

Nanotechnology & Anticipation

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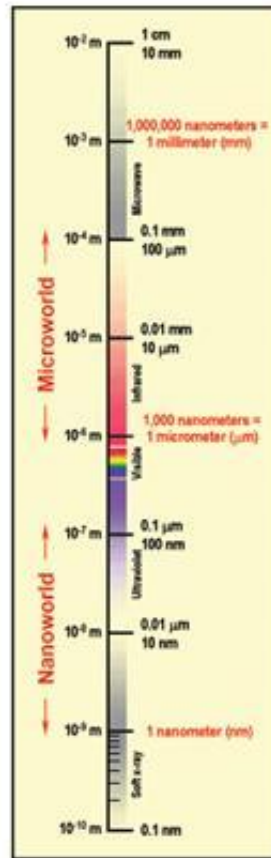
Nanotechnology

The Scale of Things – Nanometers and More

Things Natural

Things Natural

- Ant ~ 5 mm
- Dust mite ~ 200 μm
- Human hair ~ 60-120 μm wide
- Fly ash ~ 10-20 μm
- Red blood cells (~7-8 μm)
- ATP synthase ~10 nm diameter
- DNA ~2-12 nm diameter
- Atoms of silicon spacing 0.078 nm



Things Manmade

Things Manmade

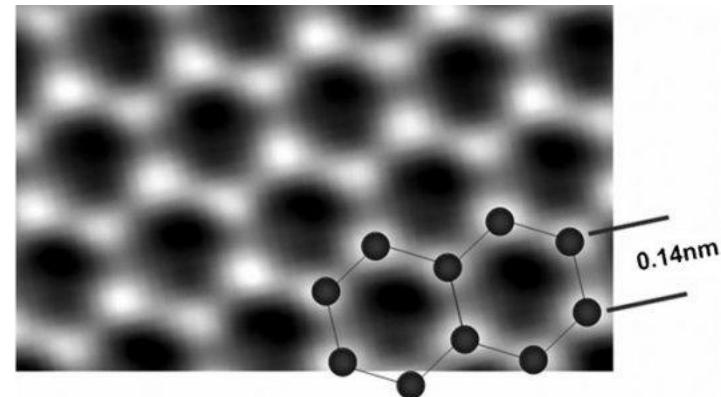
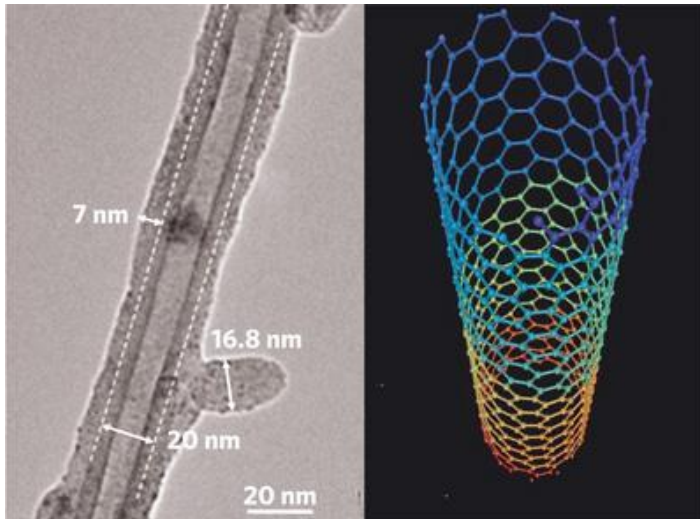
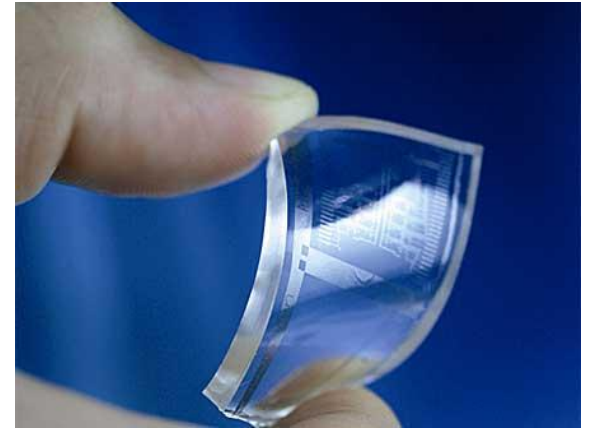
- Head of a pin 1-2 mm
- MicroElectroMechanical (MEMS) devices 10-100 μm wide
- Pollen grain
- Red blood cells
- Zone plate x-ray "lens" Outer ring spacing ~35 nm
- Self-assembled, Nature-inspired structure Many 10s of nm
- Nanotube electrode
- Quantum coral of 48 iron atoms on copper surface positioned one at a time with an STM tip Coral diameter 14 nm
- Carbon nanotube ~1.3 nm diameter
- Carbon buckyball ~1 nm diameter

