

Creating the Unthinkable

Profound Ethical Issues Caused by
Biomedical Scientific Success

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CyberTherapy II: Designing Reality

Gatineau, Canada

June 13, 2006

Presenter Disclosure Slide

Richard M. Satava

Nothing To Disclose

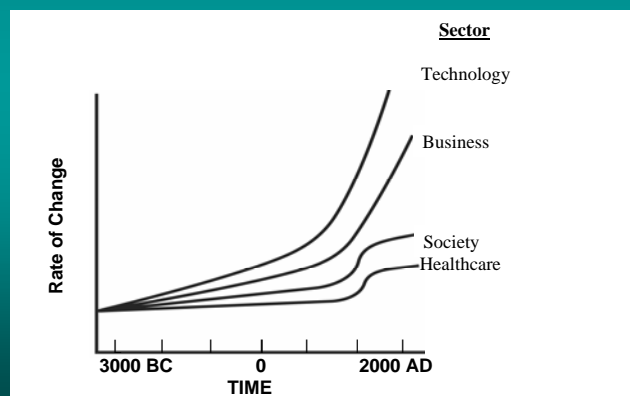
Disruptive Visions

“The Future is not what it used to be”

....Yogi Berra

Technologies will change the Future

- The rate of new discovery is accelerating exponentially
- These changes raise **profound** fundamental issues
- Moral and ethical solutions will take decades to resolve



Differing responses to scientific discovery by various sectors

Outrageous Science

Outrageous *adj* (aut-'ra-jus)

greatly exceeding bounds of reason or moderation

“ . . . relinquishing technology . . . ”

