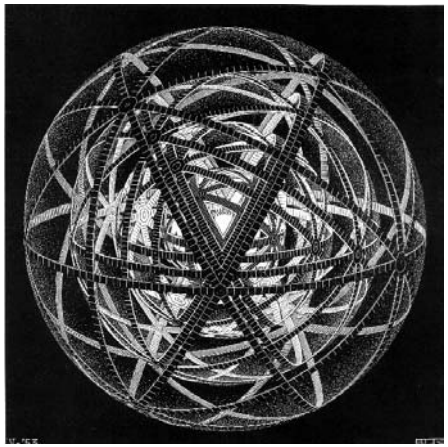
CT3340/CD5540

Research Methodology for Computer Science and Engineering

Theory of Science

Lecture 5 – THE GOLEM



Gordana Dodig-Crnkovic

Department of Computer Science and Engineering
Mälardalen University

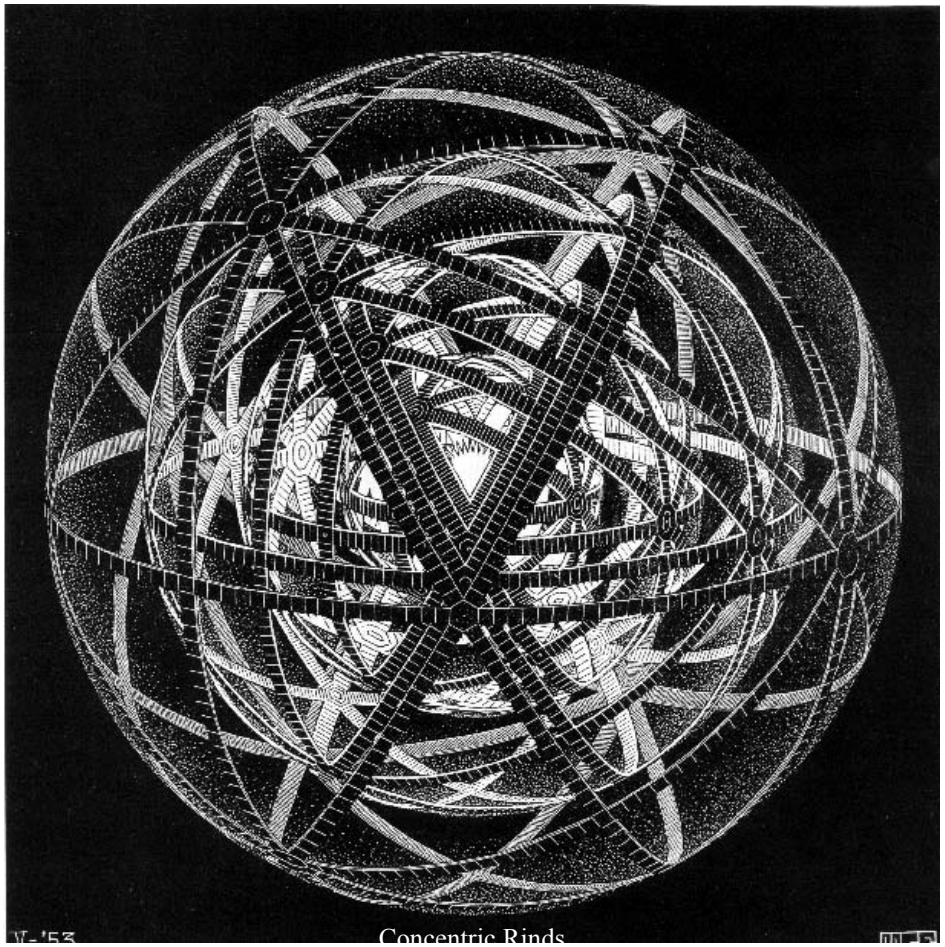
2004

PROMISE AND PERIL – THE GOLEM, Collins and Pinch

A Golem is a mythological creature.

"It is a humanoid made by man from clay and water, with incantations and spells. It is powerful. It grows a little more powerful every day. It will follow orders, do your work, and protect you from the ever threatening enemy. But it is clumsy and dangerous. Without control, a golem may destroy its masters …"

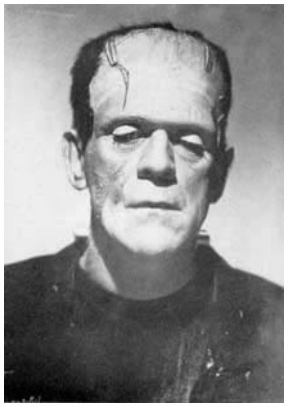
WHAT IS SCIENCE?

