

Revolutionary Concepts for Future Aerospace Endeavors

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***Creativity and imagination,
inspired by curiosity and the eternal quest for knowledge,
are necessities, not luxuries.***

- Robert Cassanova



NIAC Charter

NASA Institute for Advanced Concepts

- **Focus on Revolutionary Advanced Concepts for Architectures & Systems for NASA**

Operating Environment –

Enabling technologies may not be available

Science may not be totally understood

Aimed 10 to 40 years into the future

Actively seek credible, technical controversy

NIAC Charter

NASA Institute for Advanced Concepts

- Operate as an Independent, Technical Assessment Organization for NASA

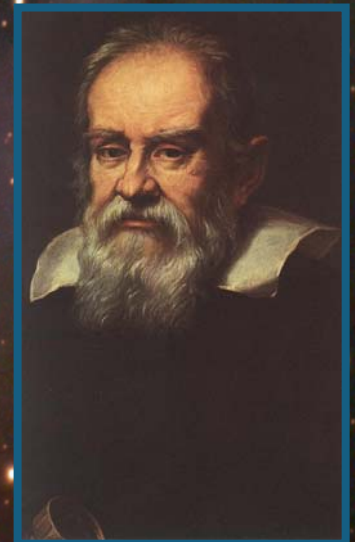
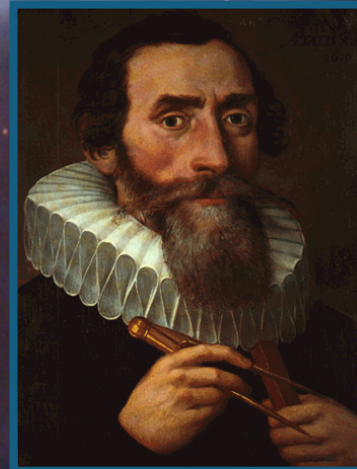
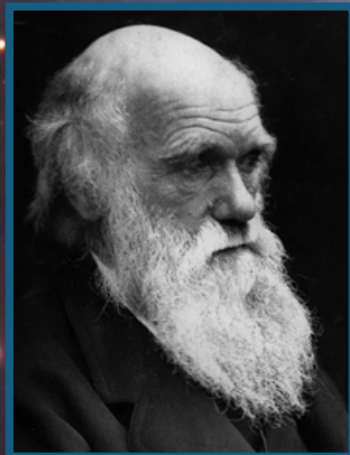
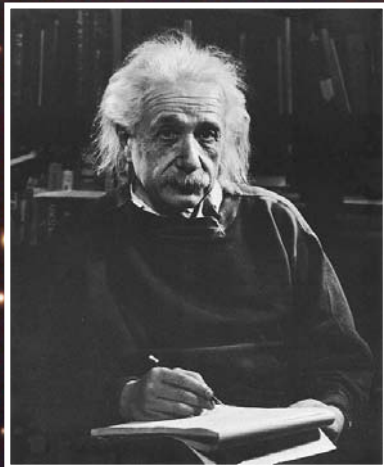
Function as a Virtual Institute over the Internet
(<http://www.niac.usra.edu>)

**Use Succinct Technical Proposal Requirements
and Peer Review**



What can we learn from the
REVOLUTIONARIES in art and sciences?

Creative People
Environment
Visionary Process



What is *Revolutionary*?

- The genius is in the generalities, and not the details

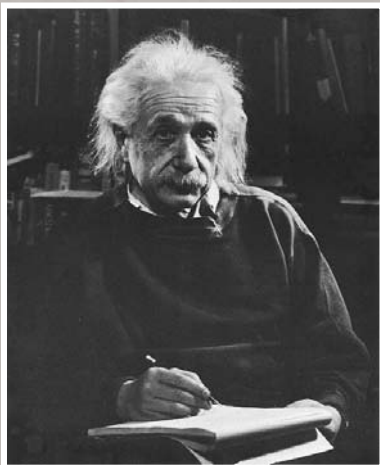
Einstein's Theory of Relativity

What is Revolutionary?

Albert Einstein (1879-1955)

“Imagination is more important than knowledge.”

“The most beautiful thing we can experience is the mysterious. It is the source of all true art and science.”



Für "Lehrbuch der Physik"
Sommer 1948

Äquivalenz von Masse und Energie ($E = mc^2$)

In der Physik gibt es zwei voneinander unabhängige Größen, die strenge Gültigkeit beanspruchen, nämlich die Erhaltung der Energie und die Erhaltung der Masse.

Im 19. Jahrhundert wurde die Energie, welche schon von Leibniz als gültig vermutet wurde, entwickelt und wesentlich als eine Folge eines Satzes der Mechanik, nämlich, dessen Masse zwischen v und h schwankt, h die Geschwindigkeit.

Es muss die Masse (Wicht) nun h höher als als im tiefsten Punkte C der Bahn. In C ist diese Höhe verloren gegangen, dafür aber hat die Masse hier eine

“The important thing is not to stop questioning.”

“I have no special talents. I am only passionately curious.”

What is *Revolutionary*?