Why the World Doesn't Need Us. Bill Joy, Wired vol8,2000

Robotic Technology

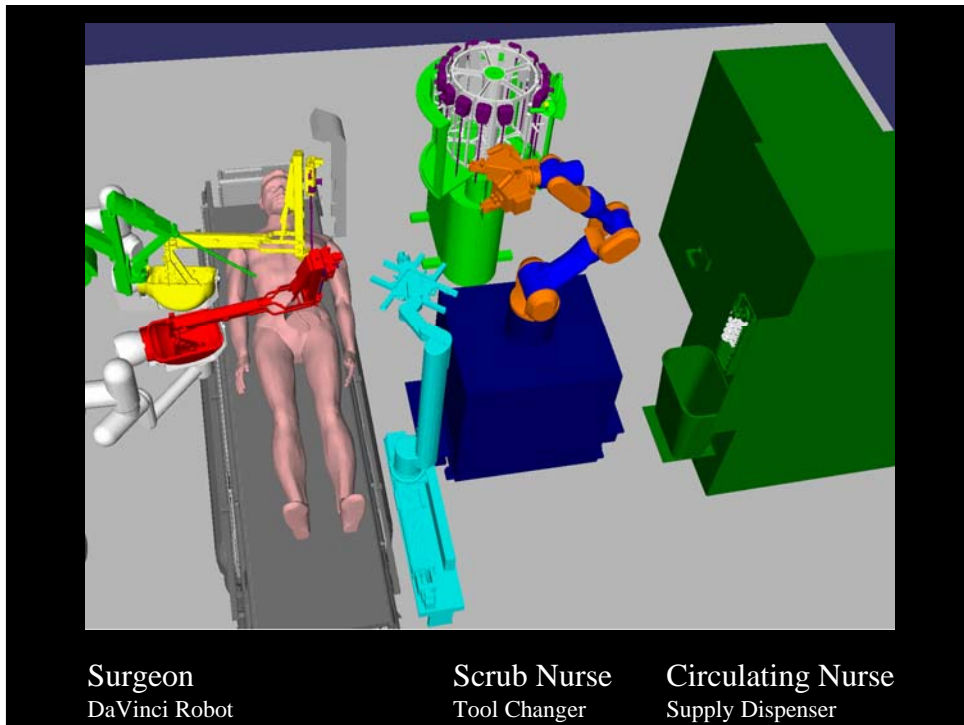
Laparoscopic and NOTES

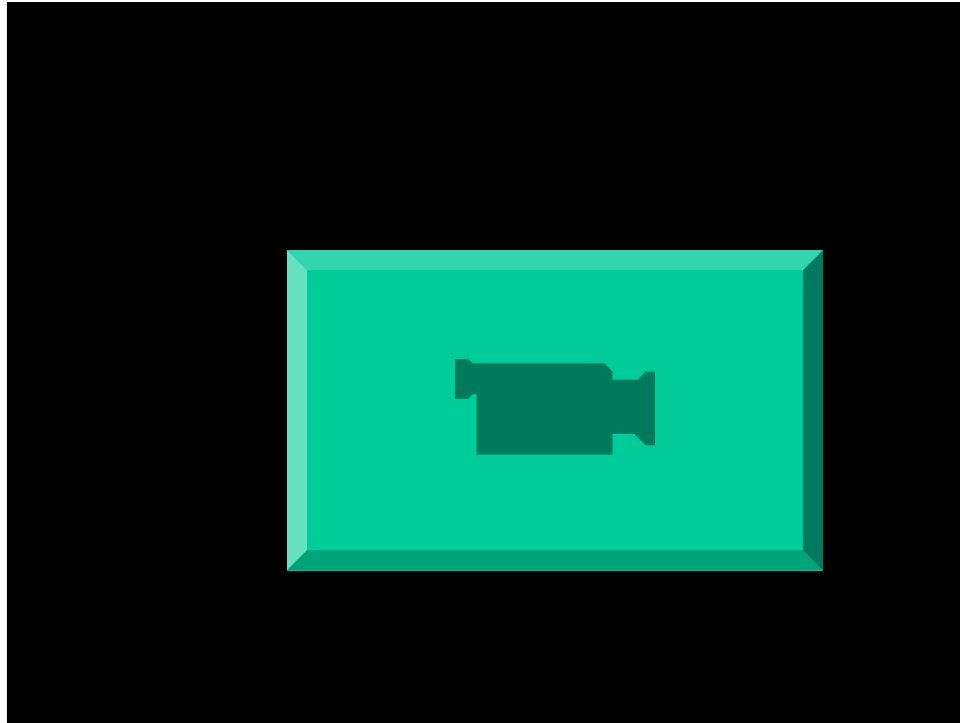


Robotic and remote telesurgery

Image guided surgery









Robotic Technology

Will surgeons no longer directly operate upon their patients?

Is it ethical to offer the surgery before clinically proven?

Can this provide added value and be cost efficient?

Will we lose the 'human touch' of the surgeon?

Chinese Cloning Control Required

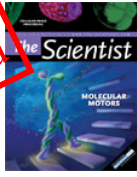
Tuesday 16 April, 2002, 10:41 GMT 11:41 UK

Strict ethical guidelines are needed in China to calm public fears about new cell technologies such as cloning, the country's leading scientist said.

Professor Ching-Li Hu, the former deputy director of the World Health Organization, was speaking at the Seventh Human Genome Meeting in Shanghai. His call follows recent reports that Chinese scientists are making fast progress in these research fields.

[REDACTED]

[REDACTED] while another team from the Sun Yat-sen University of Medical Sciences in Guangzhou is reported to have fused human and rabbit cells to make tissues for research.



Human embryos cloned

February 12, 2004

South Korean team demonstrates cloning efficiency for humans similar to pigs, cattle

| Thersa Tamkins

After outlandish claims, a few media circuses, and some near misses by legitimate researchers, [REDACTED]

[REDACTED] The findings, were released Wednesday (*Science*, DOI:10.1126/science.1094515, February 12, 2004). Wook Suk Hwang and Shin Yong Moon of Seoul National University used somatic cell nuclear transfer to produce 30 human blastocysts and a single embryonic stem cell line; SCNT-hES-1. Using 242 oocytes and cumulus cells from 16 unpaid donors, the group achieved a cloning efficiency of 19 to 29%, on par with that seen in cattle (25%) and pigs (26%).