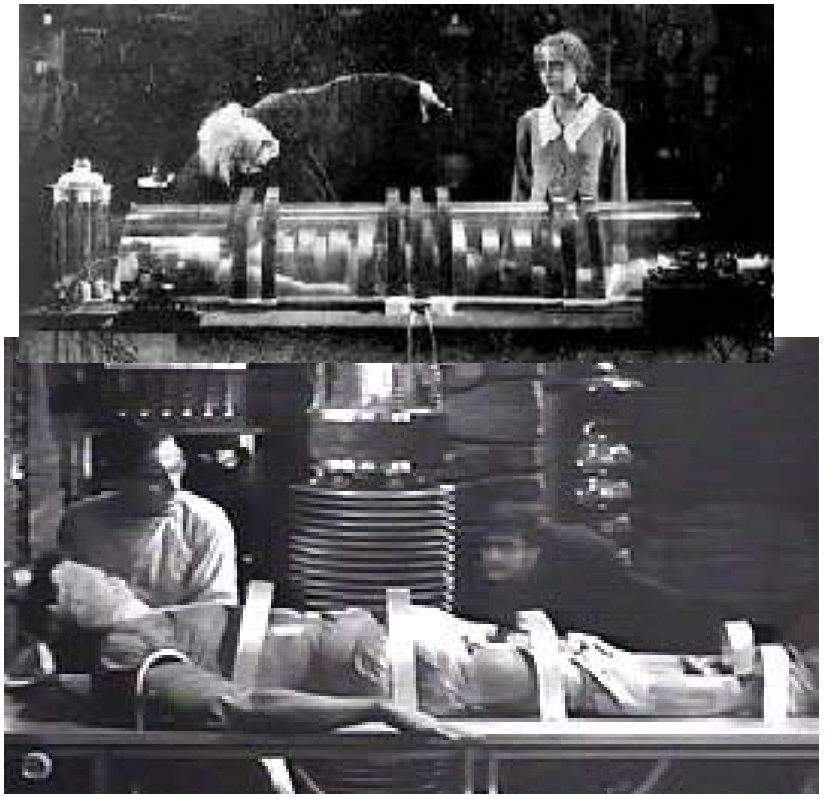


PROMISE – PROFESSOR BALTHAZAR …

http://www.professor-balthazar.nl

… AND PERIL – DR FRANKENSTEIN





http://www.thebakken.org/Frankenstein/book-1831-edition.htm

SCIENTISTS

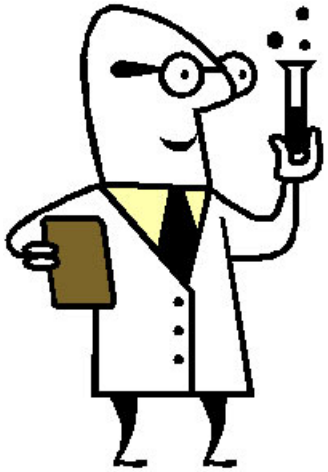
"Scientists are people of very dissimilar temperaments doing different things in very different ways. Among scientists are collectors, classifiers and compulsive tidiers-up; many are detectives by temperament and many are explorers; some are artists and others artisans. There are poet-scientists and philosopher-scientists and even a few mystics."

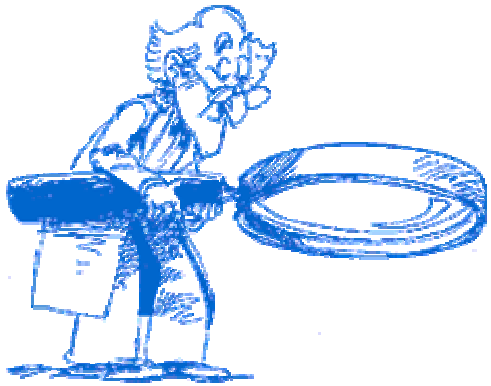
Peter Medawar, Pluto's Republic

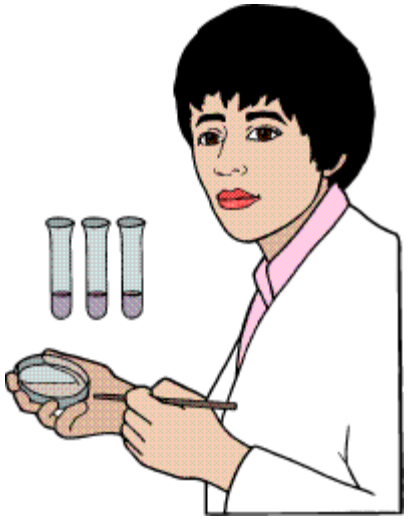
Scenes from a Scientist's Life

The Scientist

(Google Search results)