- The genius is in the generalities, and not the details

Einstein's Theory of Relativity

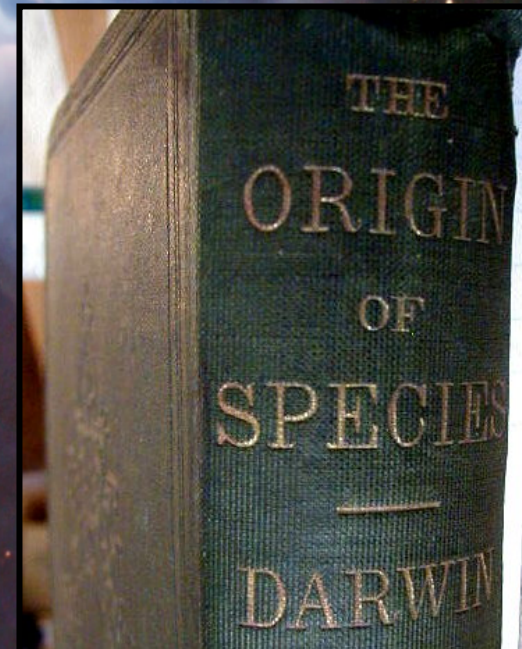
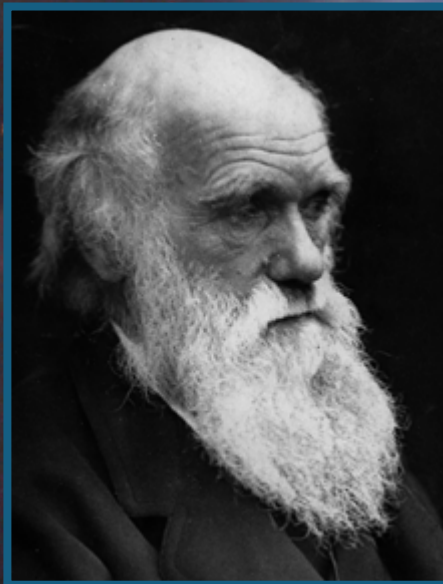
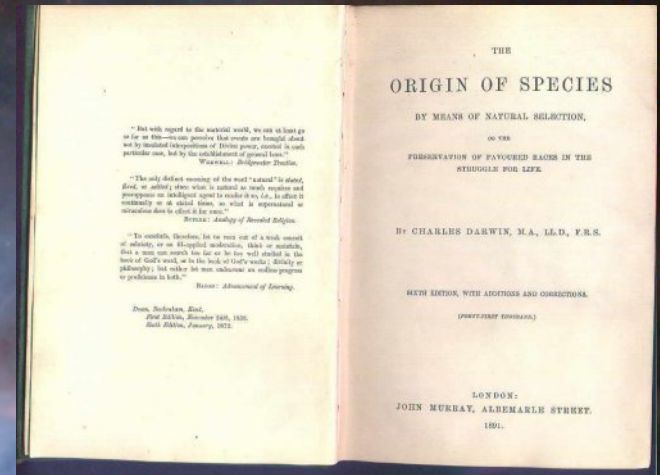
Darwin's Origin of Species

What is *Revolutionary*?

Charles Darwin (1809 - 1882)

"I love fools' experiments. I am always making them."

"A man who dares to waste one hour of time has not discovered the value of life."



What is *Revolutionary*?

- The genius is in the generalities, and not the details

Einstein's Theory of Relativity

Darwin's origin of species

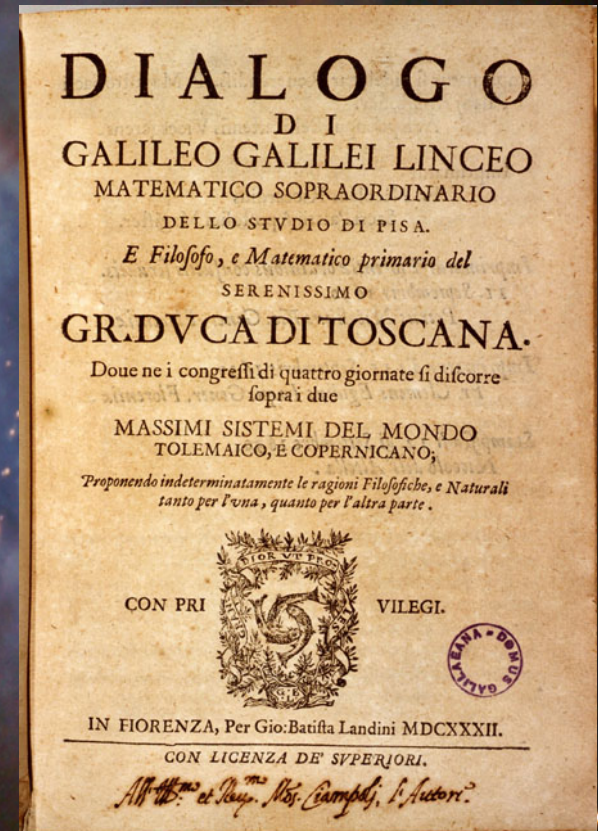
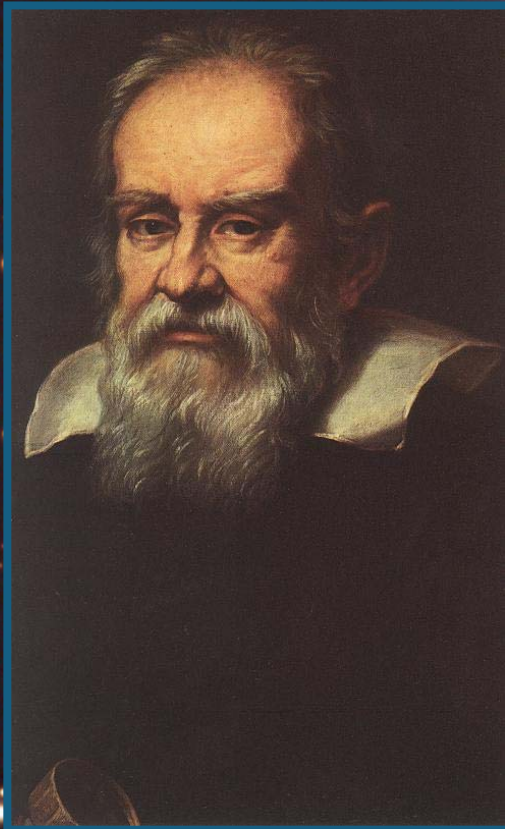
Galileo

