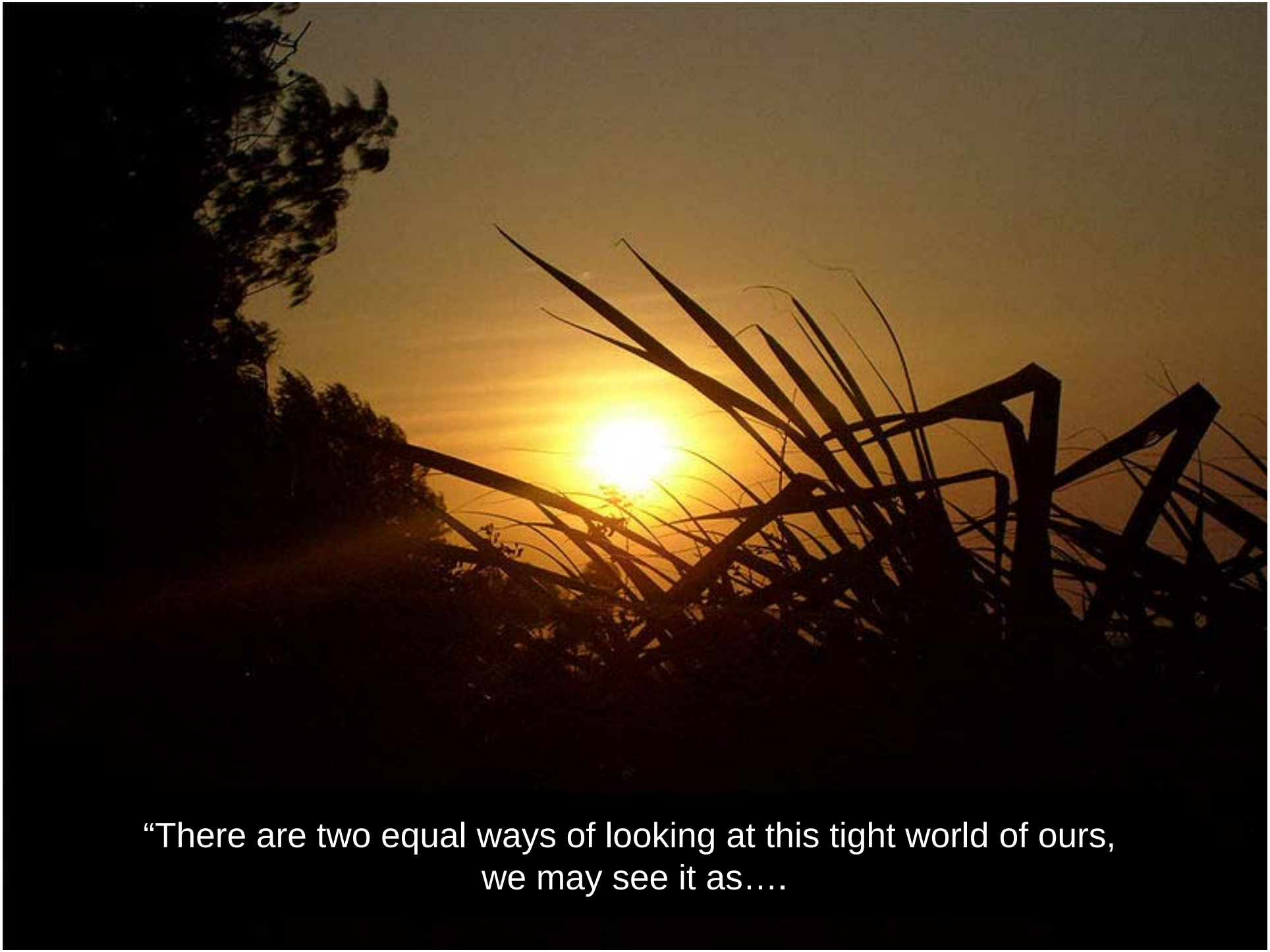
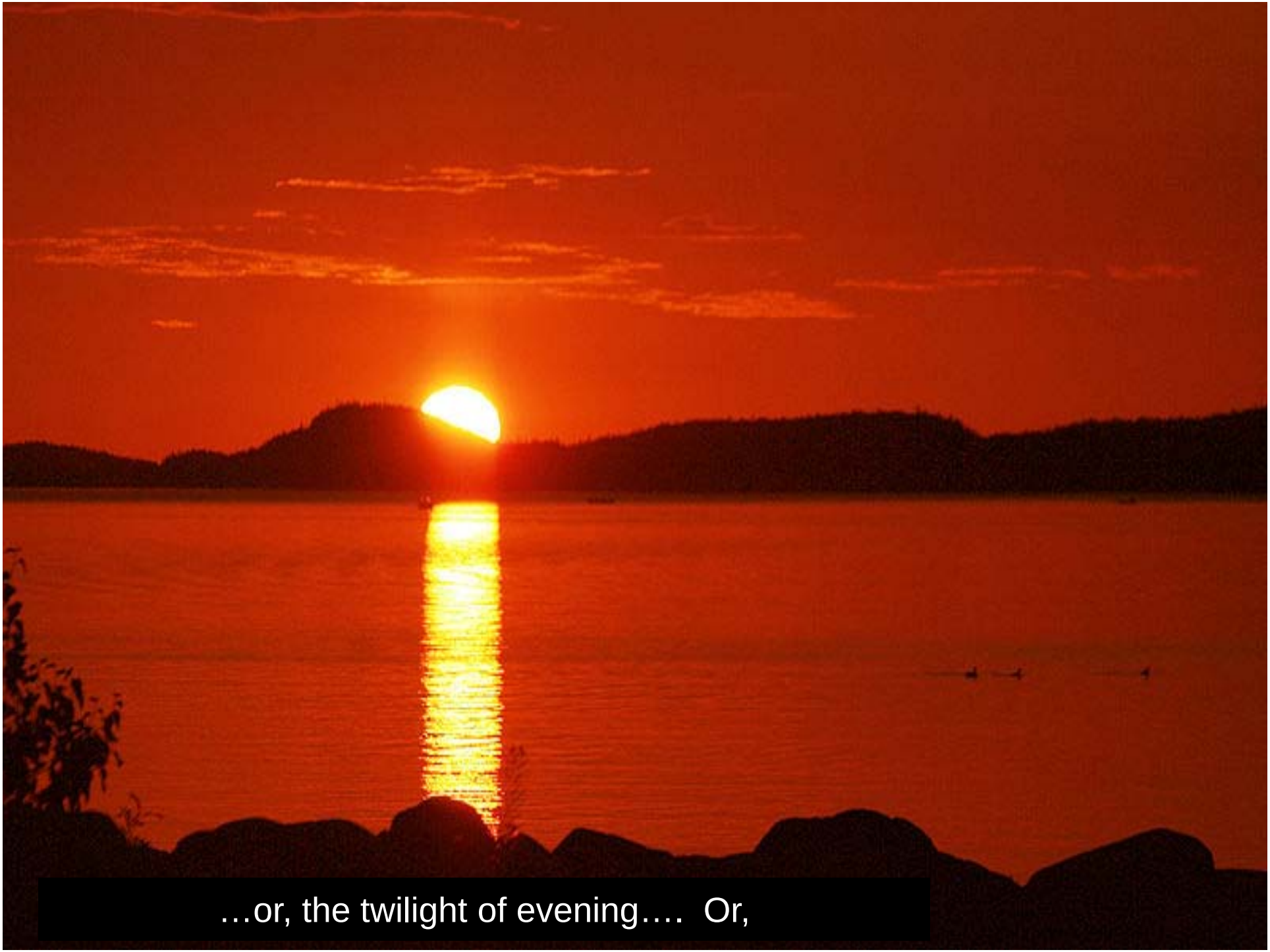
Innovation Cubed!

Minnesota Renewable Energy Roundtable
Bemidji, Minnesota
July 24, 2012

Jim Bensen, President Emeritus
Bemidji State University


“There are two equal ways of looking at this tight world of ours,
we may see it as….


…or, the twilight of evening…. Or,


the twilight of morning!

We may think of anything…

down to a fallen acorn….

as a descendent or as an ancestor”
C.K. Chesterson

Energy!

“Sunshine is spread out thin, so is electricity. Perhaps they are the same, sunshine is a form of energy, and the winds and the tides are manifestations of energy.

Do we use them? Oh, no! We burn up wood and coal, as renters burn up the front fence for fuel. We live as squatters, not as owners of the property.

There surely must come a time when heat and power will be stored in unlimited quantities in every community, all gathered by natural forces. Electricity should be as cheap as oxygen…..”

Thomas Edison

Audacious Ideas!

Naivete is an enabler of audacious ideas. Often it is easier to try new ideas when you haven't ever seen "the way it was always done," or at least haven't seen the way things were always done for very long.

That may be one reason that young people have the fresh revolutionary ideas, while the so-called seasoned experts get stuck in doing what in what has worked in the past.

Historically, most societies have preached conformity. Schools, religious institutions , corporations, and assembly lines usually like to discourage audaciousness.

Kind of sad, but the world can take only so many audacious SOBs , right? Are you one?

Noah Graf, "Do you think you are better than everyone else?"
Today's Machining World, May 16, 2012


Keep Track of….
…”fly by night ideas”!

In 1995 technological breakthroughs in North America arrived once every 17 minutes ….with 10 associated services with each breakthrough!

25,000 a Day!

In the Hot Seat
With a Hot Idea!

Today, we witness 17 major breakthroughs every minute, with 200 associated services following on their heels!

Jeff Davidson, *Managing with Confidence in a World of Change*

The Digital Universe!

2 Miles +/-

Peter Lyman & Hal Varian, University of California, quantified the world's information again in 2002, finding that we had doubled the amount in 2000.