The Scientist

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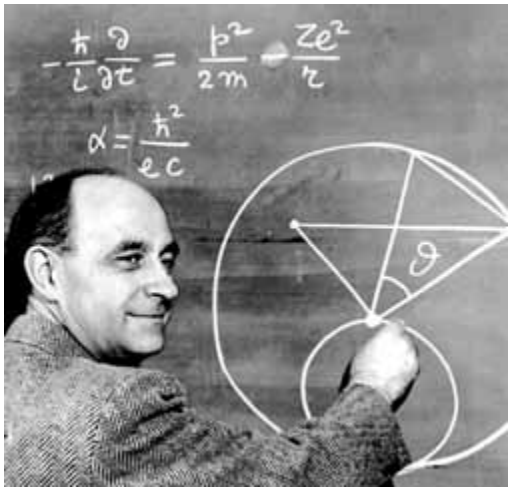
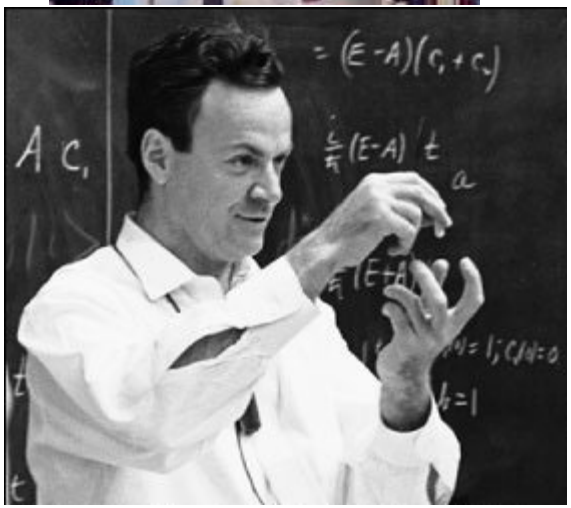
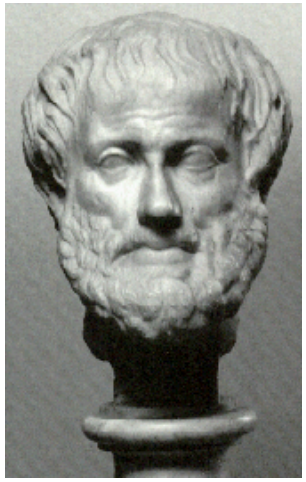
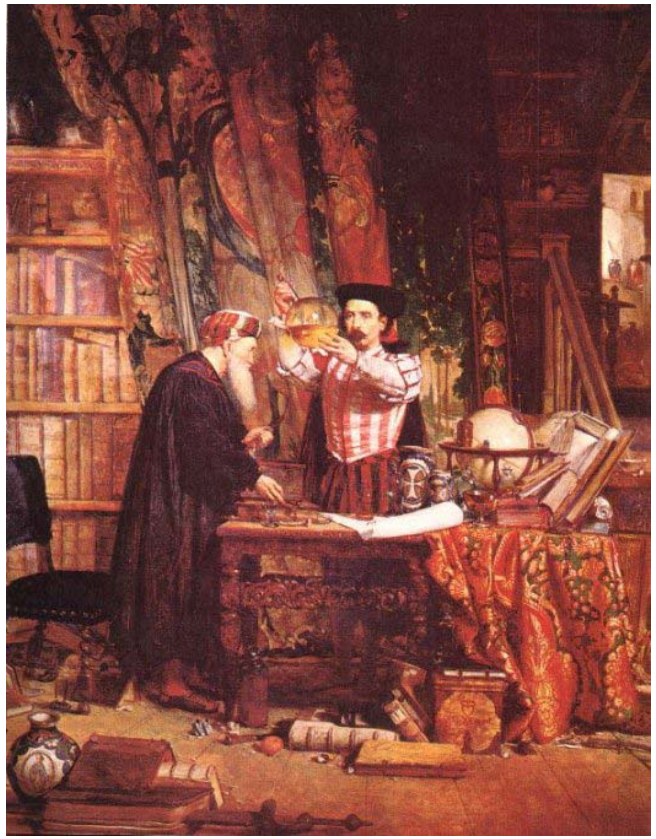


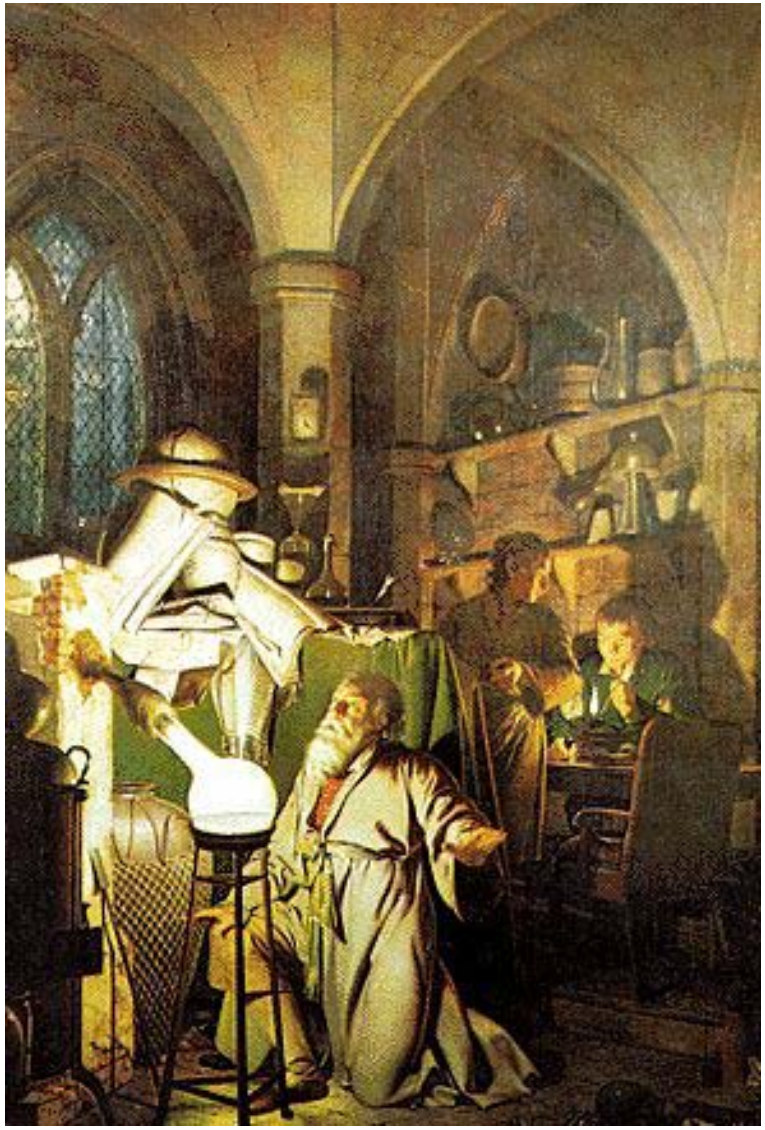


Ancient Scientists





Ancient Scientists: How about Alchemy?