What is *Revolutionary*?

Galileo Gallilei (1564-1642)

*“All truths are easy to understand once they are discovered;
the point is to discover them.”*

“Doubt is the father of invention.”



What is *Revolutionary*?

- The genius is in the generalities, and not the details

Einstein's Theory of Relativity

Darwin's origin of species

Galileo

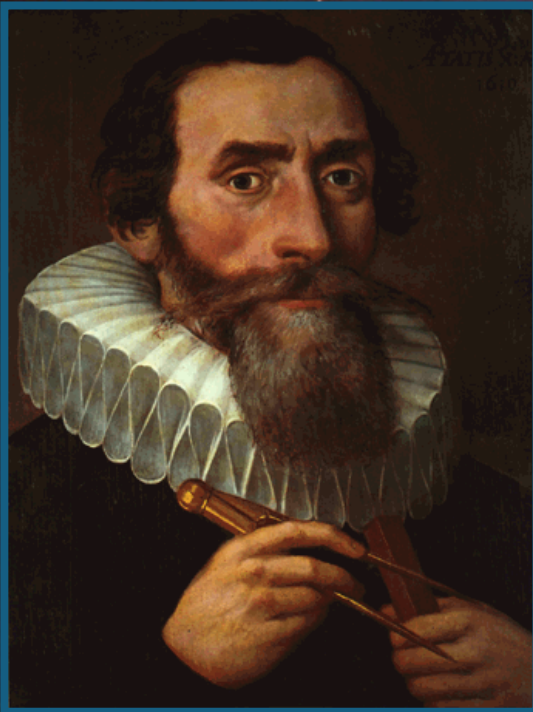
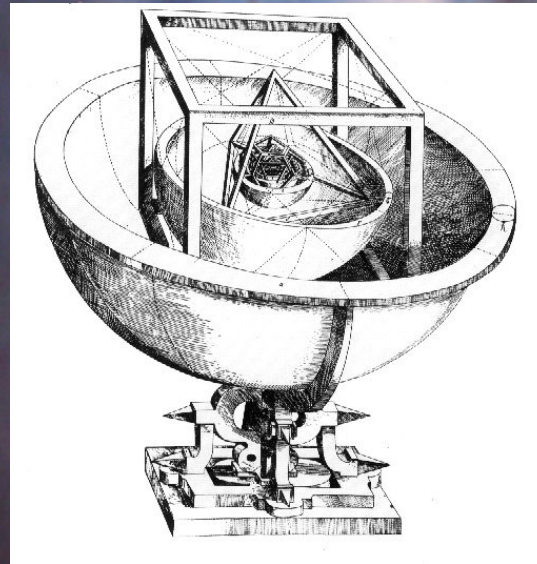
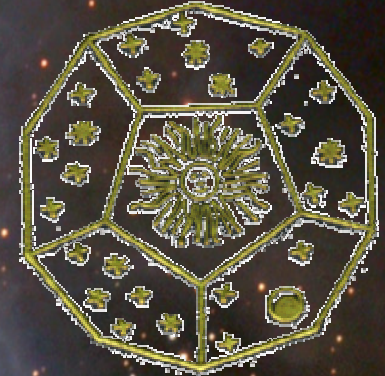
Kepler and many others

Genius is the ability to transcend experience.

What is *Revolutionary*?

Johannes Kepler (1571-1630)

"The diversity of the phenomena of nature is so great, and the treasures hidden in the heavens so rich, that the human mind shall never be lacking in fresh nourishment."



What is *Revolutionary*?

- The new idea illuminates a pathway towards a significant expansion of knowledge.

A sense of malfunction can lead to crisis as a prerequisite to revolution.

May be the basis for a new tradition of normal science.

New paradigms seem revolutionary only to those whose paradigms are affected by them.

What is *Revolutionary*?

Leonardo Da Vinci (1452 – 1519)

“You do ill if you praise, but worse if you censure, what you do not understand.”