This time they had to employ a new term of measurement: the exabyte, or a million terabytes. (a terabyte is a million megabytes)

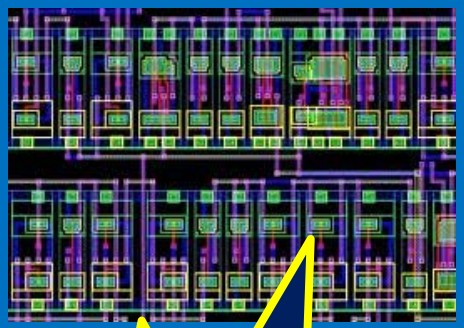
In 2002 people generate[d] 5 Exabytes [of] information, the equivalent of a half a million new libraries the size of the Library of Congress.

With the world's population of 6.3 billion, that's about 800 megabytes of recorded information produced per person, which would take [up] 30 ft. of books [spac]e on paper!

1,800 Exabytes in 2011!

Moore’s Law …and more!

The number of transistors on integrated circuits double every 18 months.



Exponential growth for half a century!!!

Competitors Are Relentless!

“Don’t look back, something may be gaining on you!”

Satchel Paige

“I didn’t get old on purpose.
It just happened!”

“If you are lucky, maybe it will happen to you!”

Andy Rooney

How Fast ……..is Really, Really, Really Fast?

Faster!

Faster!

Faster!

Wavecrest Corp-
Eden Prairie, MN

+ Nano Second (billion)

+ Pica Second (trillion)

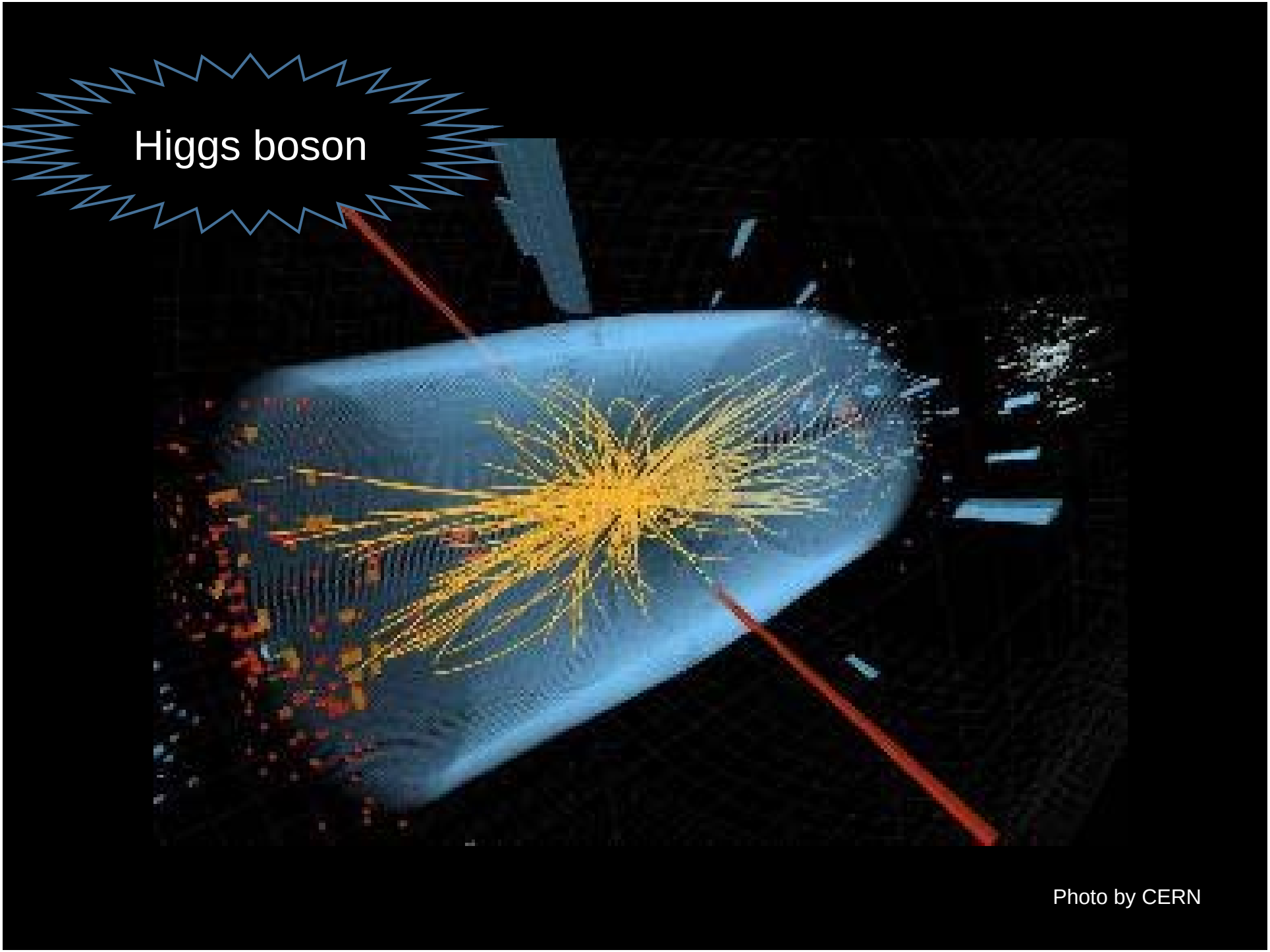
Ratio: 1p/sec. = 1 sec/32,000 yrs.

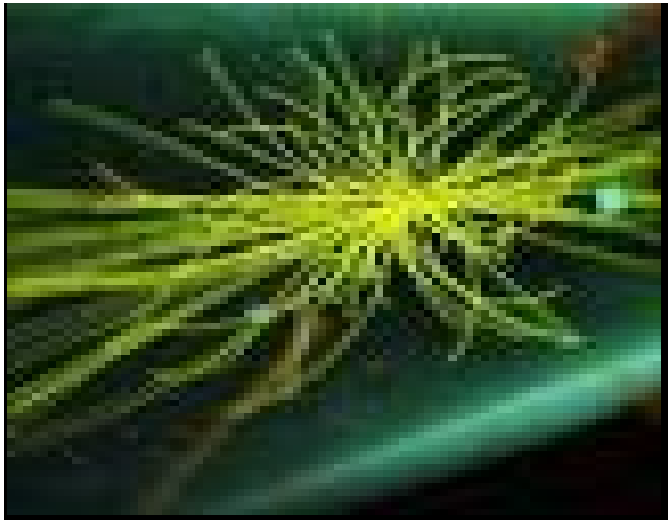
+ Femto Second (quadrillion)

…the length of time it takes light to travel across a single cell!

+Atta Second (quintillion)

…the length of time it takes light to travel across a single atom!


Higgs boson
Photo by CERN



Theory formulated by Professor Yoichiro Nambu, Nobel in Physics, University of Chicago.

Named after Peter Higgs, Professor emeritus, University of Edinburgh. Wrote early paper on the particle.

Boson: a type of particle that allows multiple identical particles to exist in the same place in the same quantum state.

The sub-atomic particle , “Higgs boson”, hunted for more than 40 years has been discovered at long last. The European Organization for Nuclear Research, CERN, on the Swiss-French border announced the discovery.

The Higgs boson, also known as the “God’s particle”, is responsible for the existence of mass, commonly thought of as weight in all matter.

According to the Standard Model, every substance consists of 17 ultramicroscopic particles that cannot be divided into any smaller units.

The Final Building Block:

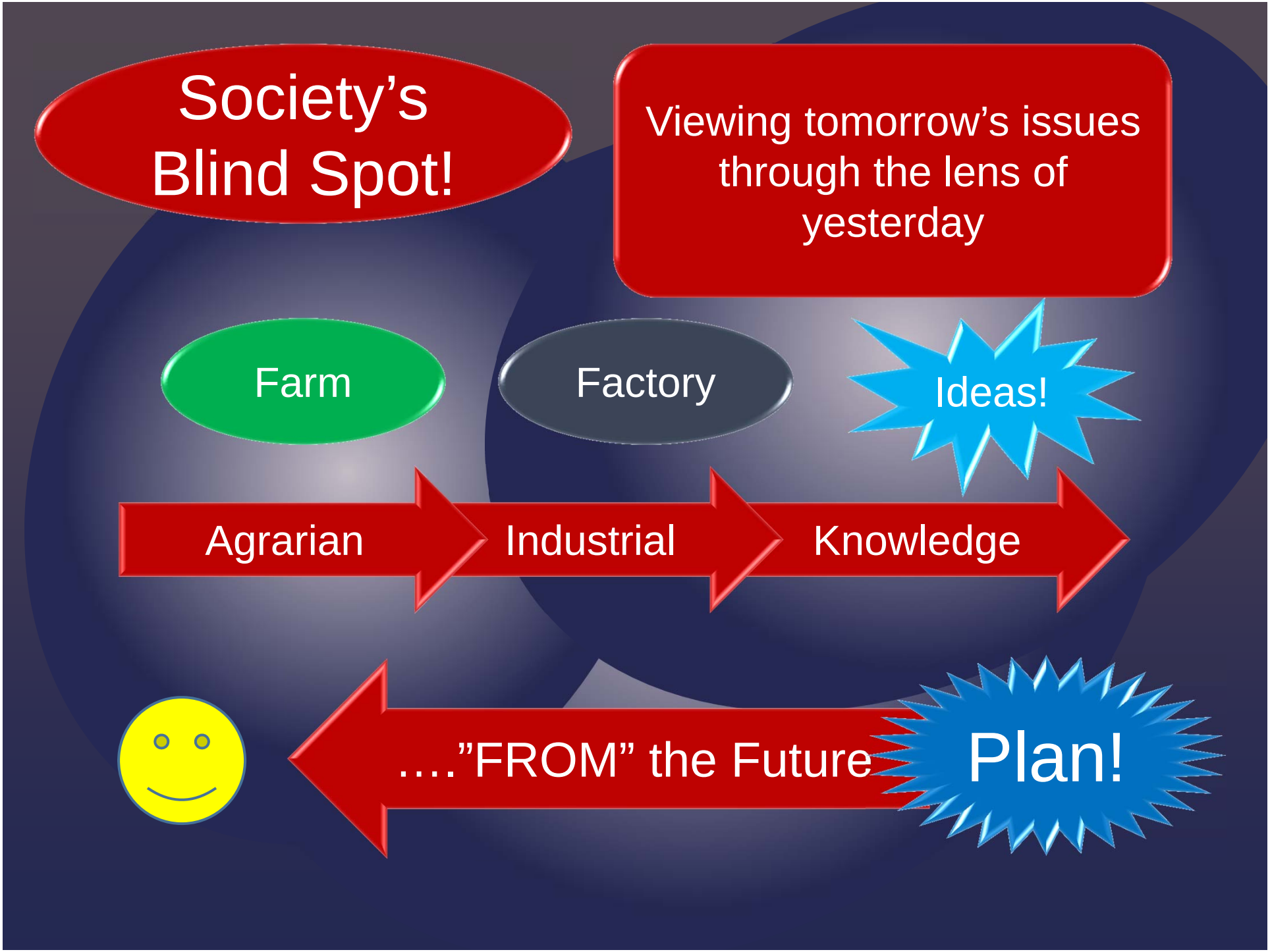
Of such particles, electrons were first discovered in 1897, while the existence of a total of 16 particles – every subatomic particle except the Higgs boson – had been confirmed by 2000.

