Once the pain is acute, the opportunity for large-scale changes in the forces acting on the climate or planetary engineering techniques to reverse the climate instabilities will likely be lost.

The technology could finally catch up, but not before significant loss of life and treasure is endured worldwide. This will uproot many cultures, as crops will need to be changed and coastal areas will need to be redesigned. This uprooting will further the trend of a mobile populace.

As the complexity of our world increases, the challenges we face require greater planning and more lead time to accomplish. We will have to adapt our culture, our governments, and ourselves to meet them.

"You're 34, Tim. You aren't old enough to be making any commitments. You're just exploring. These women are sweet and convenient here in our pod, but the world is a big place. You'll find just the right one in time."

"Right, Mom," Timmy smiled sardonically.

Suddenly, this multigenerational intentional pod community was too small. He thought of Lisa Glasspool down under, whom he had chatted with at the last epigenetic forum. Now, she was beautiful. And seemed to respect what he had to say. Their conversation seemed synergistic to him.

"Margo," he said as he walked toward his room, "see if Lisa Glasspool is available to chat sometime today." He could feel the oxytocin rush lightening his step as he opened the windows of his room and settled into work.

Game Changers for the Next Century

By Arthur Shostak

Underlying today's dazzling, seemingly science-fiction developments are such brow-arching matters as artificial intelligence, biotechnology, fusion power, genomics, "green" ways of living, integrated automation, nanotechnology, space industry, and robotized weaponry.

These are extraordinary game changers in themselves, and especially in combination. But three other emerging developments dwarf even these in their potential to alter life by 2100.

The first, brain–machine interface systems could enable individuals to control "smart" equipment merely by using their minds, much as today certain paralyzed patients can control a computer or a prostheses through thought. Our descendants may be able to turn on and off, aim, and otherwise control inanimate objects just by thinking a command.

Like all such major changes, this one is double-edged, as it could encourage couch-potato sloth leading to ill health. Today's diabetes and obesity plague may seem mild in comparison. Alternatively, we could employ newly gained time and energy to achieve mind–body advances once only dreamed of in neo-utopian blueprints.

The second emerging game changer is whole-brain emulation. Proponents expect to import the equivalent of a human mind—the most complicated device found to date in the universe—into a nonbiological substrate. While the brain today remains one of the biggest mysteries of all, the next 88 years are likely to host neuroscience advances, bolstered by the power of quantum computing, that could make an uploaded mind an actuality.

By 2100, advances in law, philosophy, and politics should help answer such questions as Is it human? and if so, What are its rights and responsibilities? What do we owe it, and vice versa—what are we owed? (A good start in answering these questions is available in Isaac Asimov's "Three Laws of Robotics.")

A third underrecognized game changer, and arguably the most consequential, is futuristics itself. Vastly improved by computer science gains in data coverage and model building, foresight work should also profit from unprecedented artistic flights of imagination and fancy. Best of all, it will probably have become a prized feature in lifelong learning.

Hailed for helping us mitigate the worst long-range threats posed by ongoing climate change, futuristics will benefit from diversity, with increasing input from female forecasters and non-Western seers (China and India, for example, have long been helping improve Western futuristics).

By 2100, futuristics could be regarded as the most valuable of all the mental tools that humans will need for the next century, when *the* "big thing" will be our new relationship with things that actually seem able to think.

Tools

Scenarios and Long-Term Thinking

By House of Futures (Gitte Larsen, Søren Steen Olsen, and Steen Svendsen)

It is almost impossible to make any plausible direct extrapolations from historic trends a hundred years into the future. The present contains seeds of the future, but it is very unlikely to unfold in any straightforward manner.

That is why we need scenarios to get a better idea of the enormous transformations that will happen in the decades ahead, including how we might try to shape the future and create the ones we prefer.

Scenarios are alternative images of the future that can inform decisions in the present. It is an approach that is used by decision makers in the public and private sectors, on many levels and in many contexts.