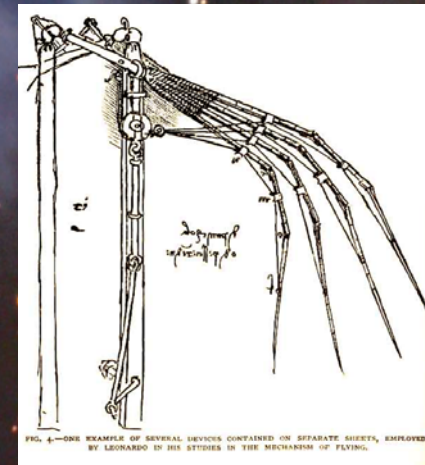
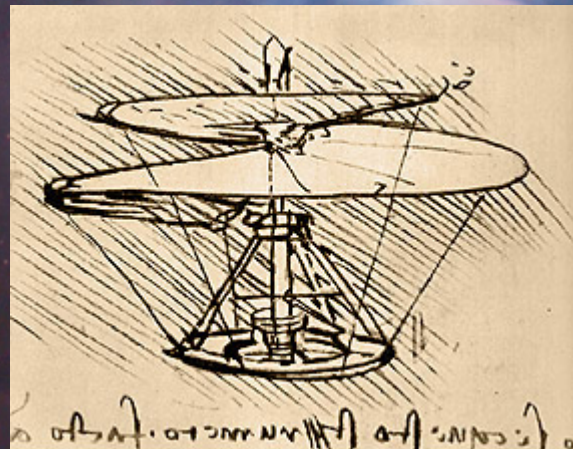
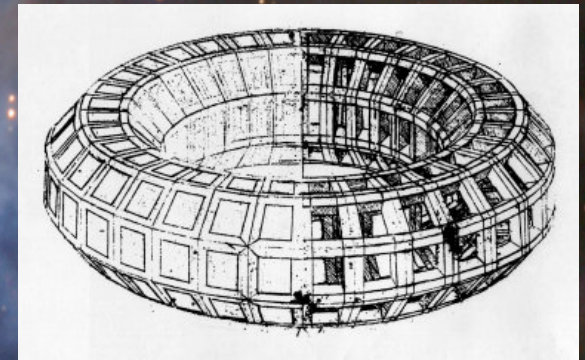
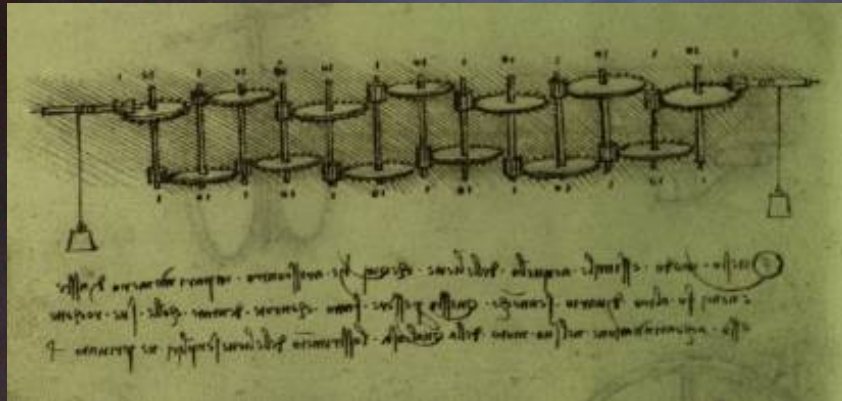


FIG. 4.—ONE EXAMPLE OF SEVERAL DEVICES CONTAINED ON SEPARATE SHEETS, EMPLOYED BY LEONARDO IN HIS STUDIES IN THE MECHANISM OF FLYING.

What is *Revolutionary*?

- It inspires others to produce useful science and further elaboration of the fundamental idea.

Imagination and visualization are, generally, the first step in learning, or creating, something radically new.

Revolutionary art and visionary physics are both investigations in the nature of reality.

“A mind, once stretched by a new idea, never regains its original dimensions.”
- Oliver Wendell Holmes (1809 - 1894)

Pablo Picasso (1881 – 1973)

What is *Revolutionary*?

“Every child is an artist. The problem is how to remain an artist once he grows up.”

“I paint objects as I think them, not as I see them.”