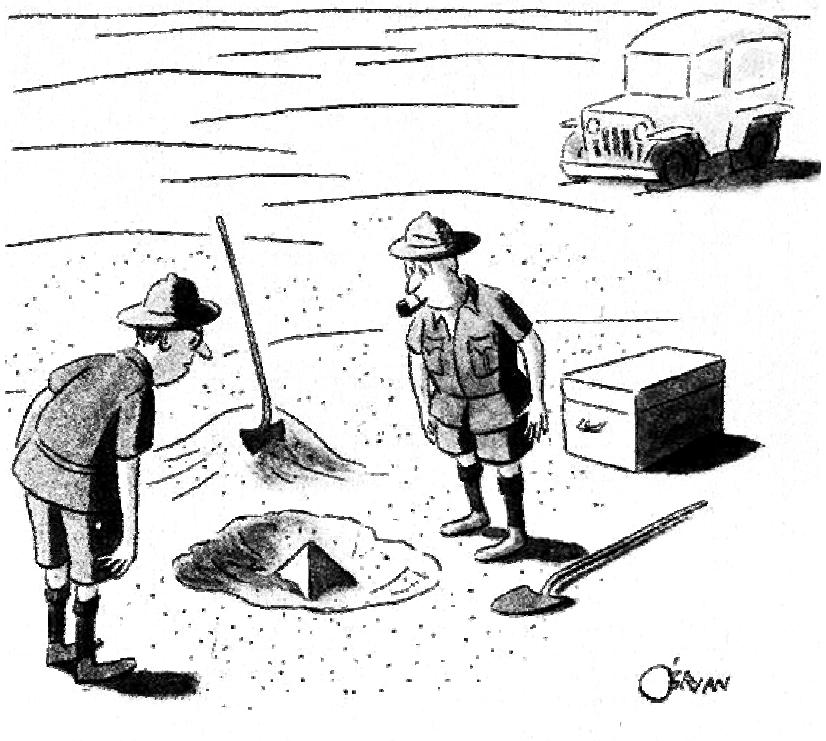


Hening Brand (c.1630-1692) was a German merchant who discovered Phosphorus in 1669. Being bankrupt, he tried to discover the *Philisophers Stone* to convert silver to gold. He experimented with destilling human urine, until he finally got a white glowing substance.

However he kept his discovery *secret*, so it was until **Robert Boyle** rediscovered it 1680 when the new element became public.

"The Discovery of Phosphorus" by the English painter, Joseph Wright (1734-1797), of Derby, England

Some More Scenes from a Scientist's Life …

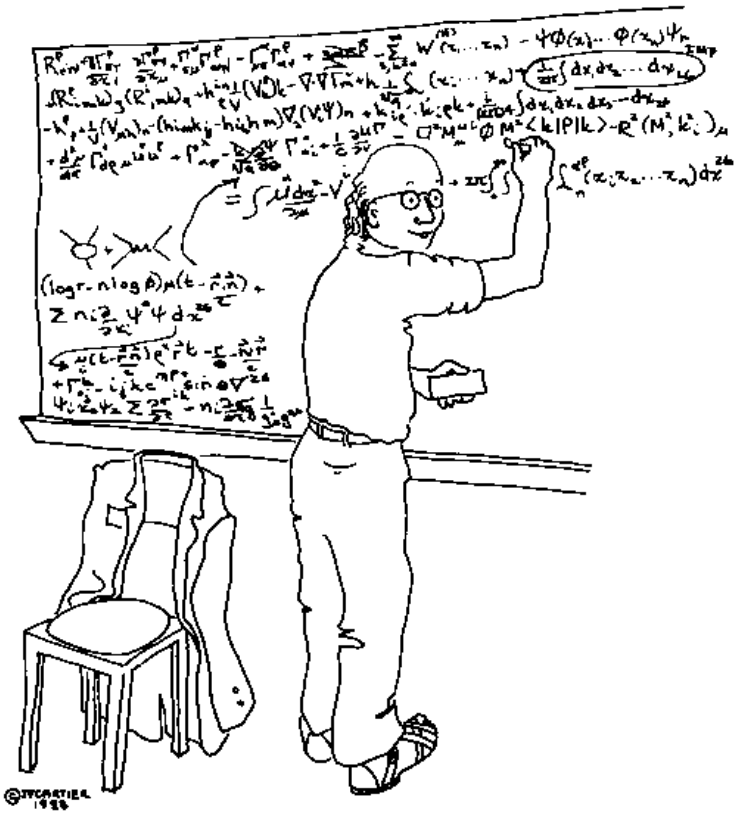


"This could be the discovery of the century. Depending, of course, on how far down it goes."

Some More Scenes from a Scientist's Life …

Some More Scenes from a Scientist's Life …

Some More Scenes from a Scientist's Life …



"At this point we notice that this equation is beautifully simplified if we assume that space–time has 92 dimensions."

Some More Scenes from a Scientist's Life …

Thomas Kuhn and History of Science

Thomas Samuel Kuhn (1922-1996) became the one of most influential philosophers of science of the twentieth century, perhaps the most influential—his *The Structure of Scientific Revolutions* is one of the most cited academic books of all time.

His contribution to the philosophy science marked not only a break with several key positivist doctrines but also inaugurated a new style of philosophy of science that brought it much closer to the history of science.