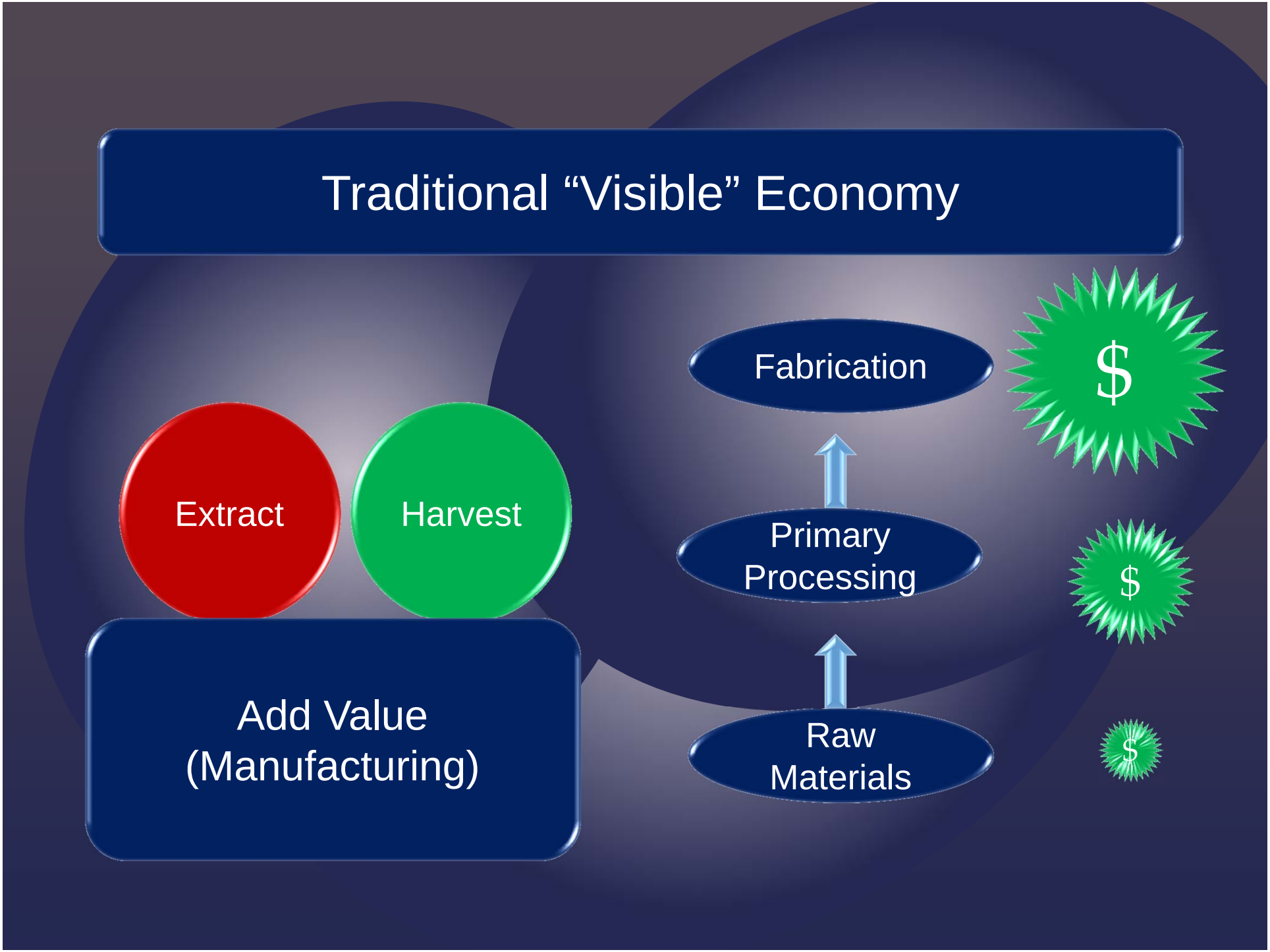
The achievement was made using CERN's circular 27 kilometer underground proton accelerator. The accelerator can make protons, a kind of microparticle, collide with each other in a vacuum at nearly the speed of light for a high-energy collision.

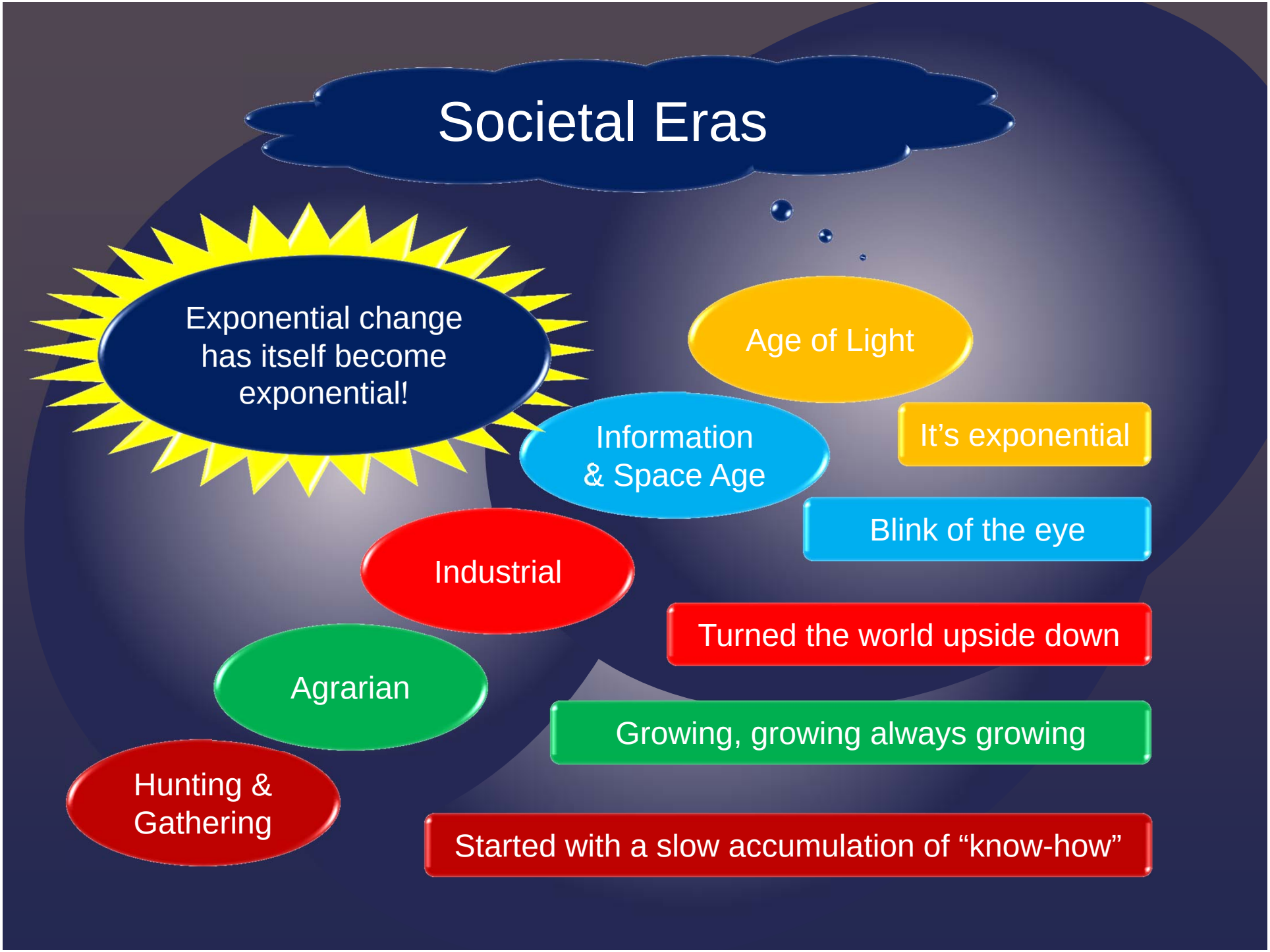
CERN researchers repeated such collisions 1.1 quadrillion times, analyzing in detail the fragments produced by the impacts. These include the new Higgs particles, which they identified with 99.99998 certainty.

The pursuit of the mysteries of the universe is certain to go on. Experiments with the newly found subatomic particle will lead to the elucidation of its properties & may crack open a new cosmic theory.