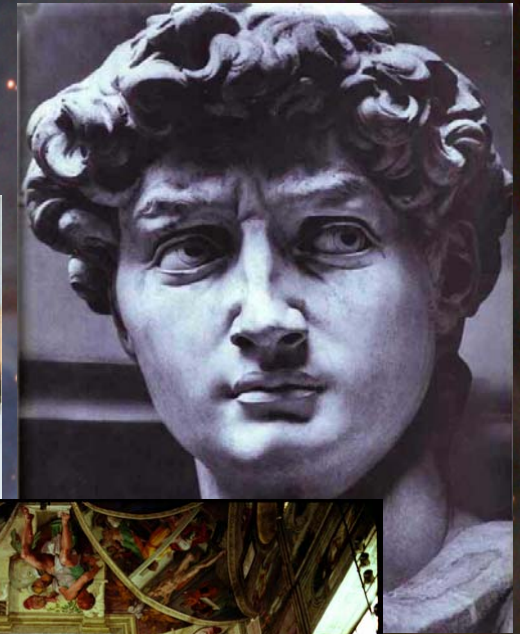
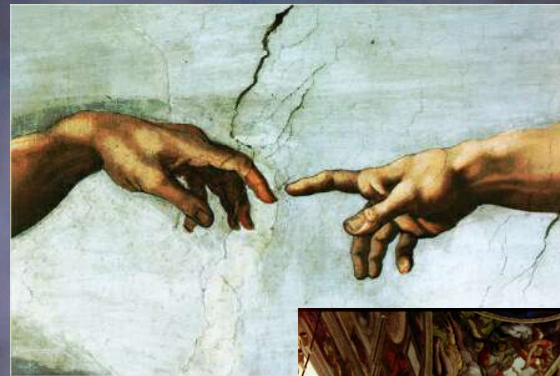
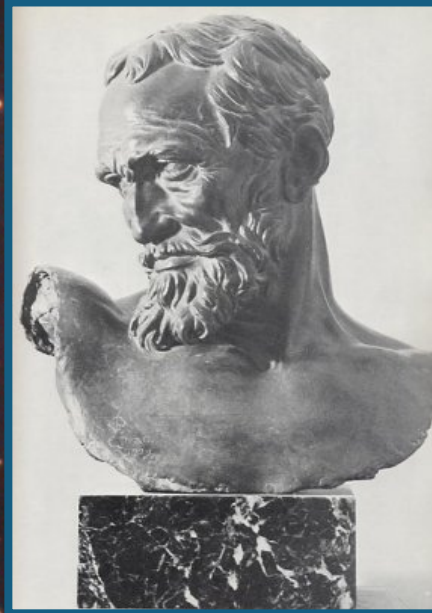


“I am always doing that which I can not do, in order that I may learn how to do it.”

What is *Revolutionary*?

Michelangelo Buonarroti (1475 – 1564)

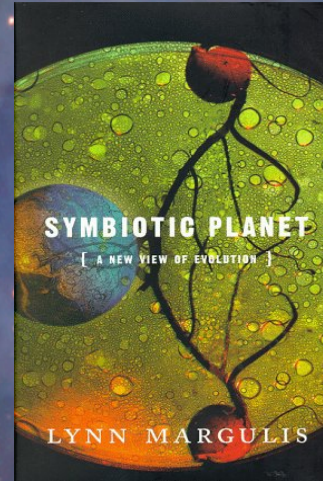
“A man paints with his brains and not with his hands.”



Dr. Lynn Margulis (1938 -)

What is *Revolutionary*?

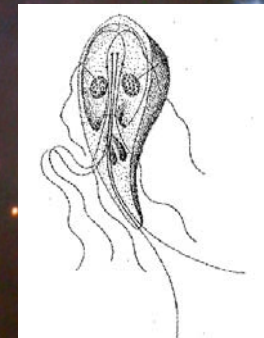
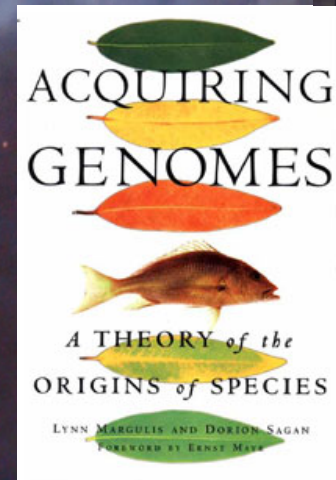
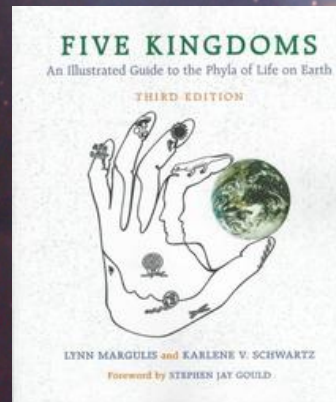
“Life produces fascinating “designs” in a similar way (to fractal geometry) by repeating the chemical cycles of its cellular growth and reproduction. Order is generated by nonconscious repetitious activities.”



Microcosm

Symbiosis

Gaia Theory



What is *Revolutionary*?

- It contributes to a major change in the framework of aerospace possibilities.

“Scientific research is an art form in this sense: it does not matter how you make your discovery, only that your claim is true and convincingly validated.”

- Edward O. Wilson



Robert H. Goddard (1882 – 1945)

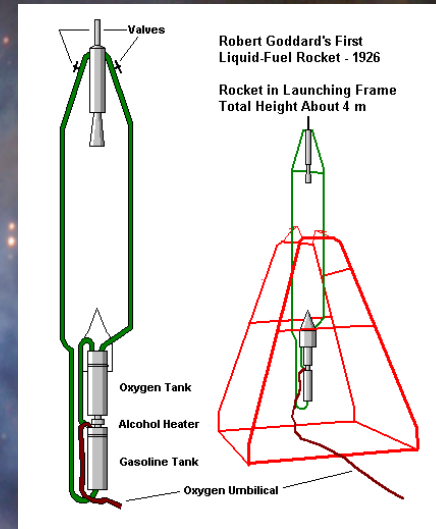
U.S. physicist & pioneer rocket engineer

What is *Revolutionary*?