Thomas Kuhn and History of Science

Kuhns account of the development of science held that science enjoys periods of stable growth punctuated by scientific revolutions, to which he added the controversial '*incommensurability thesis*', that theories from differing periods suffer from certain deep kinds of failure of comparability. For Kuhn competing paradigms were *incommensurable* - they involved looking at the world in radically different ways.

Stanford Encyclopedia of Philosophy

Thomas Kuhn as Forerunner of Posmodernism

Thomas Kuhn and Paul Feyerabend, were undoubtedly (and perhaps unwittingly) forerunners of postmodernism in their questioning of scientific rationality. Of the two it was Kuhn who was the closest to realism — he held that even after a revolution at least part of the previously 'normal' science proves to be permanent, and that science offers us our surest example of sound knowledge. Indeed, it is hard to see in what way there could be a growth of scientific knowledge except from a realist stance, however finely nuanced that claim to realism may be.

Paul Feyerabend

Feyerabend, acting as a provocatively to all scientific pretensions, held that there was no such thing as *the* scientific method and saw science as an essentially anarchic enterprise in which ‘anything goes’.

The one scarcely follows from the other, however.

It is true that there is no single method that marks out science from any other form of rational enquiry but nonetheless there are a range of criteria — such as explanatory scope, predictive power, experimental repeatability, consistency with other well-established theory — that make it a different sort of enterprise to, say, astrology or alchemy.

Feyerabend could scarcely have expected that his remark that "science is the myth of today", intended no doubt as a provocation, would so soon become *orthodoxy*, at least in the Humanities.

Postmodernist Epistemology

All knowledge, scientific knowledge included, is held to be socially constructed through and through.

Science is therefore merely one story among others. The world we know is one that is constructed by human discourses, giving us not so much truths as ‘truth-effects’ which may or may not be pragmatically useful.

From this point of view, epistemologically speaking, a scientific text is understood as being on a par with a literary text.

Postmodernism as a Movement

Postmodernism is an artistic, architectural, philosophical, and cultural movement, said to arise after and in reaction to modernism.

Whereas modernism frames itself as the culmination of the Enlightenment's quest for an rational aesthetics, ethics, and knowledge, postmodernism is concerned with how the authority of those ideals, sometimes called metanarratives, are undermined through fragmentation, consumerism, and deconstruction.

Jean-François Lyotard famously described postmodernism as an "incredulity toward metanarratives" (Lyotard, 1984). Postmodernism attacks the notions of monolithic universals and encourages fractured, fluid and multiple perspectives and is marked by an increasing importance in the ideas from the Sociology of knowledge.

Antiscience And The Science Wars

From the mid 1970s to the late 1990s a cluster of anti-rationalist ideas became increasingly prevalent among academic sociologists in America, France and Britain.

The ideas were variously known as Deconstructionism, Sociology of Scientific Knowledge, (SSK), Social Constructivism, or Science and Technology Studies (STS). The umbrella term for these movements was Postmodernism.

The branch of sociology known as Sociology of Scientific Knowledge (SSK) or Science and Technology Studies (STS), had the objective of showing that the results of scientific findings did not represent any underlying reality, but were purely the ideology of dominant groups within society.

The famous Sokal hoax was one of the contributions in the debate.

The Anti-Scientism of Postmodernism

All forms of post-modernism were anti-scientific, anti-philosophical and generally anti-rational. The view of science as a search for truths (or approximate truths) about the world was rejected.

According to SSK, the natural world has a small or non-existent role in the construction of scientific knowledge. Science was just another social practice, producing ``narrations'' and ``myths'' with no more validity than the myths of pre-scientific peoples.

``*I see some parallels between the shifts of fashion in mathematics and in music. In music, the popular new styles of jazz and rock became fashionable a little earlier than the new mathematical styles of chaos and complexity theory. Jazz and rock were long despised by classical musicians, but have emerged as art-forms more accessible than classical music to a wide section of the public. Jazz and rock are no longer to be despised as passing fads. Neither are chaos and complexity theory. But still, classical music and classical mathematics are not dead. Mozart lives, and so does Euler. When the wheel of fashion turns once more, quantum mechanics and hard analysis will once again be in style."*

Freeman Dyson's review of *Nature's Numbers* by Ian Stewart (Basic Books, 1995; From p. 612 in the **American Mathematical Monthly**, August-September 1996)

``The dictum that everything that people do is 'cultural' ... licenses the idea that every cultural critic can meaningfully analyze even the most intricate accomplishments of art and science. ... It is distinctly weird to listen to pronouncements on the nature of mathematics from the lips of someone who cannot tell you what a complex number is!"

Norman Levitt, from "The flight From Science and Reason," New York Academy of Science. Quoted from p. 183 in the October 11, 1996 **Science**)

`` One of the beauties of learning is that it admits its provisionality, its imperfections. This scholarly scrupulousness, this willingness to admit that even the best-supported of theories is still a theory, is now being exploited by the unscrupulous. But that we do not know everything does not mean we know nothing. Not all theories are of equal weight. The moon, even the moon over Kansas, is not made of green cheese. Genesis, as a theory, is bunk.