There are many types of scenarios, and the choice of scenario depends on the purpose. One can work with many or few, qualitative or quantitative, broad or specific, and long or short-term scenarios.

The scenario process of House of Futures' "In 100 Years" project differs from more traditional scenario processes in its ambitious scope, in its perception of nature as the main driver, and in the combination of performance arts and methods as well as futures studies to make it possible to experience the scenarios.

The **Baseline Scenario** is built on trends that are relatively straightforward to track, such as population, economic growth, technological advance, and values and mind-sets. The exercise of creating a baseline scenario gives us the opportunity to think about factors that could change it, such as the availability of resources upon which economies depend or a cultural shift in views about affluence and happiness.

Two alternative scenarios that House of Futures developed in its 100Y ("In 100 Years") seminars are:

Scenario 1: Man-Made World. We realize that when we put our minds to it we can develop technologies, organizations, political institutions, and business models that allow us to prosper in ways that do not jeopardize

Scenario

Automated Government

By Peter Denning

Futurists have historically been better at describing the present than the future. Fortunately, I have been blessed with a set of communications from one of my descendants, whose eyewitness accounts of events around 2100 are far more reliable than any such speculations I can offer.

My descendant is a young girl named Ancath, who is about 9 years old in 2103. Every Christmas, starting in 2103, she sends recordings of her conversations with her great-grandmother (my granddaughter) about what it was like to live in the age of computers. You see, computers are gone in 2103. Only a few elderly people, like great-grandma, remember anything about them.

I have collected these recordings into my "Ancath Chronicles." From them, I learned that in about 2025 the U.S. Congress decides to fully automate the government as a move for dramatic efficiency. The process is well under way by that point anyway, since robots running large databases staff most government offices.

The automated government, "Ag" as they call it, is so successful that Congress disbands itself a few years later. Its last act is to pass authority to a set of artificial intelligences simulating senators and representatives. This enables an automated Congress to respond to problems by passing laws that are quickly implemented by the automated bureaucracy.

But within a few years Ag exhibits amazing feats of artificial stupidity.

Around 2035, Ag discovers that simulations are much less costly than real things, like transportation. It ends 30 years of airline crises by banning flights and instead simulating planes flying simulated passengers. No real airplanes, no pilots, no airports, no cost! Former air travelers do not complain because they get to know their neighbors, and like them.

Soon Ag does the same for the medical system to end the health crisis: Simulated doctors treat simulated diseases in simulated hospitals. Since people now never have to go to a hospital, everyone is much healthier and life expectancy surges.

Planet Earth. Collectively, we are approaching a state of global stewardship in which we manage our planet rationally, like any sensible landowner would with his property.

Scenario 2: Power of Nature. We realize that everything is nature, and so are we. We are one with Mother Earth, and we share a common biology and collective consciousness. On a deeper level, these are the sources of meaning that we all tap into, regardless of nationality, religion, or culture.

Questions

Ten Big Questions for 2100

By Michael Marien

Imagining scenarios of what life might be like in 2100 is a fun exercise, but we should not use it as an escape from addressing the many huge uncertainties of the early twenty-first century and the unfolding Global MegaCrisis.

Facing the uncertainties and complexities—about environment, resources, population, society, and technology—sooner, rather than later, will likely make life in 2100 better for most or all people, and improve our chances of making it to the twenty-second century, which is not guaranteed.

Consider these 10 big and overlapping questions—surely not the only ones to ponder, but good candidates for a short list that should be widely circulated and continuously updated:

1. How Much Global Warming Is Ahead?

The world has already warmed by 1°C over preindustrial levels, and there is near-zero chance of stopping warming at 2°C. Many climate scientists now think that worrisome 4°C warming is most likely in the 2050-2100 period, and that a disastrous 6°C or more is possible. Some scientists, such as James Hansen of NASA, warn of possible tipping points leading to runaway global warming "out of humanity's control."