“It is difficult to say what is impossible, for the dream of yesterday is the hope of today and the reality of tomorrow.”



“GODDARD’S WORK WAS VIRTUALLY IGNORED IN THE UNITED STATES AND MADE LITTLE IMPRESSION UPON GOVERNMENT OFFICIALS.”



What is *Revolutionary*?

- It triggers a transformation of intuition

Theories help to put INTUITION AND observations into context and to create a framework for further understanding

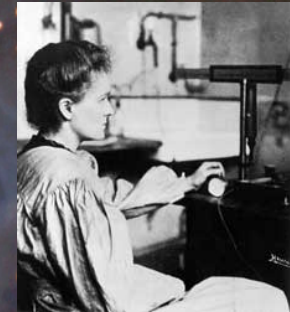
Scientific theories are the product of informed imagination

"Science is not a heartless pursuit of objective information. It is a creative human activity, its geniuses acting more as artists than information processors. Changes in theory are not simply the derivative results of new discoveries but the work of creative imagination influenced by contemporary social and political forces." - Stephen Jay Gould

What is *Revolutionary*?

Marie Curie (1867 – 1934)

“I am among those who think that science has great beauty. A scientist in his laboratory is not only a technician, he is also a child placed before natural phenomena which impress him like a fairy tale.”



“Nothing in life is to be feared, it is only to be understood.”

What is *Revolutionary*?

- **Revolutionary paradigm shifts are often simple, elegant, majestic, beautiful and are characterized by order and symmetry**

Creative paradigm changes are often the result of a non-linear, orthogonal imagination

Symmetry and order can be visually pleasing

Non-symmetry may be richer, more diverse and less boring

Aristotle (384 BC – 322 BC)

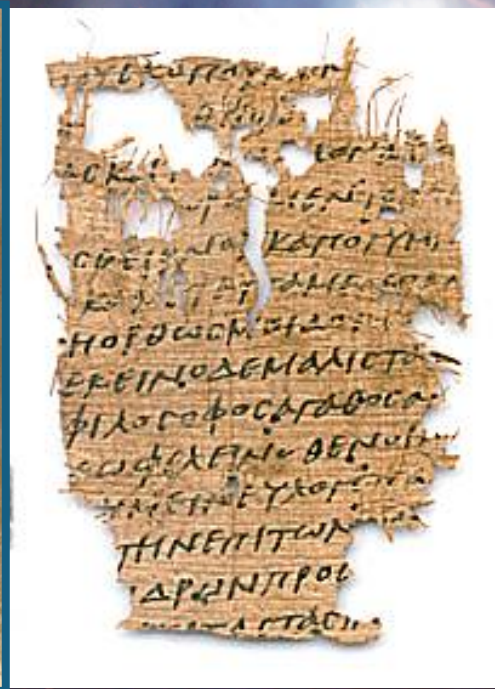
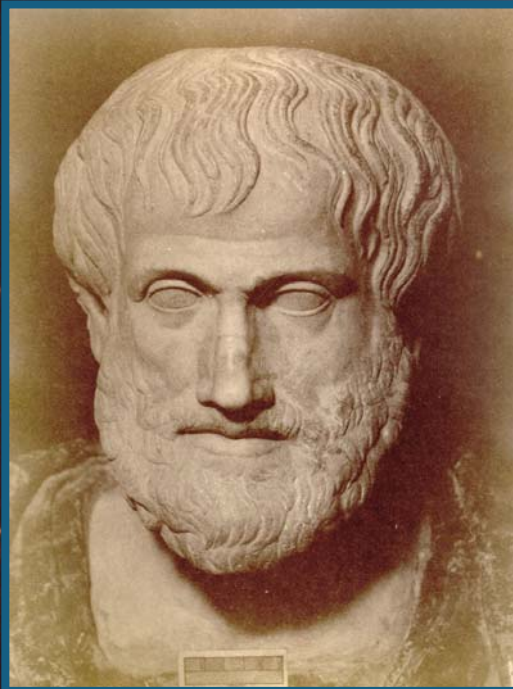
“All men by nature desire knowledge.”

“The mathematical sciences particularly exhibit order, symmetry, and limitation; and these are the greatest forms of the beautiful.”

Metaphysica, 3-1078b.

What is *Revolutionary*?

σκεπάσματος δέομαι,
ἰμάτιον δὲ σκέπασμα·
ἰματίου δέομαι. οὐ δέομαι
ποιητέον· ἰματίου δέομαι·
ἰμάτιον ποιητέον. καὶ τὸ
συμπέρασμα, ἰμάτιον
ποιητέον. πρᾶξις ἔστιν.

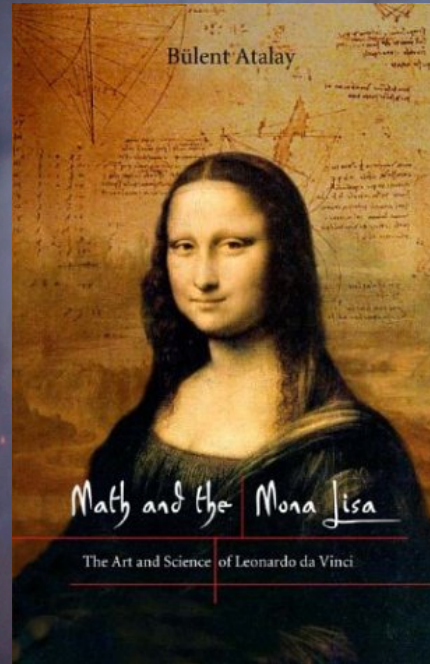


What is *Revolutionary*?