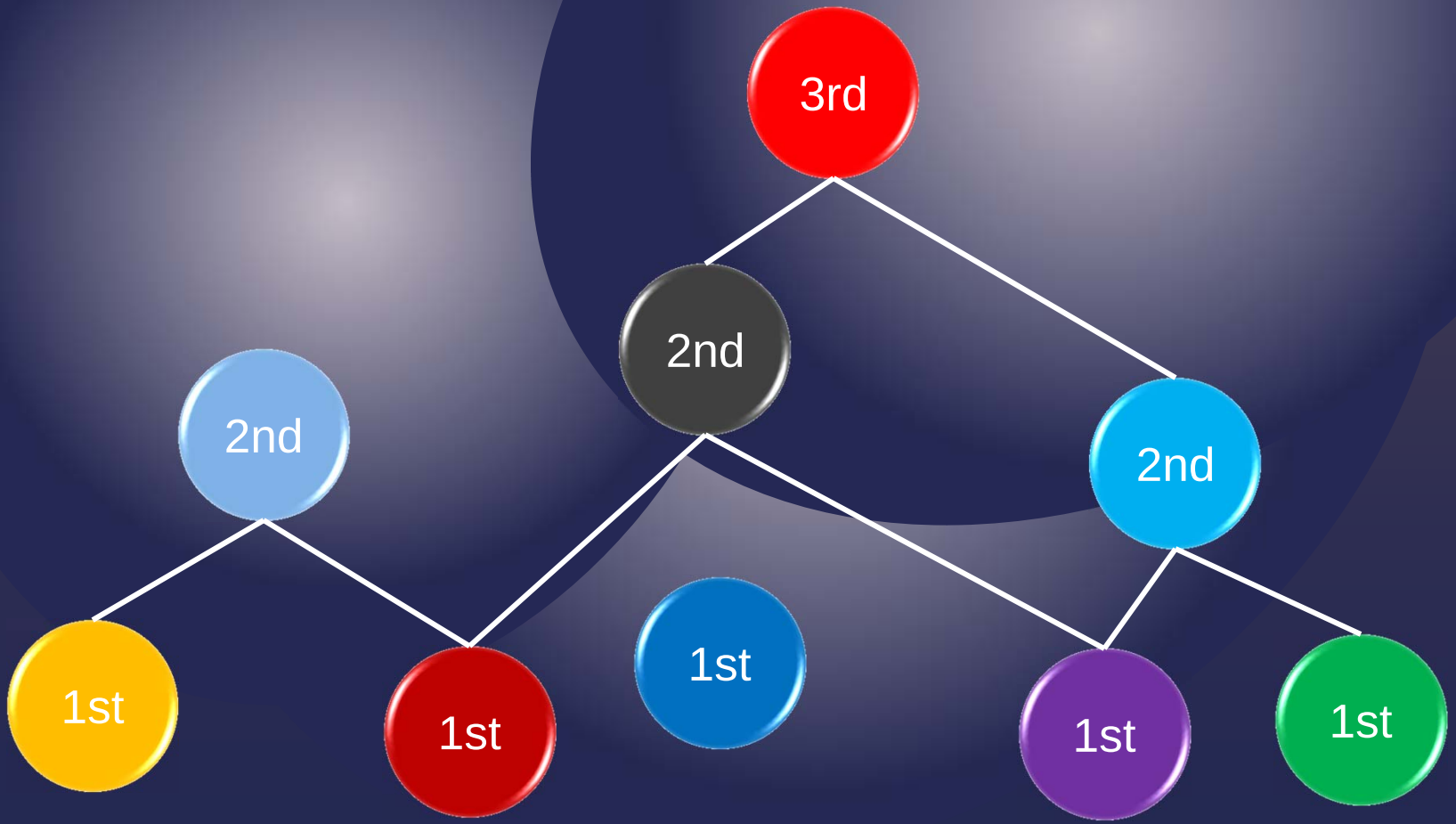
Current theory can account for only 4 percent of the energy that lets matter, and the universe, itself, exist!


Society's Blind Spot!
Viewing tomorrow's issues through the lens of yesterday
Farm
Factory
Ideas!
Agrarian
Industrial
Knowledge
…."FROM" the Future
Plan!


Traditional “Visible” Economy
Extract
Harvest
Add Value
(Manufacturing)
Raw
Materials
Primary
Processing
Fabrication
$
$
$


Societal Eras
Exponential change has itself become exponential!
Age of Light
It's exponential
Information & Space Age
Blink of the eye
Industrial
Turned the world upside down
Agrarian
Growing, growing always growing
Hunting & Gathering
Started with a slow accumulation of "know-how"

1st, 2nd, & 3rd Order Concepts

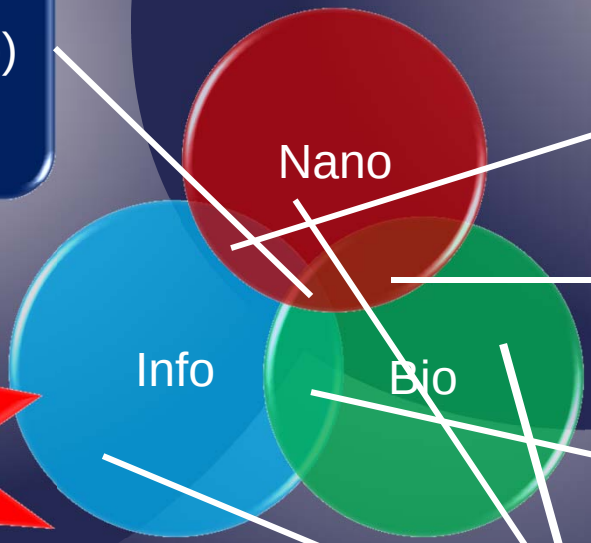


Invisible Economy

Transformation!

Nano Stethoscope
Cancer Assassin (Robo)
Programmable Tattoo

Self-Replicating



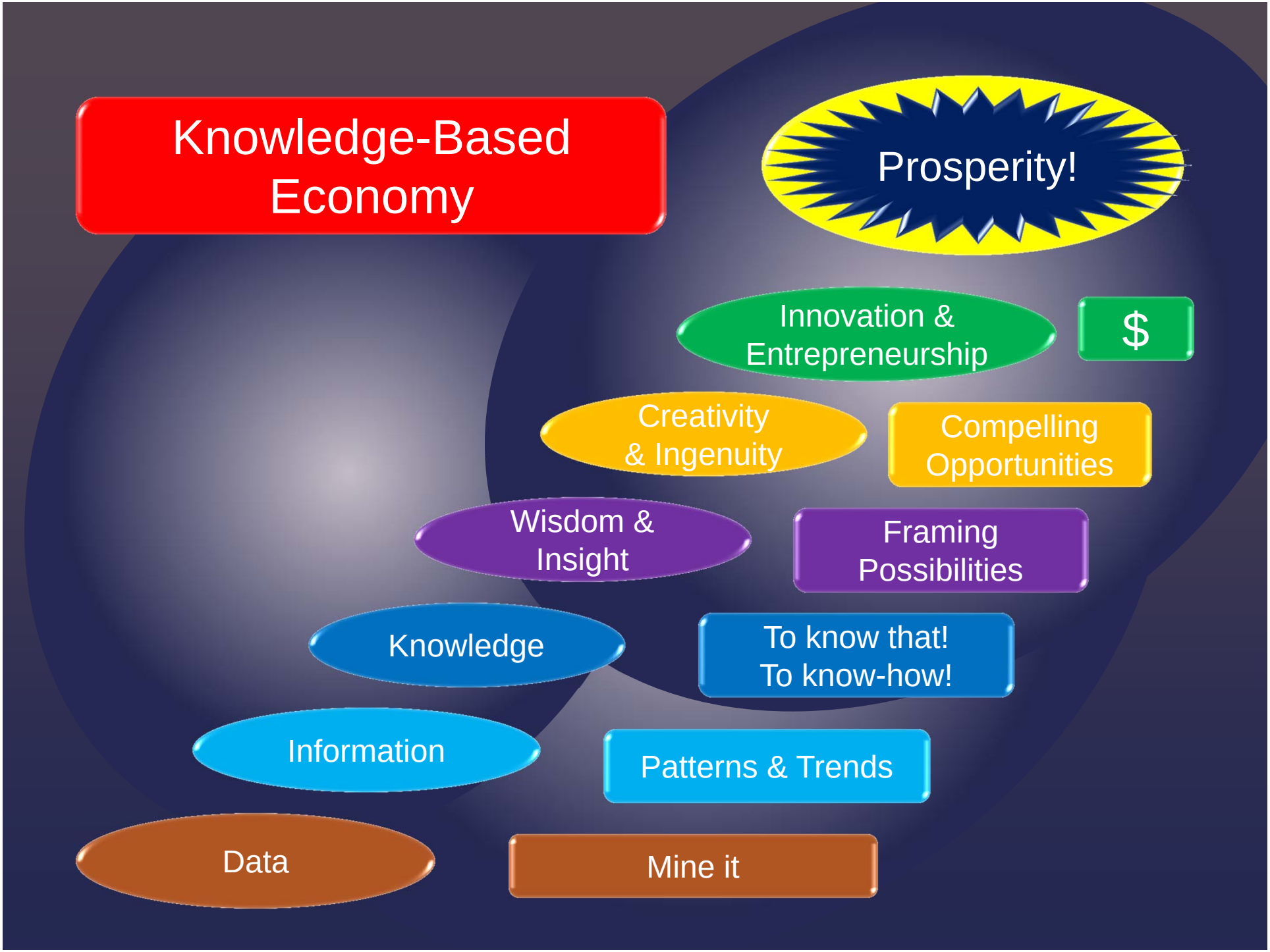
Integration

Smart Dust

Bio Steel

Synthetic Biology

Information


Knowledge-Based Economy
Prosperity!
Innovation & Entrepreneurship
$
Creativity & Ingenuity
Compelling Opportunities
Wisdom & Insight
Framing Possibilities
Knowledge
To know that! To know-how!
Information
Patterns & Trends
Data
Mine it

Hormel Institute!

Austin, Minnesota

Hormel Foundation -- University of Minnesota -- Mayo Clinic

Cancer Research!