If the overabundant new knowledge of the modern age is, let's say, a tornado, then Oz is the extraordinary, Technicolored new world in which it has landed us, the world from which --- life not being a movie --- there is no way home. In the immortal words of Dorothy Gale, `Toto, something tells me we're not in Kansas any more.' To which one can only add: Thank goodness '

Salman Rushdie, From his article "Locking out that disruptive Darwin fellow" in the *Globe and Mail* , September 2, 1999

"Similarly, and ignoring some self-promoting and cynical rhetoricians, I have never met a serious social critic or historian of science who espoused anything close to a doctrine of pure relativism. The true, insightful, and fundamental statement that science, as a quintessentially human activity, must reflect a surrounding social context does not imply either that no accessible external reality exists, or that science, as a socially embedded and constructed institution, cannot achieve progressively more adequate understanding of nature's facts and mechanisms. "

Stephen J. Gould, From the article: 'Deconstructing the "Science Wars" by Reconstructing an Old Mold' in *Science*, Jan 14, 2000: 253-261.

``2000 was a banner year for scientists deciphering the "book of life"; this year saw the completion of the genome sequences of complex organisms ranging from the fruit fly to the human. Genomes carry the torch of life from one generation to the next for every organism on Earth. Each genome--physically just molecules of DNA--is a script written in a four-letter alphabet.

Not too long ago, determining the precise sequence of those letters was such a slow, tedious process that only the most dedicated geneticist would attempt to read any one "paragraph"--a single gene.

But today, genome sequencing is a billion-dollar, worldwide enterprise. Terabytes of sequence data generated ***through a melding of biology, chemistry, physics, mathematics, computer science, and engineering*** *are changing the way biologists work and think.*

Science marks the production of this torrent of genome data as the Breakthrough of 2000; it might well be the breakthrough of the decade, perhaps even the century, for all its potential to alter our view of the world we live in."

Elizabeth Pennisi, From "BREAKTHROUGH OF THE YEAR: Genomics Comes of Age." Cover story in *Science* of December 22, 2000.

"*The problems of mathematics are not problems in a vacuum. There pulses in them the life of ideas which realize themselves in concreto through our [or throught] human endeavors in our historical existence, but forming an indissoluble whole transcending any particular science."*

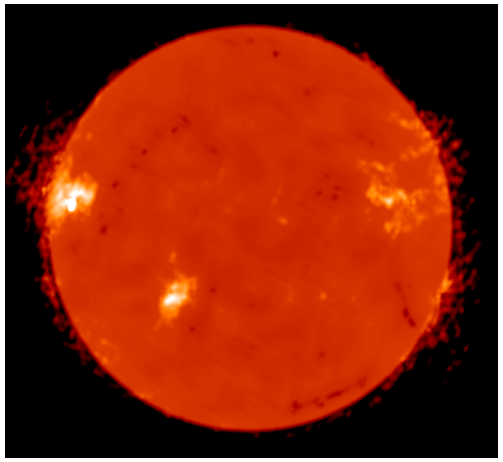
Hermann Weyl, In "David Hilbert and his mathematical work," *Bull. Am. Math. Soc.,* **50** (1944), p. 615.

`` Old ideas give way slowly; for they are more than abstract logical forms and categories. They are habits, predispositions, deeply engrained attitudes of aversion and preference. Moreover, the conviction persists-though history shows it to be a hallucination that all the questions that the human mind has asked are questions that can be answered in terms of the alternatives that the questions themselves present. But in fact intellectual progress usually occurs through sheer abandonment of questions together with both of the alternatives they assume an abandonment that results from their decreasing vitality and a change of urgent interest. We do not solve them: we get over them.

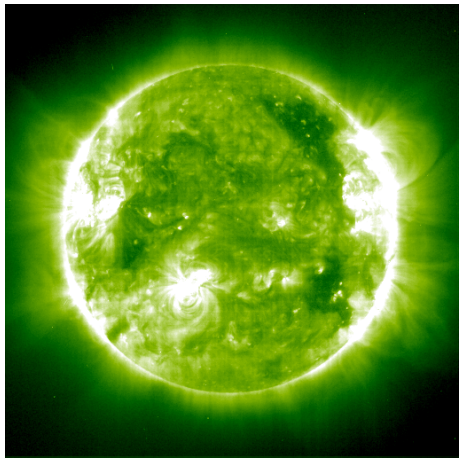
Old questions are solved by disappearing, evaporating, while new questions corresponding to the changed attitude of endeavor and preference take their place. Doubtless the greatest dissolvent in contemporary thought of old questions, the greatest precipitant of new methods, new intentions, new problems, is the one effected by the scientific revolution that found its climax in the " Origin of Species." ``

John Dewey, Quoted from *The Influence of Darwin on Philosophy*, 1910.

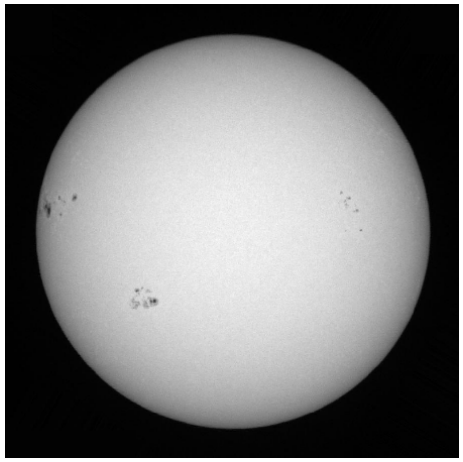
Images Of The Sun – Which is The True Sun?