Bulent Atalay

"The artist is interested in interpreting the visible world, the scientist in explaining why and how nature operates."

Synergy between art, mathematics and science.



Logarithmic and Hyperbolic Spirals

Spiral Phyllotaxis



Photographs by
Robert Cassanova



“The universe is built on a plan the profound symmetry of which is somehow present in the inner structure of our intellect.”

Paul Valery 1871 – 1945
(Science/Symmetry -French writer)



Photograph by Robert Cassanova



Photograph by Robert Cassanova

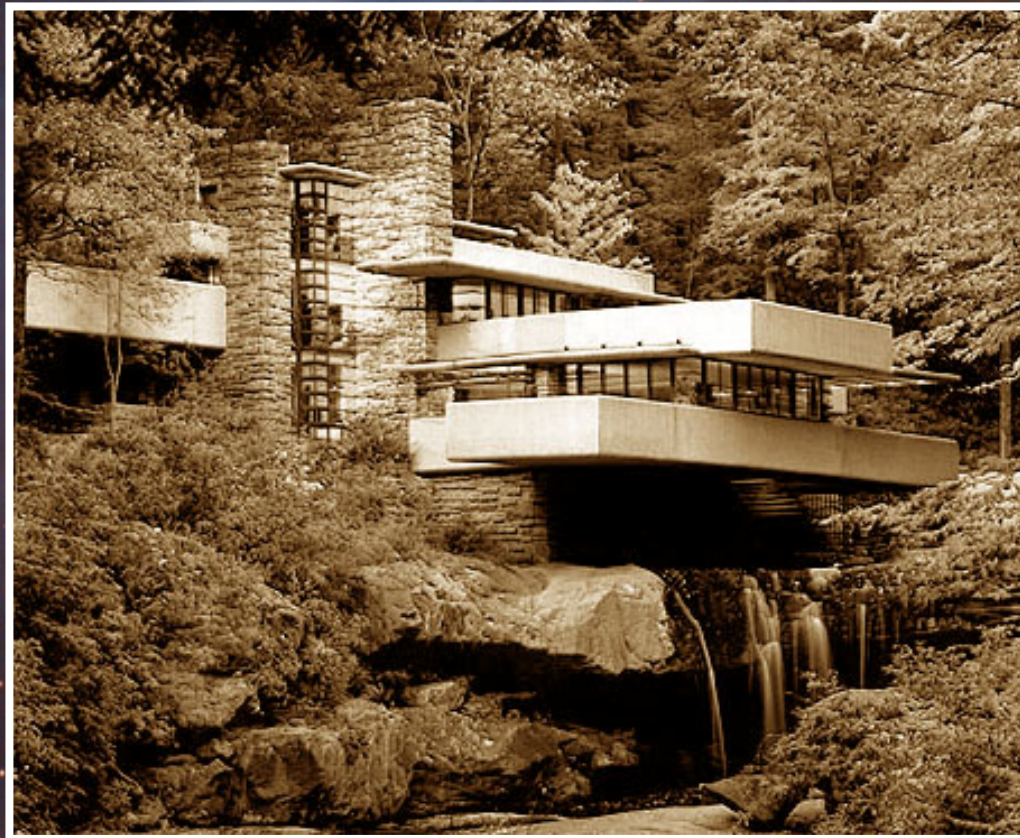
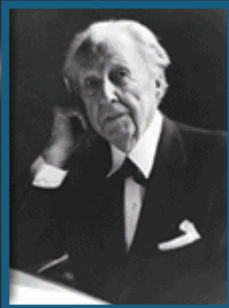
“Order is the shape upon which beauty depends.”

Pearl Buck (1892-1973)

What is *Revolutionary*?

Frank Lloyd Wright (1869 – 1959)

“An idea is salvation by imagination.”



Don't let your preoccupation with reality stifle your imagination.

- Robert Cassanova and Sharon Garrison



What is *Revolutionary*?

- The genius is in the generalities, and not the details
- The new idea creates a pathway that addresses a roadblock
- It inspires others to produce useful science and further elaboration of the fundamental idea
- It contributes to a major change in the framework of aerospace possibilities
- It triggers a transformation of intuition
- Revolutionary paradigm shifts are often simple, elegant, majestic, beautiful and are characterized by order and symmetry

There is a subtle yet significant difference between a creative and credible concept, and an imaginary pursuit.

- Robert Cassanova, Ron Turner, Pat Russell



NIAC

<http://www.niac.usra.edu>

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inspired by curiosity and the eternal quest for knowledge,
are necessities, not luxuries.***

- Robert Cassanova

**Interviews from the NIAC Annual Meeting
October 2004
Seattle, Washington**





NIAC Student Fellows Prize (Funded by USRA)

CALL FOR PROPOSALS



NIAC Student Fellows Prize

The NASA Institute for Advanced Concepts (NIAC) seeks to identify creative and innovative students who possess an extraordinary potential for developing advanced concepts in the fields of aeronautics, space and the sciences.