2. Will Methane Eclipse Carbon Dioxide?

Methane in the atmosphere is only about one-fifth of CO_2 in volume, but is 20-25 times more potent as a greenhouse gas, although not as long lasting. In addition to other sources, such as livestock, methane is now being released in large quantities by melting Arctic permafrost—a process likely to accelerate. If large amounts of methane are also released from clathrates on the ocean floor, catastrophe is likely. But there are no estimates as to what could trigger how much release, or when.

Adding to the methane threat is nitrous oxide, about one-tenth of CO_2 in volume but 300 times more effective than CO_2 in trapping heat.

3. How High Will Sea Levels Rise?

The conventional projection of sea-level rise by 2100 is currently about 20 inches (0.5 meters). But check out *The Fate of Greenland: Lessons from Abrupt Climate Change* (MIT Press, 2011), especially for the 70 striking photos of melting ice. The authors warn that "in the fate of Greenland lies clues to the fate of the world" and that "uncertainties dominate on the bad side." Based on past records, it is possible that the Greenland ice sheet could melt in a few decades, raising sea levels by some 24 feet worldwide. Melting of the West Antarctic ice sheet would raise sea levels by 16 feet.

4. Will We Run Out of Essential Resources?

Renewable resources (notably water) and many nonrenewable resources (oil, arable land, minerals, rare earth elements) are becoming more difficult to acquire even as demand increases—what Michael T. Klare calls

By 2040, Ag has bankrupted nearly all businesses. A deep depression grips the world. Finally, in 2050, a group of graybeard programmers create a solution: They build an Automated Citizen, programming it to be helpless and adoring, and install a copy on every Internet port. Soon, the automated government is completely occupied with taking care of the automated citizens, and it leaves all the real people alone. People forge a new, free society. Everyone prospers.

Around 2090, the automated Department of Energy declares that an obscure cloud farm in Iowa is consuming too much electricity, and it pulls the plug. This shuts off the Ag. But no one notices.

"the end of easy everything" in his book *The Race for What's Left* (Metropolitan Books, 2012; the GlobalForesightBooks.org Book of the Month for May 2012).

Prices are rising and will surely continue to do so, as companies and nations also scramble to adapt through conservation, substitution, and new technologies. One writer estimates that supply shortfall by 2030 is "nearly certain" for cadmium, gold, mercury, tellurium, and tungsten.

5. How Many People Will There Be in 2100?

Global population projections are pretty much settled on 9–10 billion people by 2100, or roughly 50% growth from today's 7.1 billion. This is a substantial addition, even as the rate of growth slows. But it may be more useful to think in terms of four scenarios:

- **Sharp Decline** due to a global pandemic or a world war.
- **Slow Decline** where modernization leads to smaller families.
- **Slow Increase** due to general improvements in medicine and health outpacing smaller families.
- **Rapid Increase** due to success in antiaging and life-extending technologies, made accessible to many people. Demographers never consider this possibility, but experts on Bill Halal's TechCast.org panel forecast life extension to 100 years as probable by 2040.

6. What Will Be the Quality of People in 2100?

Genetic and robotic enhancements may create "better" or at least different human beings, but will these options be popular? Even if widely available at low cost, could these improvements be more than offset by endocrine disruptors and other pernicious chemicals in the environment, taking overdoses or inappropriate drugs (both illegal and legal), and overeating of food (leading to obesity and diabetes)?

7. Will Decent Employment Be Available to All?

Assuming that livelihoods will be necessary and desirable, will everyone have jobs or self-employment that provides for basic needs? At present, this is a serious long-term problem, especially for younger generations. Any Year 2100 notions about cornucopian futures where governments or corporations provide free food, housing, education, health care, etc., are simply escapist fantasies.

8. Will Inequality and Plutocracy Continue?

Global trends to more inequality within and between nations are unmistakable in recent decades and seem likely to continue, as well as the parallel trend to governance by the rich. There is no definition as to when a "democracy" becomes overtaken by "plutocracy," but, arguably, this is happening or has happened, with no substantial reversal in sight.