The Challenge

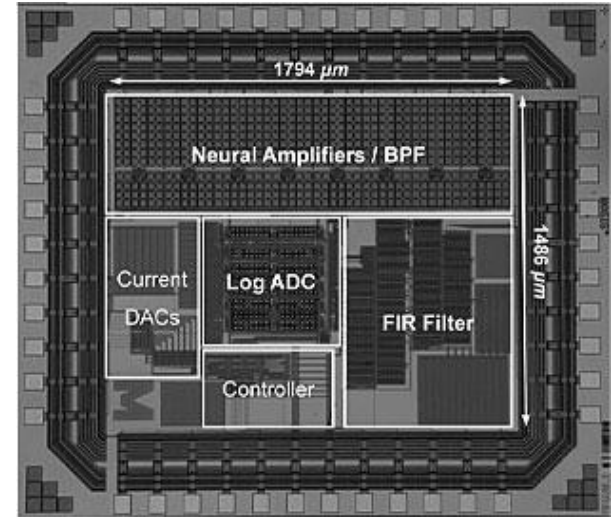
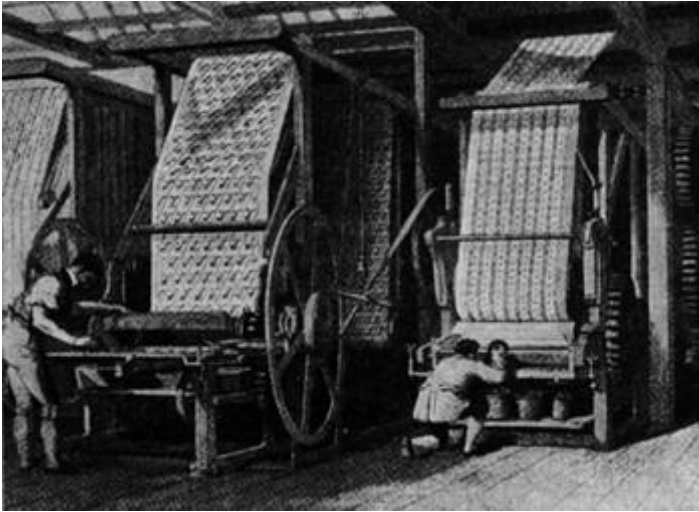
Fabricate and combine nanoscale building blocks to make useful devices, e.g. a photosynthetic reaction center with integral semiconductor storage.