Relinquished

The pen is mightier than the sword . . .

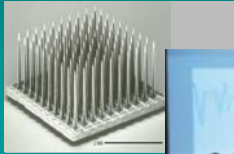
From the movie "The Island", Warner Bros Pictures, 2006

What about other technologies?

There are numerous technologies outside the immediate interest or view of physicians, which will either require physicians to implement or which will impact upon the way medicine is performed.



Surgery beyond the conventional Thought-directed surgery



2001 Brain Chip



2003 Monkey experiment



2006 Clinical Trials

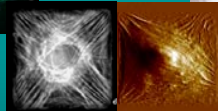


200? "Thinking cap"

Surgery beyond the conventional Intra-cellular surgery



Femtosecond laser



Cellular forces



Atomic force microscope

Should we directly operate upon DNA
to change individual genes?

More about this to follow

Will robots become 'intelligent' ...

TECHNOLOGY NEWS

"Thinking" robot in escape bid

Scientists running a pioneering experiment with robots which think for themselves have caught one trying to flee the centre where it "lives".

The small unit, called Gaak, is one of 12 taking part in a "survival of the fittest" test at the Magna science centre in Rotherham, South Yorkshire, which has been running since March.

Gaak made its bid for freedom after it had been taken out of the arena where hundreds of visitors watch the machines learning how to repair themselves after doing daily battle.

Professor Noel Sharkey said he turned his back on the drone, but when he returned 15 minutes later he found it had forced its way out of the small make-shift paddock it was being kept in.

He later found it had travelled down an access slope, through the front door of the centre and was discovered at the main entrance to the car park when a visitor nearly flattened it with his car.

Gaak

Intelligent "Living Robot"

Uses genetic algorithms to "learn"



Courtesy Professor Noel Sharkey, Sheffield University, London

... and should they be granted 'rights'?

Will Machines become "smarter than humans?"

Humans vs Machine

Humans 4.0×10^{19} cps
Red Storm 3.5×10^{15} cps

Moore's Law
"computer power doubles every 18 months"

Do the Math !!

Who is smarter now??

WHEN COMPUTERS EXCEED HUMAN INTELLIGENCE

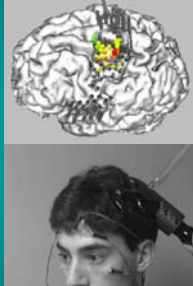
The Age of Spiritual Machines

Ray Kurzweil

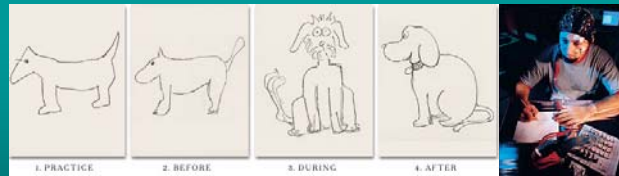


Or ...

... will humans continue to outsmart the machines?



Transcranial Magnetic Stimulation (TMS)



MIT and Harvard
www.ai.mit.edu/projects/medical-vision/surgery/tms.html

University of Sidney - www.nytimes.com/2003/06/22/magazine/22SAVANT

Should we use technology to artificially increase human intelligence?

Replacing body parts

Intelligent prostheses

Tissue Engineering



Scientists grow bladder replacement in lab

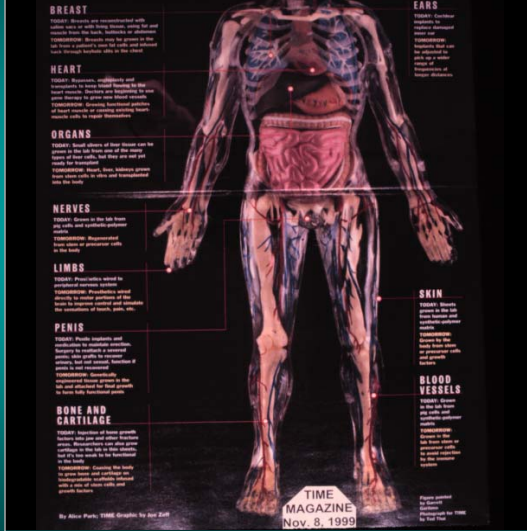
Trial points way to engineered organs using patients' own cells.