9. Will the Energy Transition Be a Clear and Rapid Success?

A transition away from fossil fuels has begun, and everyone favors energy that is cheap, safe, nonpolluting, renewable, and available to all. But this transition will likely take decades at best, and the ultimate mix is highly uncertain: Solar, wind, nuclear, biomass, hydro, and geothermal are the known competitors to oil, gas, and coal, but could soon be joined by ocean algae, ultra-deep geothermal, solar power beamed from space, nuclear fusion, widely distributed LENR (low-energy nuclear reactor) generators, or other technologies not yet on the horizon.

The competition is fierce, and a level playing field will surely help this crucial transition, which, in turn,

Geonautics was the name of the spaceship traveling between Cosmos and Earth. They would be approaching their destination today. One by one, all geonauts came into the conference room for the briefing.

Ayanda was looking out of the window, her thoughts circling around the question of what to expect this time during her visit to Mumbai-II, when the commander's voice reached her: "When we come to pick you up again I expect every team to have got out at least 10% more from every GEP—just to make this very clear."

Initially, Cosmos had only been planned as platform for transplanetary journeys. But when the fight for survival had assumed superhuman dimensions on Planet Earth, and when survival outside protective establishments had become impossible, Cosmos had developed into a place of refuge for space travel experts, heads of state, and the affluent who could afford this place of residence. Hopelessly overcrowded, the station lacked virtually

will mitigate global warming. Unfortunately for sustainable energy, the transition is being delayed somewhat as a result of new and controversial hydrofracking technology that enables easier access to unconventional oil and natural gas.

10. Will Nuclear Weapons or Bioweapons Be Our Undoing?

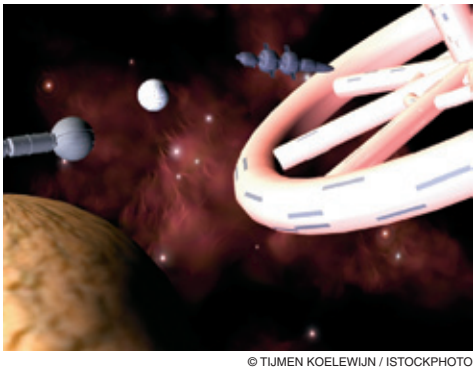
The number of nuclear weapons is slowly declining, while bioweapons—much easier to make—are probably increasing. The Cold War threat of nuclear holocaust and/or the follow-on environmental disaster of nuclear winter has lessened, but is still a not-so-wild-card possibility. And widespread global use of bioweapons could keep most or all of us from reaching the year 2100. Much depends on the future of fanaticism, religious or nonreligious, leading to use of these or other destructive technologies.

This is merely a starter list of huge uncertainties that we face on the bumpy road to 2100. There will be many surprises ahead: negative (e.g., cyberwar), positive (e.g., nanotechnology fully developed), and perhaps ambiguous (e.g., contact with extraterrestrial intelligence), as well as many surprises that we can't even imagine. Global governance and global law are huge challenges at a time when we can't agree on governing our nation-states, and the growing distractions of info-glut are formidable.

Scenario

Geonautics

By Gereon Klein



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everything; in particular, however, energy was scarce.

Everything that seemed reasonably plausible to produce energy had been tried. Then, the successful linking of small-scale biochemical power stations with electricity factories signaled a breakthrough.

The Earth served as factory premises. Light, oxygen, and carbon dioxide as operating resources were available in sufficient supplies. Plants could be reconstructed on site to become reactors and could be configured into Green Energy Plants (GEP). A beam from Earth to Cosmos had been installed for energy transport. Since an additional energy repeater had been positioned in a geostationary orbit, energy transfer ran smoothly and without interruptions. For the operation and optimization of the GEPs, teams of experts commuted between Cosmos and Earth with the *Geonautics.*

During this trip, Ayanda had the official task of increasing the energy density of GEP processes. Secretly, however, she was to investigate inconsistencies of GEP9. During the last maintenance, she had installed an innovative DNA for the filtering of electrons. This DNA had been developed from recombining germ cells of different mammals. Tests had yielded promising results, but ever since GEP9.1 was back in operation, interferences occurred constantly—and every time, it was a different error. They were faced with a mystery.