Bonding for Expansion!

IBM

Blue Gene Super Computer!

120 New Jobs!

Data Mining For New Cash Cows!

"….if you are not focused on finding and discovering the hidden value in your company, the invisible goldmine that will give birth to many new cash cows , but instead are milking the old cash cows, you will end up floundering to the point that your customers and consumers will simply move on to a more relevant company."

Danial Burrus,
TECHTrends, 7-12

MIT Establishes Research Center to Harness “Big Data”!

Big Data!

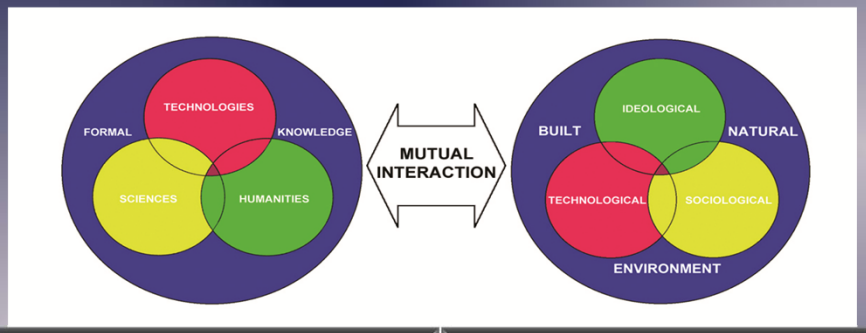
Big Machine?

MIT announces a research initiative to tame Big Data, sets of information that are so complex and fast-growing that they defy traditional methods of analysis. Examples are the data involved in financial transactions of banks or collected by social networks.

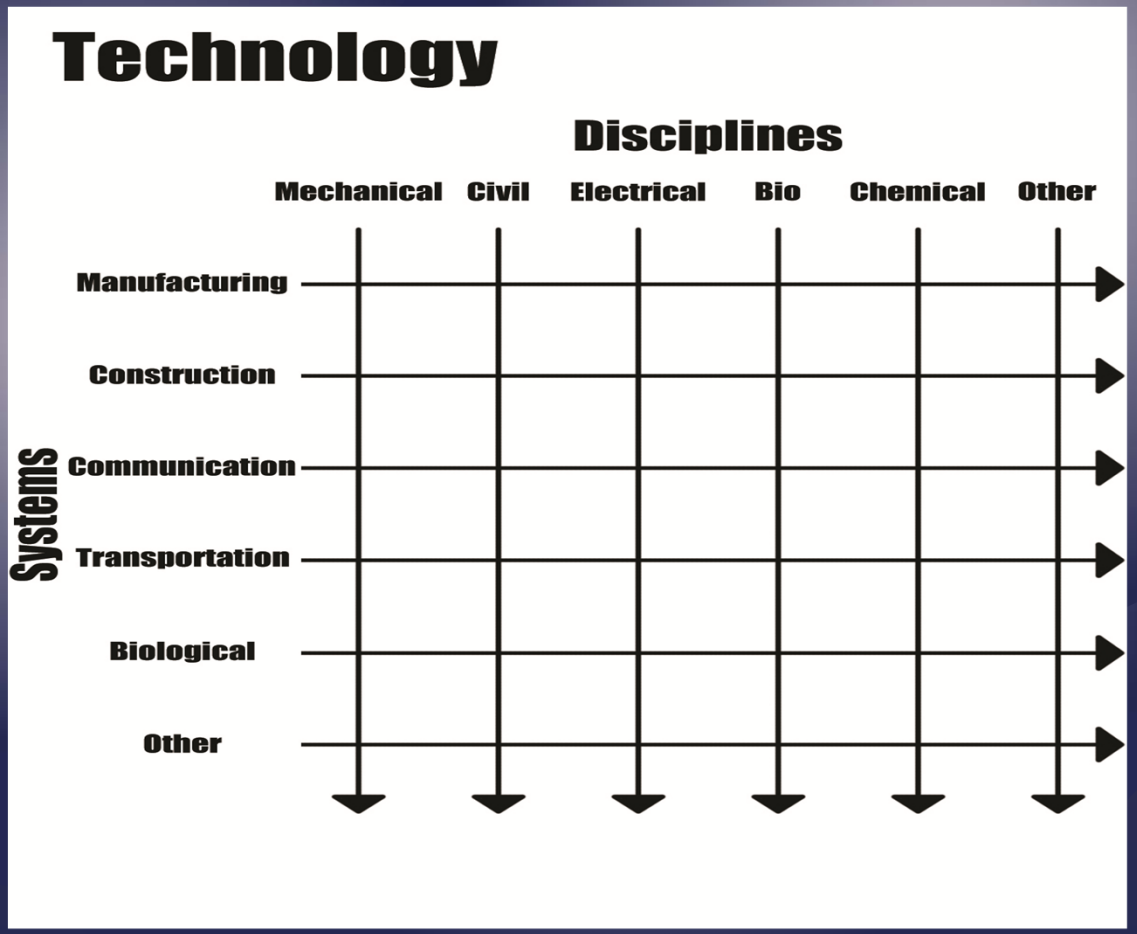
Key to the effort will be the creation of the Intel Science & Technology Center for Big Data, which will reside in MIT's Computer Science & Artificial Intelligence Laboratory. Intel will contribute $2.5 million a year to the research center and will work with a number of companies.

With the right tools, they propose to make sense of the data and use it to solve any number of pressing social problems. They also intend to address privacy concerns raised by massive data sets. Professor Sam Madden states, "we need to look at what are the technical solutions to keeping data private and securing data , and then work with the policy makers to help them develop policies to protect the privacy of data."

Structuring Knowledge: Disciplines vs Systems!



The Grand Matrix!



Process

Scientific Method

State the question
Develop hypothesis
Design & conduct the experiment
Observe/gather data/ draw inferences
Build theory/state law
Replicate research

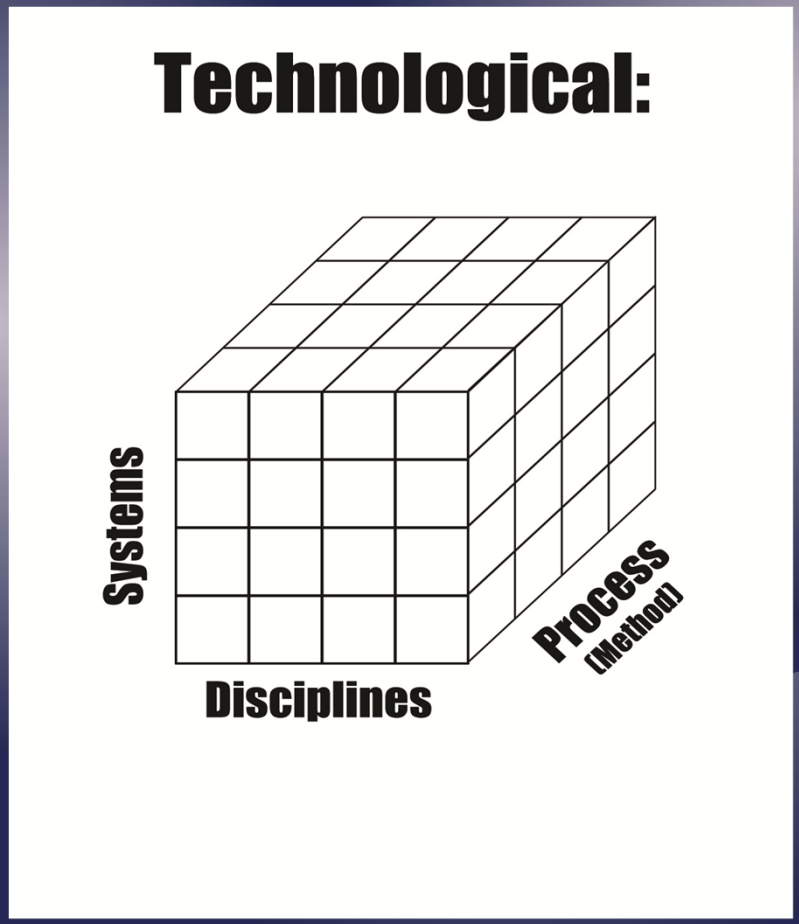
"to know that!"