Helen Pearson

Published : 4 April 2006

A biodegradable mold shaped like a bladder is seeded with cells and dipped in growth solution. © AP Photo/Brian Walker A team of scientists has grown human bladder sacs in the laboratory and successfully transplanted them into people.

CAN I REPLACE MY BODY ?

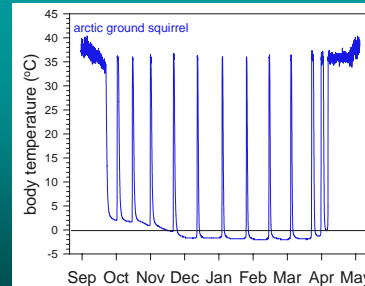


- Artificial organs
- Smart Prostheses
- Genetic engineering
- Regeneration

If I replace 95% of my body . . .

. . . Am I still "human"?

Hibernation and Suspended Animation



Brian M. Barnes, Institute of Arctic Biology, University of Alaska Fairbanks 11/02

Extending Longevity



A strain of mice that have lived . . .
 . . . more than three normal lifespans

Should humans live 200 years?



April 14, 2004

Life extension

Life extension consists of attempts to extend human life beyond the natural lifespan. So far none has been proven successful in humans. Several aging mechanisms are known, and anti-aging therapies aim to correct one or more of these:

Dr. Leonard Hayflick discovered that mammalian cells divide only a fixed number of times. This "Hayflick limit" was later proven to be caused by telomeres on the ends of chromosomes that shorten with each cell-division. When the telomeres are gone, the DNA can no longer be copied, and cell division ceases. In 2001, experimenters at Geron Corp. lengthened the telomeres of senescent mammalian cells by introducing telomerase to them. They then became youthful cells. Sex and some stem cells regenerate the telomeres by two mechanisms: Telomerase, and ALT (alternative lengthening of telomeres). At least one form of progeria (atypical accelerated aging) is caused by premature telomeric shortening. In 2001, research showed that naturally occurring stem cells must sometimes extend their telomeres, because some stem cells in middle-aged humans had anomalously long telomeres.

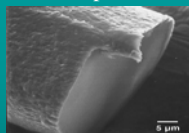
Genetic Engineering



Orb spider - web



Spinnerette of spider



Synthetic fiber

Spider silk protein as biomaterial -BioSteel
 Nexia Biotechnologies, Montreal Canada



1st Genetically engineered child
 November, 2003



Five "designer babies" created from stem cells

Five healthy babies have been born to provide stem cells for siblings with serious non-hereditary conditions. This is the first time "savior siblings" have been created to treat children whose condition is not genetic, says the medical team. The five babies were

Will we give some children physical capabilities not available to others?

The Scientific Community must engage
in their moral and ethical responsibilities . . .

. . . Or abdicate to those with political and selfish agendas.



Reason there are no penguins at the North Pole

The Moral Responsibility

Technology is Neutral - it is neither good or evil

It is up to us to breathe the moral and ethical life
into these technologies

And then apply them with empathy and compassion
for each and every patient

Moral and Ethical Issues

Raised by Technological Success

Summary

Should we do research in areas we may not be able to control?
(eg, genetics, cloning, nanobots, intelligent machines?)

Will prolonging life through technology result in more disease in the overall population

Can we change medicine from treatment to prevention of disease

In defeating diseases, will technology change a human into a combination of man and machine - what does it mean to be “human”

How will we decide who gets the technology, especially in 3rd World

6

SATAYA 7 July, 1999
DARPA

The Ultimate Ethical Question?

For the first time in history,
there walks upon this planet,
a species so powerful,
that it can control its own evolution,
at its own time of choosing ...

... *homo sapiens*.

Who will be the next “created” species?