Ayanda remembered that ever since the modification her pulse became faster, and she became confused when she moved closer to GEP9.1. Upon closer inspection, Ayanda found a voice in her mind. It always occurred in the same tone and fell silent when her distance to GEP9.1 increased. She could hear the voice clearly, but was unable to understand it.

Her frequency meter showed no signals. When she asked colleagues in passing, they noticed nothing. Then the geonauts had to head back to Cosmos.

Now she was back and would have a closer look at GEP9.1. Ayanda's thoughts were interrupted by the security briefing from afar: "And remember that without protective clothing you will have 10 minutes before you have accumulated the life-threatening dose of radiation."

What had happened to her electricity machine since the DNA modification? Did this generator have a language or even intelligence? If only she could understand the voice. Slightly uneasy and with gooseflesh all over her body, Ayanda was looking forward to her arrival at GEP9.1 on Mumbai-II.

In 2003, Sir Martin Rees, Great Britain's Astronomer Royal, wrote that "the odds are no better than 50-50" that our present civilization will survive to 2100. It's still a pretty good bet.

On Being Human: Questioning Ourselves

By David Brin

What do you mean by "people"? Will that term signify the same thing in 88 years?

Its meaning already changed during the twentieth century, as the great big Inclusion Movement brought more kinds of beings into the tribal firelight. All of our old tribes defined a stark, moral difference between outsiders and those who could be called "human beings," deserving protection of morality and law. But gradually, then with accelerating speed, we've seen races, classes, and genders who were previously excluded demand and attain the respect of adult citizenship.

Indeed, as technology and wealth gradually lowered fear levels, one result was an expansion of our perceived horizons: Horizons of space, as maps became continental, then planetary, then interstellar. Horizons of time, as evidenced by this magazine and this very article! Hori-

Scenario

2099: Headlines Warn of Global Cooling

By Tsvi Bisk

Howard Nathan was reading his hologram news "paper" at breakfast (funny how archaisms survive, he thought—there hadn't been paper newspapers for well over 50 years). It was December 2099, and the pundits had begun to pontificate about the new century.

The headline "Worried Environmentalists" caught his eye; it was an article about the impending manmade Ice Age and the disappearance of the world's deserts.

The threat of global cooling was now a hot topic for debate, since the threats to human well-being that had distressed humanity at the beginning of the century had motivated imaginative inventors and policy makers to develop successful solutions to counterbalance greenhouse gases:

1. The widespread adoption of vertical urban agriculture enabled an area the size of Denmark to provide enough food for 7 billion people. The rewilding of vast areas of the planet resulted. Forests had reconquered Europe and China; rain forests had reconquered India and Brazil. This explosion in biomass feasted on atmospheric carbon dioxide like ecological piranhas, absorbing 50 gigatons a year.

2. Artificial photosynthesis that absorbed CO_2 more than 1,000 times faster than plant life had been developed in the first decade of the twenty-first century. Engineers had developed economical ways to extract this CO_2 and make petroleum using bacteria and sunlight. Since hydrocarbons were still needed as the feedstock for more than 500,000 useful products (plastics, medicines, cosmetics, etc.), this process had spread across the planet.

3. Nanotechnologies accelerated the advent of energy-autonomous vehicles and buildings. Cars were now built out of buckypaper (weighing less than the driver), which also functioned as a hyper-efficient photovoltaic skin providing electric energy to run the car. Most buildings were outfitted with mini-depolymerization units that converted all human waste, garbage, and trash to gas that provided all the electricity, heating, and cooking the building needed. The sewage system had become a thing of the past decades ago, as had garbage and trash collection. Landfills spewing methane were now long gone. The electric grid and its ugly pylons no longer existed.