Each Student Fellow will receive a total of \$9,000 for the Academic year 2005-2006.

NIAC intends for these awards to benefit talented individuals who have shown extraordinary originality and dedication in their academic pursuits and a marked capacity for self-direction. We seek exceptional creativity, and the promise for important future advances based on a track record of significant accomplishment, and potential for the fellowship to facilitate subsequent creative work.

- Applicant must be in a U.S. institute of higher education
- Applicant must be a U.S. Person
- Applicant must apply no later than their junior year of college

For more details on the NIAC Student Fellows Prize and how to apply, go to WWW.NIAC.USRA.EDU

Due Date: April 15, 2005

Photo Courtesy of the
Solar Data Analysis Center -
NASA Goddard Space Flight Center

Minority, female and disadvantaged students are encouraged to respond to this Call For Proposals.

NIAC seeks to identify creative and innovative students who possess an extraordinary potential for developing advanced concepts in the fields of aeronautics, space and the sciences.

- Each Student Fellow will receive a total of \$9,000 for the Academic year 2005-2006.
- Funds will be directly disbursed to the Student Fellow in three equal increments: September 2005, December 2005, and March 2006.



Future NIAC Events and Deadlines



***Phase II Call for Proposals
due date of May 2, 2005***



***NIAC Student Fellows Prize
Call for Proposals released in January 2005
with a due date of April 15, 2005***



***NIAC Annual Meeting, October 10-11, 2005
Boulder, Colorado***

Agenda



NIAC Phase I Fellows Meeting Tuesday, March 15, 2005

- 8:00am - 8:30am** Registration
- 8:30am - 9:00am** **Welcome and Status of NIAC Activities**
Robert A. Cassanova, NIAC Director
- 9:00am - 10:00am** Keynote Speaker - **What Do We Really Know about How Animals Develop and Behave in Weightlessness?**
Richard Wassersug, Dalhousie University
- 10:00am - 10:30am** Break
- 10:30am - 12:00pm** NIAC Phase I Status Reports
- (45 minutes)** **A Deep Field Infrared Observatory Near the Lunar Pole**
Roger Angel, University of Arizona
- (45 minutes)** **New World Imager**
Webster Cash, University of Colorado
- 12:00pm - 1:00pm** Buffet Lunch
- 1:00pm -- 2:00pm** Keynote Speaker - **Whatever Happened to the Space Age?**
Joel Achenbach, Washington Post
- 2:00pm - 2:30pm** NIAC Student Fellow Report
- (30 minutes)** **Deployment of an Interstellar Electromagnetic Acceleration System**
Andrew Bingham, Clarkson University
- 2:30pm - 3:00pm** Break
- 3:00pm - 5:15pm** NIAC Phase I Status Reports
- (45 minutes)** **Redesigning Living Organisms to Survive on Mars**
Wendy Boss, North Carolina State University
- (45 minutes)** **Analysis of a Lunar Base Electrostatic Radiation Shield Concept**
Charles Buhler, ASRC Aerospace Corporation
- (45 minutes)** **Use of Superconducting Magnet Technology for Astronaut Radiation Protection**
Jeffrey Hoffman and Peter Fisher, MIT
- 5:00pm - 6:30pm** Reception



NIAC Phase I Fellows Meeting Wednesday, March 16, 2005

- 8:45am** **Welcome**
Robert Cassanova, NIAC Director
- 9:00am - 10:00am** Keynote Speaker - **Overview of NASA's Space Technology Program**
Chris Moore
NASA HQ
- 10:00am - 10:30am** Break
- 10:30am - 12:00pm** NIAC Phase I Status Reports
- (45 minutes)** **Lunar Space Elevators for Cislunar Space Development**
Jerome Pearson, Star Technology & Research, Inc.
- (45 minutes)** **Magnetized Beamed Plasma Propulsion (MagBeam)**
Robert Winglee, University of Washington
- 12:00pm - 1:00pm** Buffet Lunch
- 1:00pm -- 2:30pm** NIAC Phase I Status Reports
- (45 minutes)** **Extremely Large Swarm Array of Picosats for Microwave/RF Earth Sensing, Radiometry & Mapping**
Ivan Bekey, Bekey Designs Incorporated
- (45 minutes)** **A Self-Sustaining, Boundary-Layer-Adapted System for Terrain Exploration and Environmental Sampling**
Craig Woolsey, Virginia Polytechnic Institute
- 2:30pm - 3:00pm** Break
- 3:00pm - 5:15pm** NIAC Phase I Status Reports
- (45 minutes)** **Wide Bandwidth Deep Space Quantum Communications**
Rickey Morgan, Morgan Optics Corporation
- (45 minutes)** **Efficient Direct Conversion of Sunlight to Coherent Light at High Average Power in Space**
Richard Fork, University of Alabama, Huntsville
- (45 minutes)** **Large-Product General-Purpose Design and Manufacturing Using Nanoscale Modules**
Chris Phoenix, Center for Responsible Nanotechnology
- 5:00pm - 6:30pm** Adjourn