Technological Design

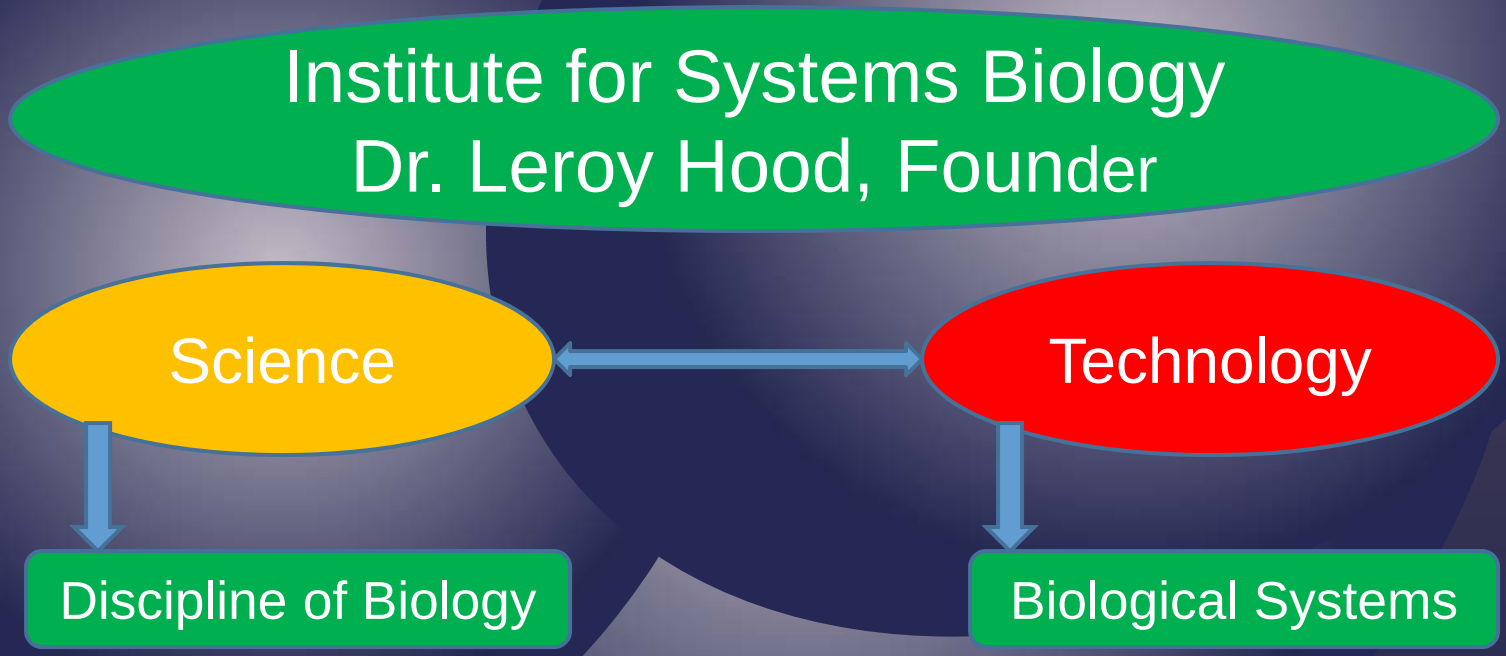
Identify want or need
Imagine alternatives
Design/create/develop/ engineer (verb)/ Invent/Innovate
Prototype/refine
Produce Solutions
Patent/license/copyright

"to know-how!"

The Magic Cube!



Education Blind Spot!



Institute For Systems Biology
Dr. Leroy Hood, Founder

Founded 10 Years Ago, Seattle, WA
Over 300 Researchers, with Support Staff

Published over 600 Refereed Research Papers
Dozens of Patents in Such Areas as:

- +Automated DNA Sequencing
- +Automated DNA Synthesizing
- +Automated Protein Sequencing
- +Automated Protein Synthesizing

Founded 14 Companies, Including:

- +Applied Biological Systems, $4 Billion Company
- +Amgen, $20 Billion Company

Fostering the Future of Predictive, Preventative , Personalized and Participatory Health Care!

Innovation Blowback!

John Hagel & John Seely Brown

Examples!

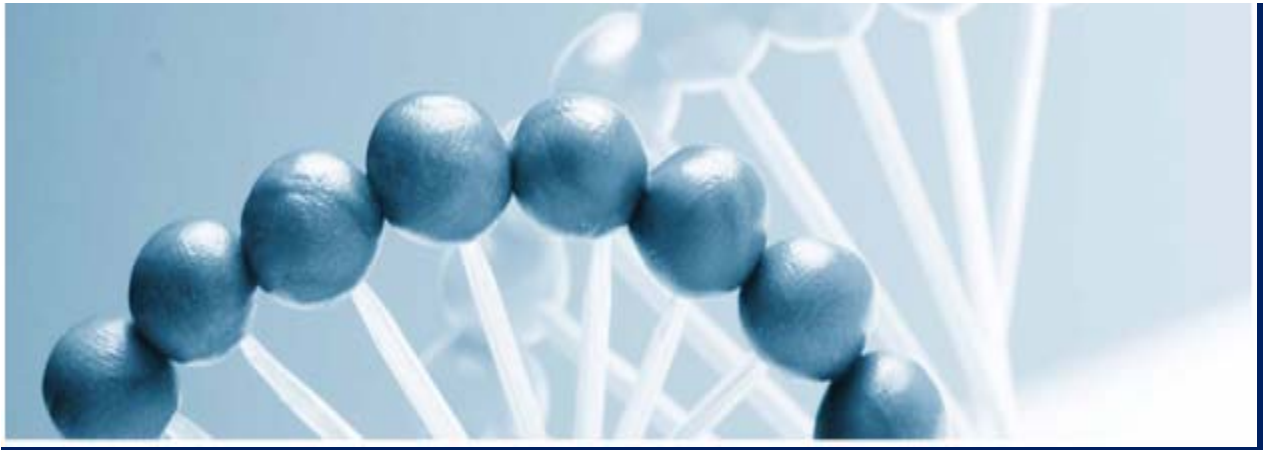
NOKIA, new U.S. phone features based on “shared phone” use in Ghana.

MICROSOFT: “dumb” phone apps to access S. Africa Web sites such as Twitter, Facebook, now provide low-cost cloud computing platform.

General Electric: ultraportable electrocardiograph developed for China/India is now sold in U.S. @80% markdown.

Proctor & Gamble: Mexican honey-based cold remedy finds profits in Europe.

NESTLE:: low-cost, low-fat noodles created for rural India is positioned as healthy alternative in Australia.



A Hand-Held DNA Sequencer for less than $900!

Oxford Nanopore Technologies, is entering the genetic sequencing race with a new portable device that will allow people to analyze DNA on the go!

“The USB stick is an absolute game changer”, Gordon Sanghera, CEO announced, “it’s plug-and-play, on-the-go DNA sequencing!”

This is NOT a HEMI!

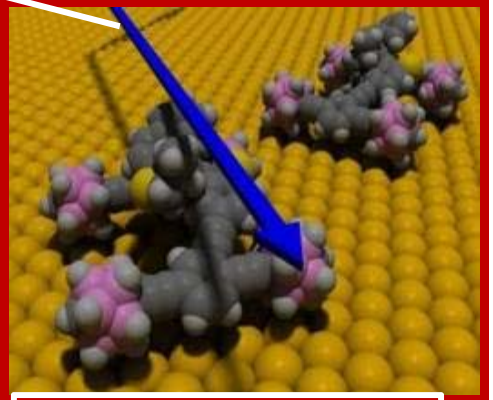
Physicists at Berkley labs have constructed what may be the world's smallest motor. The synthetic rotational nanomotor is about 300 times smaller than the diameter of a human hair,& future versions may be up to five times smaller.

The tiny motor was constructed by attaching a gold paddle-shaped rotor (between 100 & 3000 nanometers long) to a carbon nanotube shaft that is less than 10 nanometers in diameter. The carbon bonds that connect the components are virtually frictionless, so the parts never wear out.

It can hold up under the most extreme environments & is unaffected by radiation. Although the developers have measured its speed at 33,000 cycles per second, they believe it is capable of reaching up to a billion cycles per second.

Blood pressure monitors, environmental sensors, tire sensors, and PDA are only a few of the potential application for the tiny motors. (*TECHNOTrends,* 7-04)

Motor, on single molecule, car



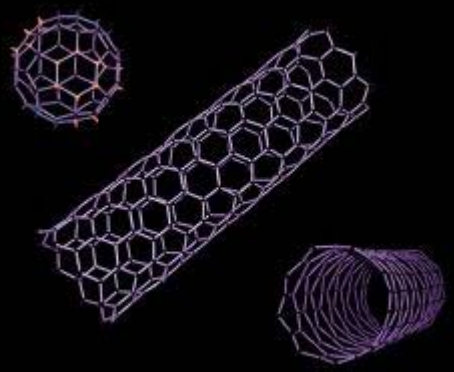
Dodge RAM!

The Light Mill!

Lawrence Berkley Labs have built a nanoscale motor that can drive a disk 4000 times bigger than itself. It is powered by the “plasmonic effect” & could be used to manipulate ultra-small objects like DNA & for powering nanoelectromechanical machines, (NEMS),

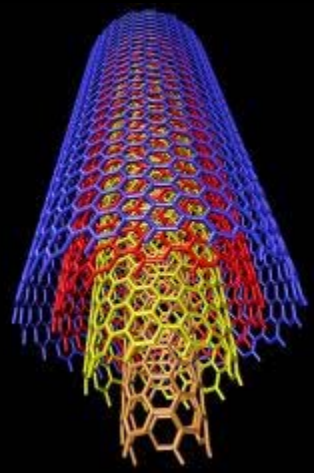
At mearly 100 NM across the motor looks like a tiny windmill, inspiring the researchers to dub it the “Light Mill”.

Nanotubes!



Fullerene technology, created by expanding the capabilities of the “Bucky Ball”

Multi-Wall Nanotubes



A nanotube “wire” one sixth the thickness of a human hair could suspend a fully loaded semi-trailer!

Self-Sculpting Sand!

No longer suppressed….

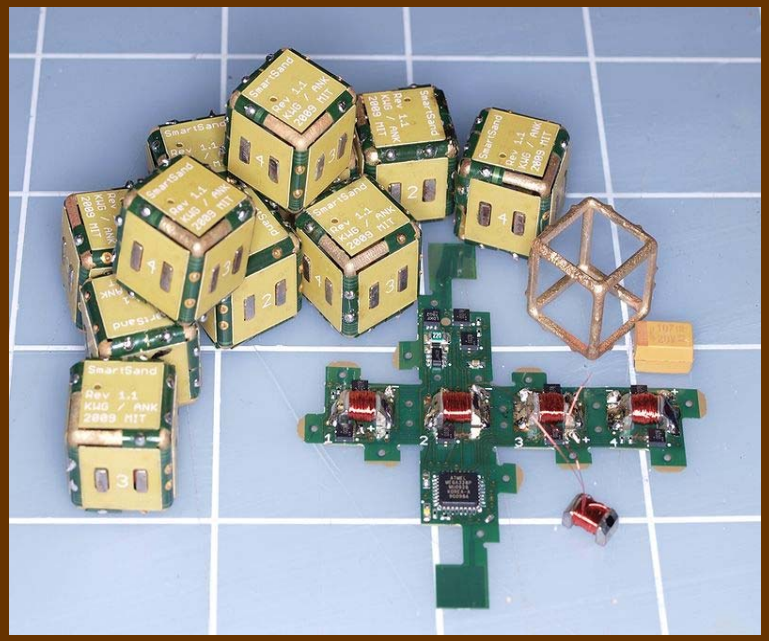
…it can form itself!