RADIO



ULTRAVIOLET



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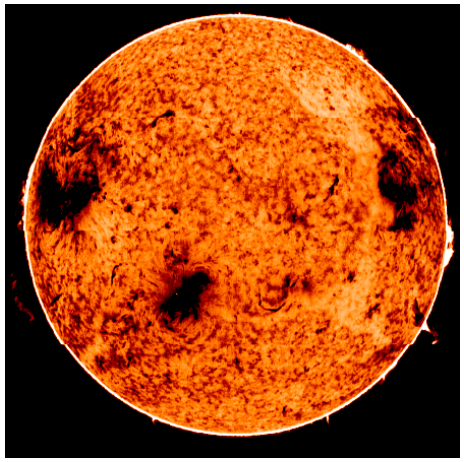

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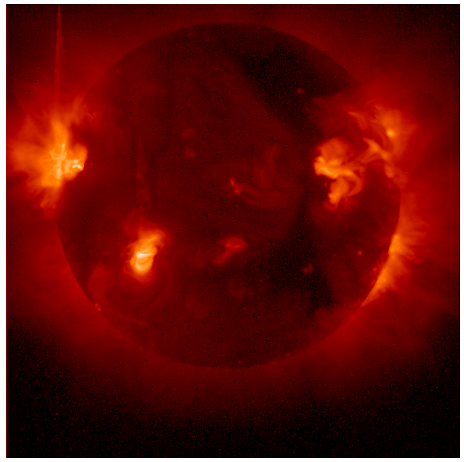
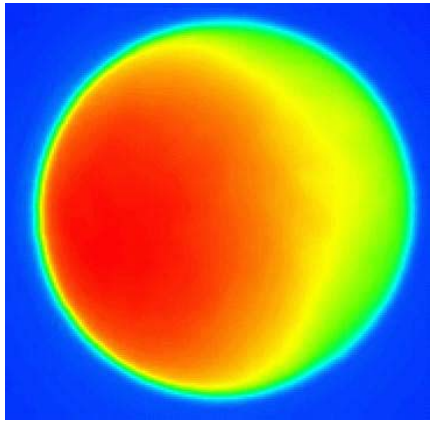


X-RAY

Images Of The Moon – Which is The True Moon?



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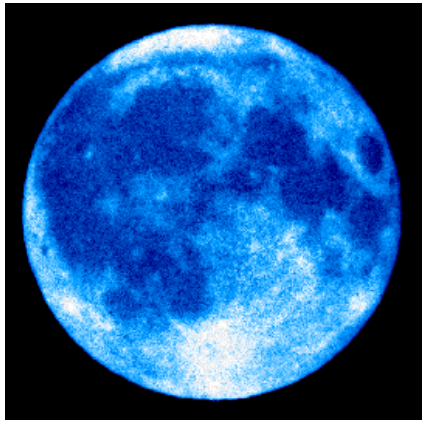

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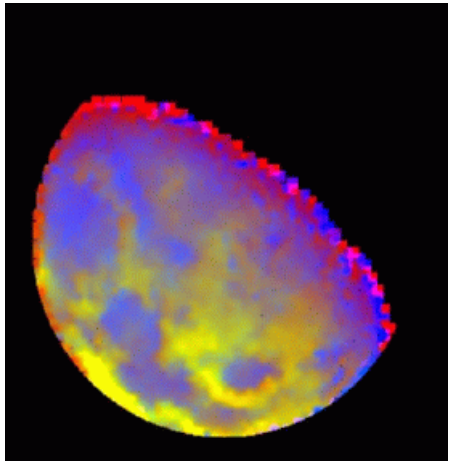

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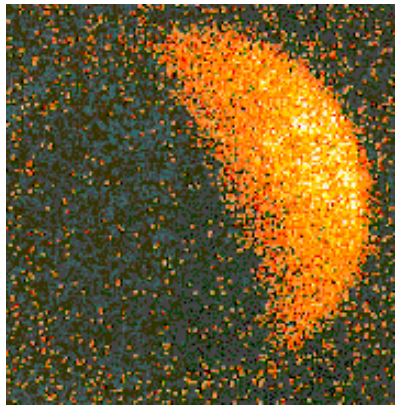


X-RAY

Is **there anything** really new under the sun?

Any **progress**?

An Example of Technological Progress - Transportation

An Example of Technological Progress

Beam me up Scotty next?

Is There Historical Progress of Technology?

progress

- Movement, as toward a goal; advance.
- Development or growth: *students who show progress.*
- Steady improvement, as of a society or civilization: *a believer in human progress.*
  See Synonyms at development.
- To advance; proceed: *Work on the new building progressed at a rapid rate.*
- To advance toward a higher or better stage; improve steadily: *as medical technology progresses.*
- ***Idiom: in progress***
  - Going on; under way: *a work in progress.*

Is There Historical Progress of Technology?

Synonyms: *development, evolution, progress*

These nouns mean a As we learn from progression from a simpler or lower to a more advanced, mature, or complex form or stage

the history of science, both science and technology started from very simple form to get complex form of today – so progress&development is a historical fact.

Is Any Progress Necessarily Good?

- Can progress be bad?
- What might be the consequences of scientific progress?
- What would be the alternative to the high technology society based on advanced science?
- Is there any known example in history where society deliberately moved back to historical forms of living (lower technology)?

AFTER POSTMODERNISMS DEATH ...
CRITICAL REALISM

Hot to Get Real Again

Is Postmodernism finally on its deathbed? Roger Caldwell examines the evidence and takes a look at its would-be successor: Critical Realism.

For the last two decades of the twentieth century the dominant cultural paradigm was that of postmodernism. But at the beginning of the new millennium a new paradigm is on offer.