4. Massive forestation of the planet's semi-arid areas had begun in the 2010s and was sucking up several gigatons of CO_2 a year (in addition to the rewilding). Genetic engineers had developed plants that could use sea water or survive on evening dew. Vast areas of desert were now overrun with these exotics, and experts worried that future generations would never see the wondrous beauty or experience the spiritual effects of the deserts.

Howard was not worried. Like his grandfather, who was also a psychologist with a thriving practice treating Global Warming Anxiety Syndrome, Howard now had a thriving practice treating Global Cooling Anxiety Syndrome. One could always depend on human neuroses to make a living. Everything had changed, but human beings had remained the same.

Scenario

Reunion: A Civil War Fable

By Cynthia G. Wagner

The twins were separated at birth in 2012, and though they had been communicating with each other for many years, they planned their physical reunion to coincide with the reunification of the United States of America on January 1, 2100.

The division between their parents was at first strictly due to spiritual clashes. But as twins Bucky and Custis grew up, hope of any future contact between them dimmed as the United States of America fell apart during Civil War II of the 2030s.

Though not technically a repeat of the North versus South Civil War of the nineteenth century, the Second Civil War was similar in its conflict over states' rights. It became clear that the phrase "united states of America" was case-sensitive: Supporters of *united States* could never align with supporters of *United states.* Fiery rhetoric soon erupted in catastrophic violence, and the United Nations formally recommended dividing the fallen superpower as a way to end violence. Voters on both sides agreed.

Recovery was surprisingly quick in urban areas, which crowdsourced a new constitution to formalize a geographically dispersed nation, the United Cities of Northern America (UCNA, whose national symbol became known as "Uncle Noam"). Bucky was elected the Chief Executive of the Legion of Mayors.

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Forced to abandon their rural neighbors, Citizens built reinforced barriers to protect against insurgents as well as invasive species. All buildings were greened with vertical farms and rooftop nature preserves to maintain self-sufficiency and biodiversity.

The economy thrived as creativity was encouraged not just to promote innovation, but also to develop a lively entertainment industry that kept people from shutting themselves in their homes and virtual communities. Even in hard times, everyone danced.

Meanwhile, in the more informally cooperative Southern States, Bucky's twin, Custis, pioneered the establishment of autonomous Pastoral Villages built around individual megachurches. While economic depression ensued quickly as the Villages cut ties to international networks, communities found strength and courage in their own shared faiths.

After decades of dislocations, forced migrations, and deportations, the hope for a harmonious homogeneity evaporated. People rebelled against the suppression of ideas deemed harmful in any way. (Even accusations of "socialism" were shouted down by Village counsels.) The lack of diversity proved harmful to economies, and the Pastoral Village experiment collapsed with the Third Civil War of the 2070s.

As brothers and as revered leaders of their respective governments, Bucky and Custis knew that they could not live without each other. Their virtual peace talks inspired hundreds of millions of Americans, Mexicans, and Canadians to look forward to a new century of open, collaborative futuring. Besides, they missed each other.

zons of inclusion and also of worry. Where our ancestors fretted over their next meal or harvest, or the next enemy invasion, we now ponder dangers that may only prove dire decades, even centuries, from now.

So, will this process continue? Will we be granting moral rights and citizenship to other species? To those we alter—or "uplift"—toward sapient equality? To intelligences that are artificial, blended, gengineered, or even alien? Precedents abound, both in real life and in the thought-experiments of science fiction.

Will even the simulated inhabitants of our games and stories start demanding liberation? Nobody ever said the future will be simple. At least, no one who remains credible.

* * *

Editor's note: The response to our call for essays was overwhelming. To read more forecasts and scenarios, and to comment or add your own thoughts about the twenty-second century, go to **www.wfs.org/futurist.** ❑