Smart Sand!

MIT

A programmable matter system is capable of forming shapes and creating objects through self-disassembly. Each of the disassembly phases is dependent upon a distributed, localized message passing algorithms executing each module.

Given a bag of Smart Sand, the user conveys the desired object to the modules and then begins shaking the bag. As the particles in the bag come in contact & exchange information, they decide when to bond to their neighbors.



After this selective bonding process, the user opens the bag, grabs the object, brushes off the extra material, and uses the object for the task at hand.

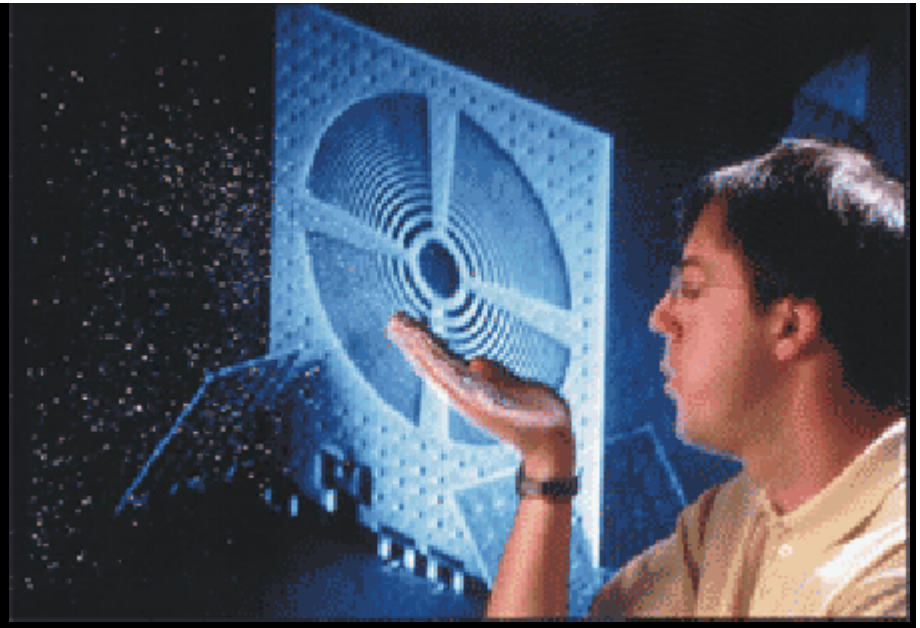
After the user is done with the object, it is tossed back in the bag where it disintegrates so that the modules can be used indefinitely!

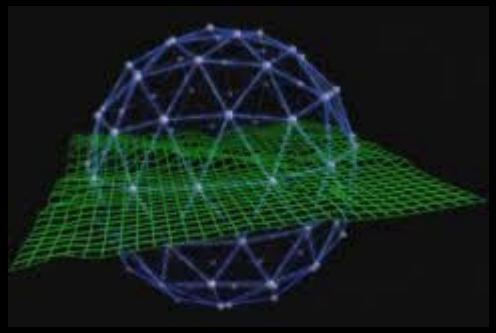
SMART DUST

B. Boser, D. Culler, J. Kahn, K. Pister

Berkeley Sensor & Actuator Center
Electrical Engineering & Computer Sciences
UC Berkeley

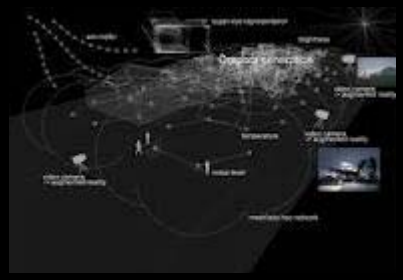
SMART DUST



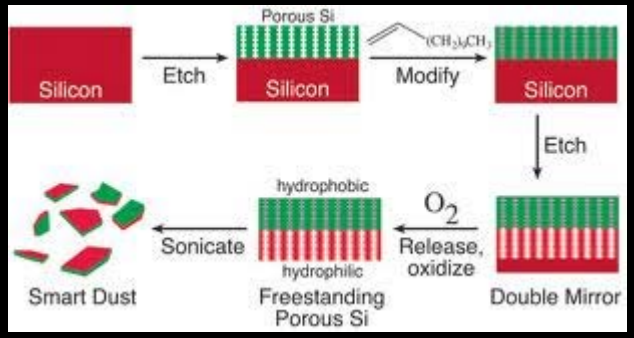


Control Grid

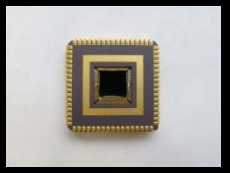
Development Process



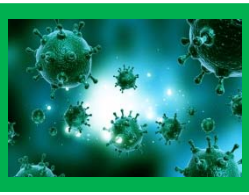
Sensor Systems



Particle



Synthetic Biology!

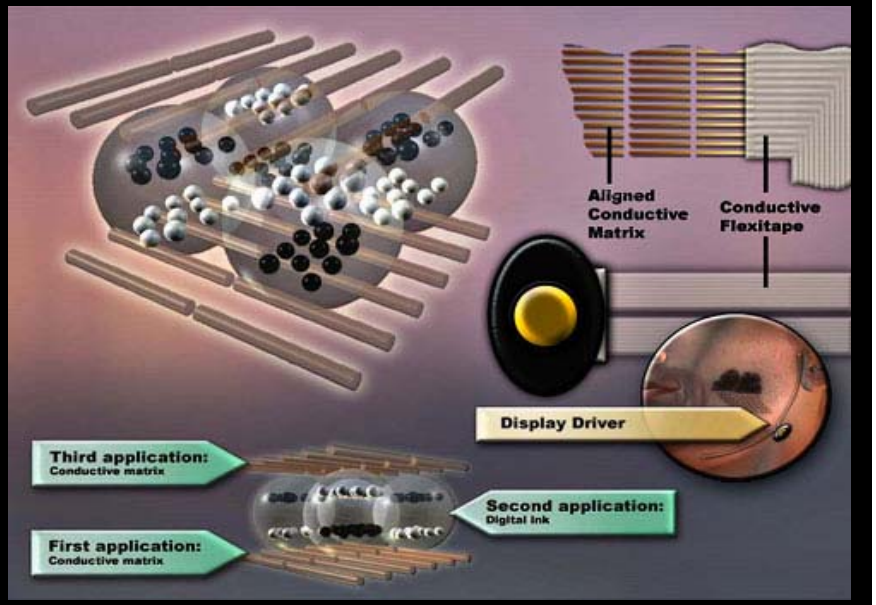


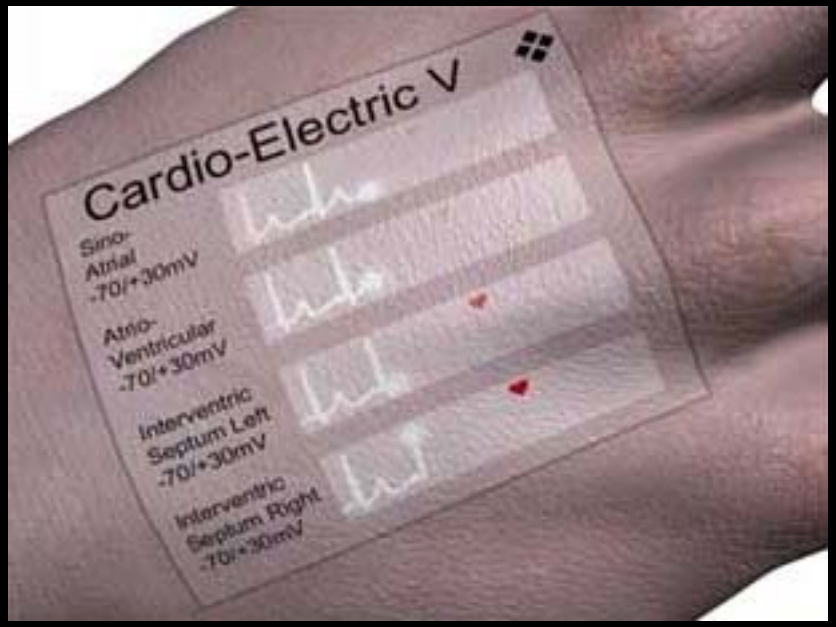
By programming cells as if they were computers, synthetic biologists are finding ways to fabricate medications & dispose of radioactive waste. Ron Weiss, Princeton University, relates that this emerging field could include “tissue engineering, molecular fabrication of biomaterials & nanostructures , synthesis of pharmaceutical products and bio-sensing….

What distinguishes synthetic biology from its post-genomic laboratory cousins – genetic modification , grounded in conventional biology & biochemistry, or nanotechnology, grounded in carbon chemistry – is that synthetic biology looks more like computer systems engineering. Its focus is the genetic circuitry that governs particular cellular and intercellular behaviors, explains Weiss…

Cells also exchange signals among themselves: They communication back & forth to coordinate responses to inputs from their environment. So synthetic biologists are simultaneously designing genetic regulatory & information-processing networks that exploit the power of multicellular reactions….” (David Ollier Weber, Health Forum Publications Archives).

Programmable Tattoo!





Is Origami the Secret of Tech?

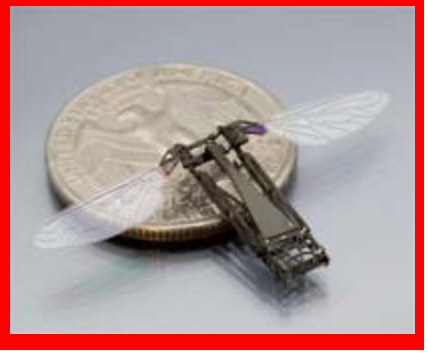
Professors Demaine & Rus, MIT, & Professor Wood, Harvard, work collaboratively on folding technology utilizing biologically inspired engineering. Flowers, leaves, wings, proteins, eyelids, ears, DNA, -- all are created by folding.