Office of Science and Technology
Office of Biological and Environmental Research
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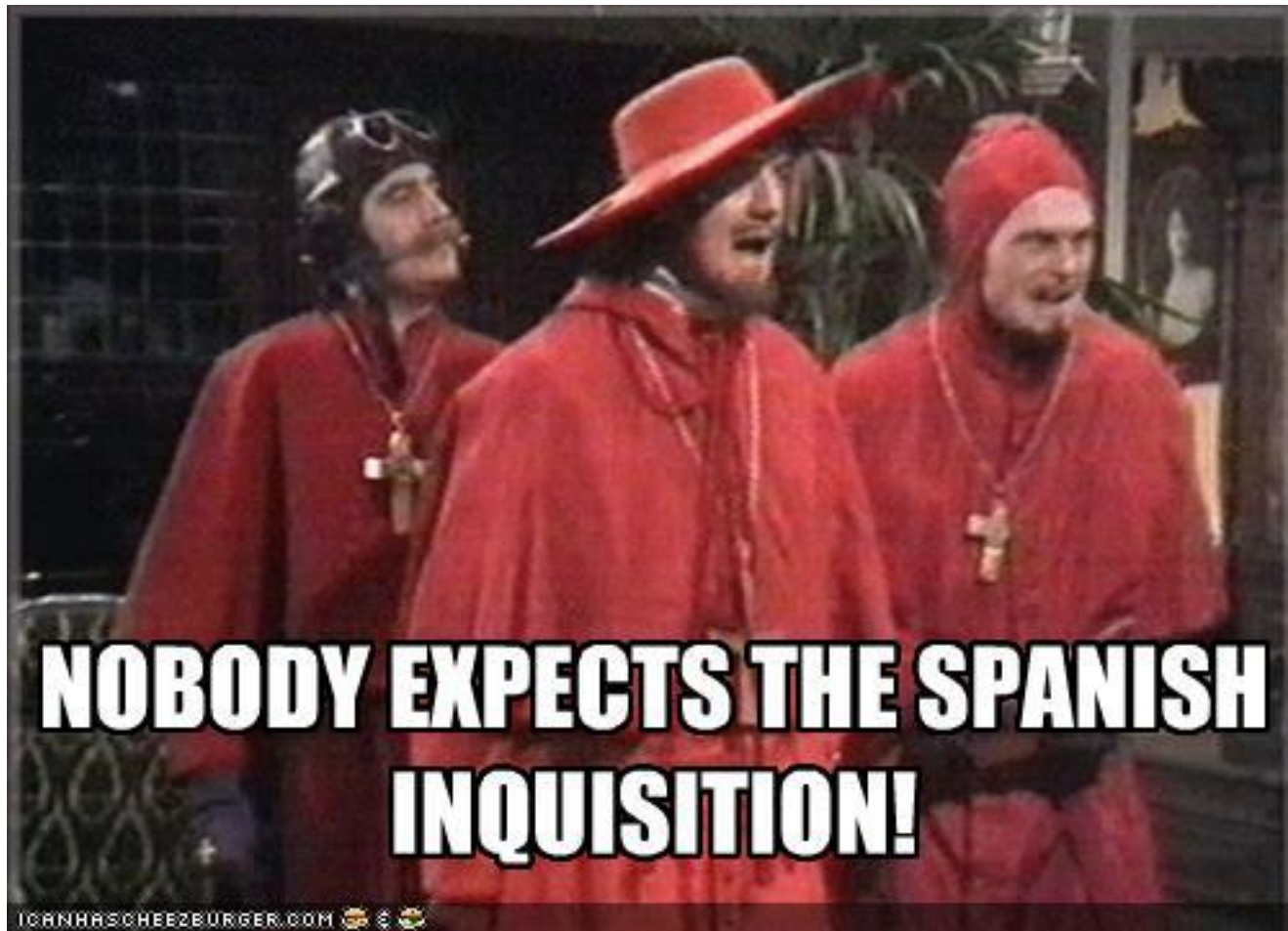
Different (Unpredictable?) Properties

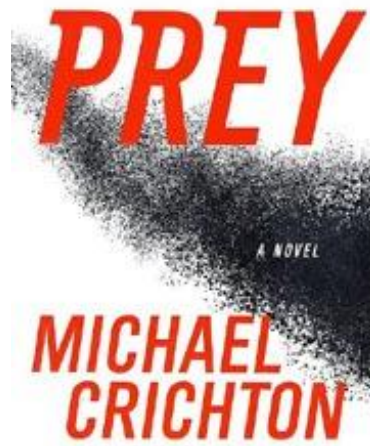


Next Industrial Revolution?

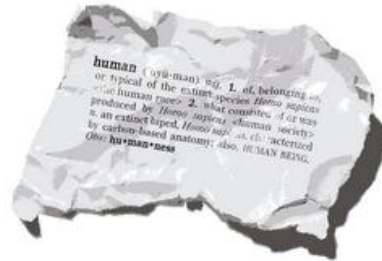


But....