Developers are looking at how materials and molecules wrinkle, drape, flex, and crease, using folding to design everything from robots to cancer drugs, from airbags to mirrors on satellite telescopes.

Origami folding is used to create a fabric of densely layered nanotubes that can generate power from body heat!

RoboBee Drone!

It takes a week to assemble a RoboBee by hand – a fraction of a second by pop-up folding fabrication!



Researchers are also working on the puzzle of how proteins fold. The building blocks of human cells, proteins are strands of amino acids – they are extruded, spaghetti-like, from cellular machines called ribosomes.

Biologists still don't fully understand what determines the intricate shapes that the long molecules snap into once they're completed.

It's a question with huge ramifications – Alzheimer's, mad cow, and various cancers are thought to be caused by protein misfolding.

What do you need to know?

The world’s largest library catalog, is operated by Online Computer Library Center, (OCLC).

WorldCat catalogs records from more than 72,000 libraries in 171 countries.

Narrative Science!

Your tweets are why the next Walter Cronkite will be a robot!

Of all the technology companies disrupting the field of journalism, none hits home quite like Narrative Science. The Chicago based company which is up for a Moxie Award, has developed an algorithm that can mimic human writing that few experts can tell which was written by the robot.

"We can pull information from Twitter conversations and source data and generate stories."

Stuart Frankel, CEO

"Good journalism isn't about writing like a human. It is about trust. And as trust in conventional authoritative sources continues to erode , robots may be lying in the wait to pick up the slack."

Innovative Enterprises!

IBM: Tops the list in patents ….approaches 5,000 a year!

Apple: CEO was the face of the company!

Microsoft: The business model to beat!

3M: Incredible innovator and product generator!

3M

"3M produces about 1,000 new products a year"
Susan Feyder, *Mpls. StarTribune* 5-6-12

During the last 5 years, that the $30 billion company made 77 acquisitions, ….it's research & development accounted for 32% of its revenue (last year) and is on pace to generate 40% of its sales from new product sales by 2016!

Eric Wieffering, *StarTribune*, 2-12-12

Paul Hunt, Hunt Utilities Group

Edgar Heteen, Polaris/Artic Cat/May Industries/ASV

Ronald. D. Offutt, Lamp Wesson, RDO

Bob Cervenka, Phillips Origin

Andy Wells, Wells Technology

And…..thousands more….!

Innovative Entrepreneurs!

Wells Technology

Andy Wells, Founded 22 Yrs ago on $1300

Economic!

Education!

Inclusion!

Wells Academy!

Transformation Personified!

Knowledge-based Manufacturing!

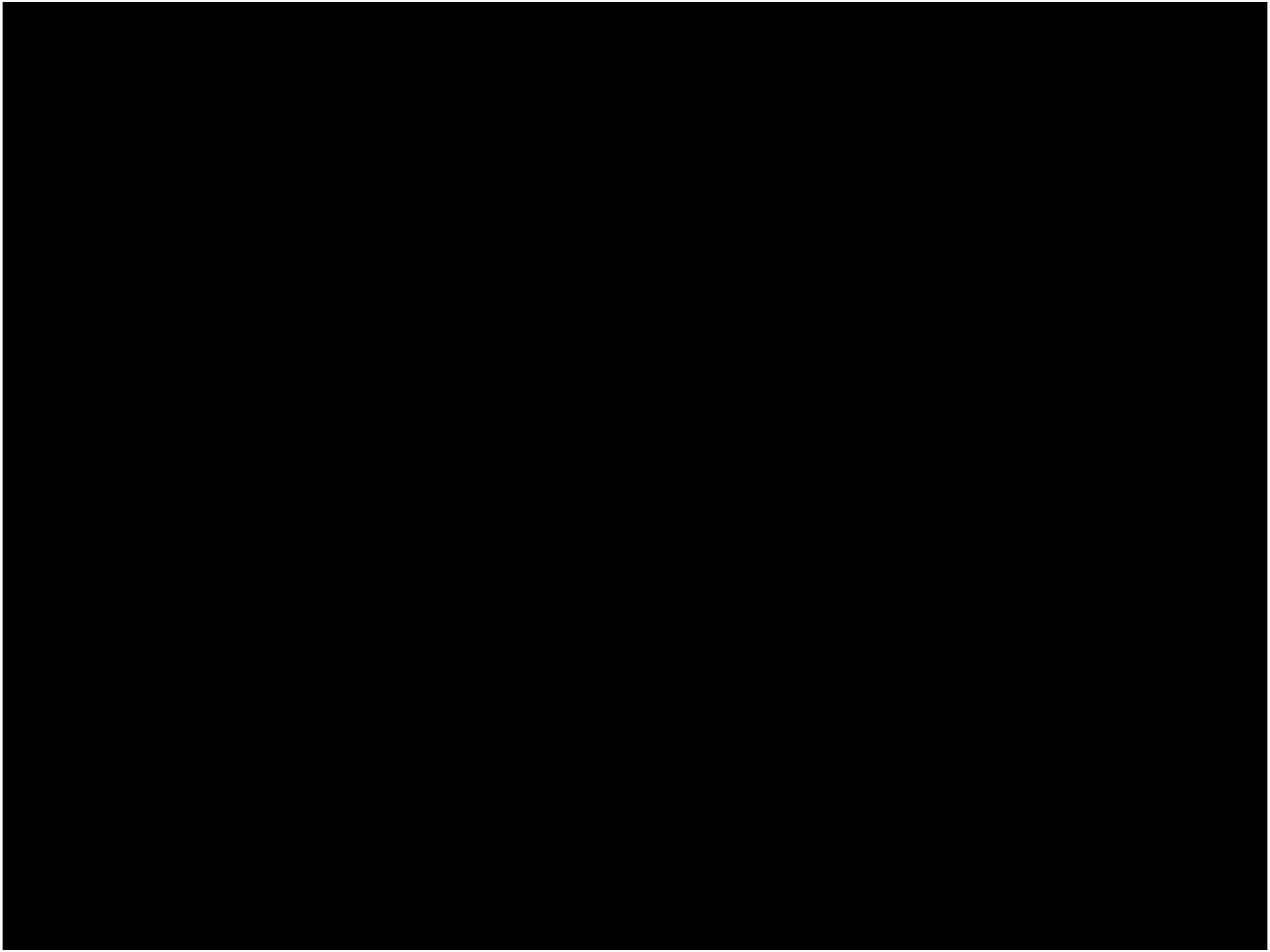
Design on the fly!

15,000 Products!

Sales in 54 Countries!

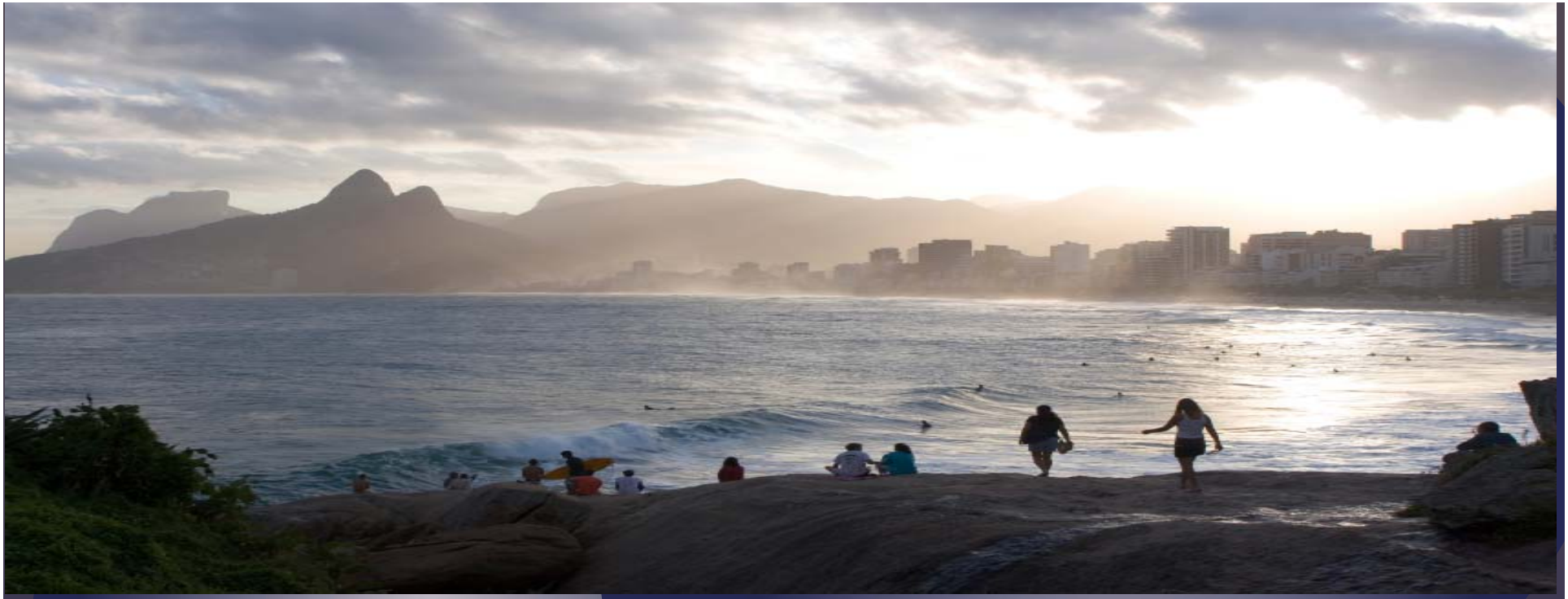
28% Growth per Year!

$83,000,000!



Exceeding Expectations!

Knock Their Socks Off!



I must hurry, for there they go,
……and, I am their leader!

Innovation “cubed” comes bouncing into our lives…..

We make sense out of it….

Time to start all over again…. !

Thank You!