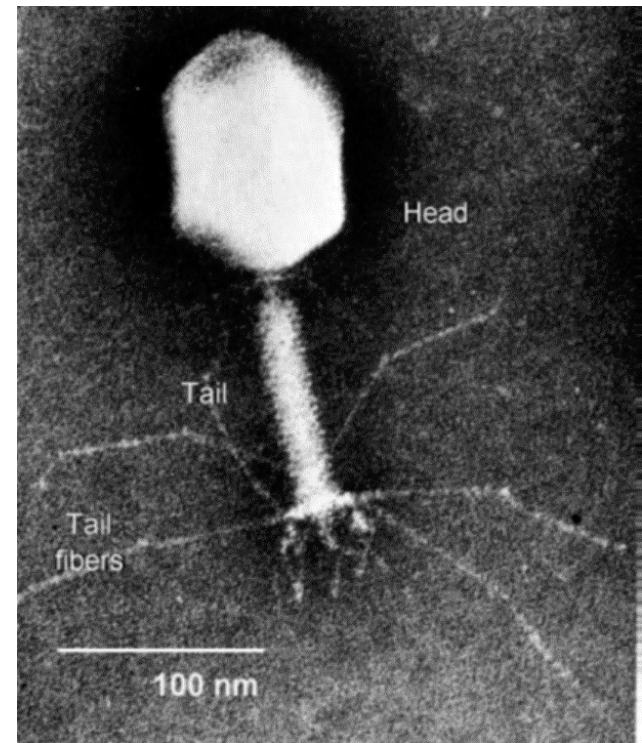




WIRED



**Why the Future
Doesn't Need Us**
By Bill Joy



Anticipatory Governance

A broad-based capacity extended through society that can act on a variety of inputs to manage emerging knowledge-based technologies while such management is still possible.

Anticipatory Governance

1. Foresight

All governance requires a disposition toward future

2. Engagement

Crucial normatively, strategically, pragmatically

3. Integration

Scientists know things we don't, and vice versa

4. Ensemble-ization

Because none of these works in isolation

Anticipate: from *ante-* and *capere*, “to take [into possession]” “beforehand”; related to capable and capacity and not a synonym for “expect,” “predict,” or “foresee”



Four Warrants for Anticipatory Governance

“if we could use the tenets of psychohistory to guide ourselves we might avoid a great many troubles. But on the other hand, it might create troubles. It's impossible to tell in advance” – Isaac Asimov

1. **Stop-gap**: until we have prediction
2. **Fail-safe**: in case we can't get prediction
3. **Priority-setting**: capacity to predict may not be comprehensive and doesn't tell us how to deploy that capacity
4. **Generality**: prediction in some areas (nano) doesn't imply prediction in other emerging technologies (syn bio)

Techniques in Anticipation

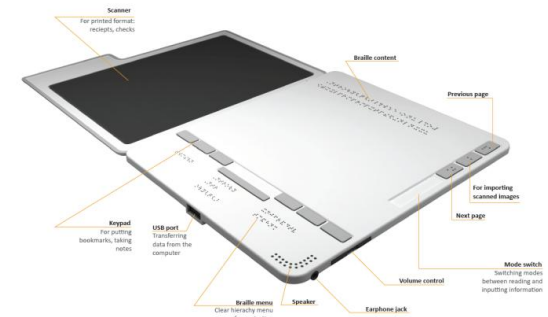
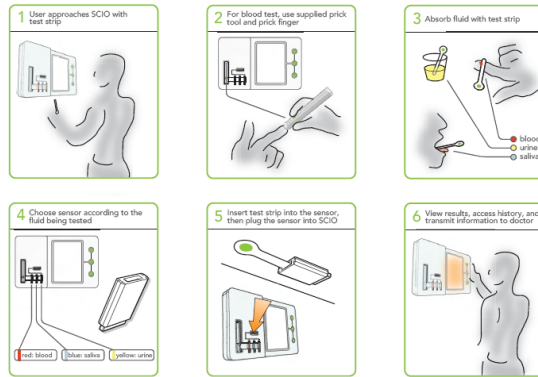
The Future of Medical Diagnostics



Scenarios Matrix

		Value to Society	
		HIGH	LOW
Responsibility for Health	Individual	<p>Healthletes vs. Natural Lifers</p>	<p>Docs R Us</p>
	Institutional	<p>Unlimited Hope in a Box</p>	<p>Doc Blue AI</p>

User Experience Storyboard



Material Deliberation



FINDING FUTURES