AFTER POSTMODERNISMS DEATH ...
CRITICAL REALISM

Postmodernism is dead. It is to be succeeded by the age of critical realism. That at least is the promise that José López and Garry Potter hold out as propagandists of the new movement (they edited a collection of essays called *After Postmodernism - An Introduction to Critical Realism*, published by Continuum in 2001).

AFTER POSTMODERNISMS DEATH ...
CRITICAL REALISM

True, the two movements have much in common in their scope — offering an overall view of science, social science and the arts, and all in the interests of an emancipatory politics. Certainly, the world looked at through the eyes of critical realism is vastly different from that seen through the eyes of postmodernism — for a start, there is a single world again — but there is more to the matter than an irrational leap from one view to the other. For critical realism begins with the awareness that the postmodernist project is fatally flawed.

Science – Golem

As we already pointed out several times, science and especially its applications are not inevitably and automatically good, but can be bad and cause harm. That is something we must have in mind and try to prevent as far as possible. We will talk more about good and bad in the lecture on Research ethics.

Science is a **human activity made by humans and *for* humans**.

Two Experiments that ”Proved” the Theory of Relativity

The Golem
(Collins, Pinch)

Michelson-Morley Experiment

After the development of Maxwell's theory of electromagnetism, several experiments were performed to prove the existence of ether and its motion relative to the Earth.

The most famous and successful was the one now known as the Michelson-Morley experiment, performed by Albert Michelson and Edward Morley.

These two scientists conducted one of the most important null result experiments in history at Case Western University in 1887.

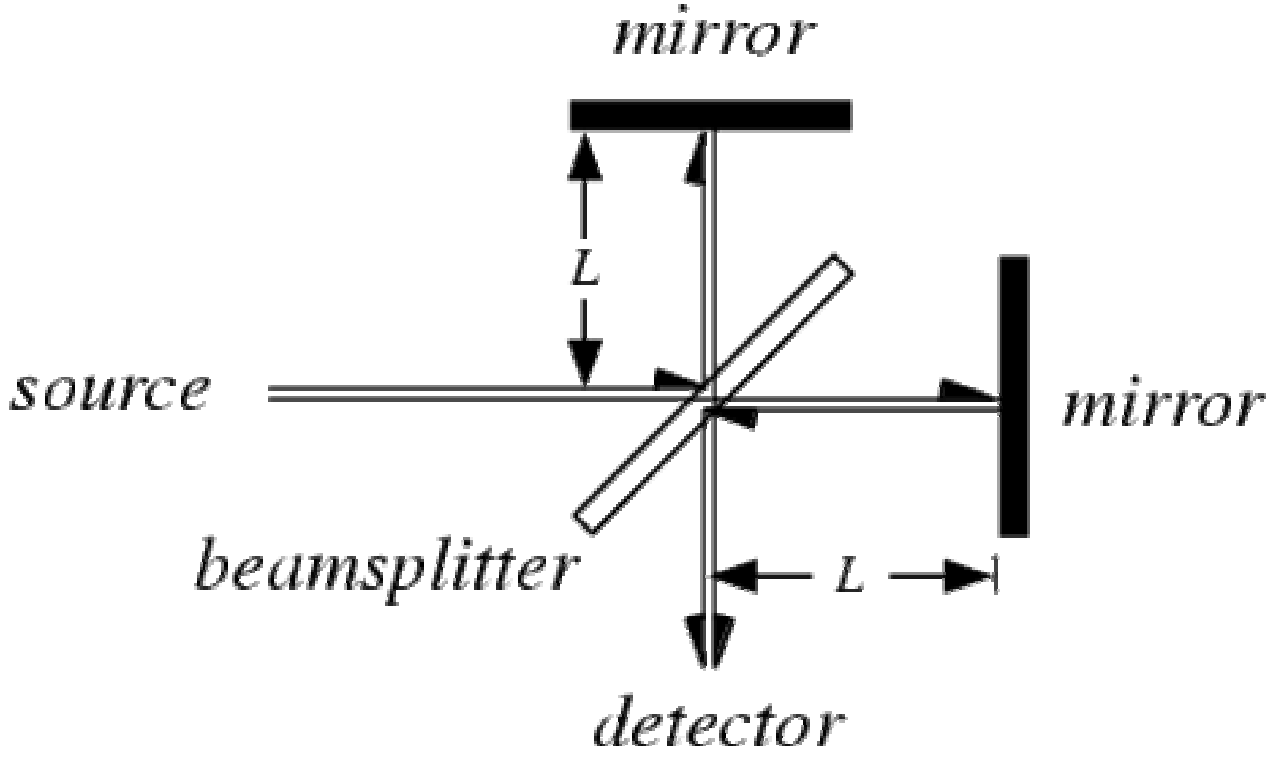
Using an interferometer floating on a pool of mercury, they tried to determine the existence of an ether wind by observing interference patterns between two light beams.

One beam traveling with the "ether wind" as the earth orbited the sun, and the other at 90º to the ether wind.

If light was a wave, then the speed of light should vary with the earth's motion through the ether - for example, like a boat traveling up and down stream; sometimes the current increases the boat's relative speed, other time it hinders, or slows, the boat's speed relative to the shore.

The interference fringes produced by the two reflected beams were observed in the telescope. It was found that these fringes did not shift when the table was rotated.

That is, the time required to travel one leg of the interferometer never varied with the time required to travel its normal counterpart. They NEVER got a changing interference pattern.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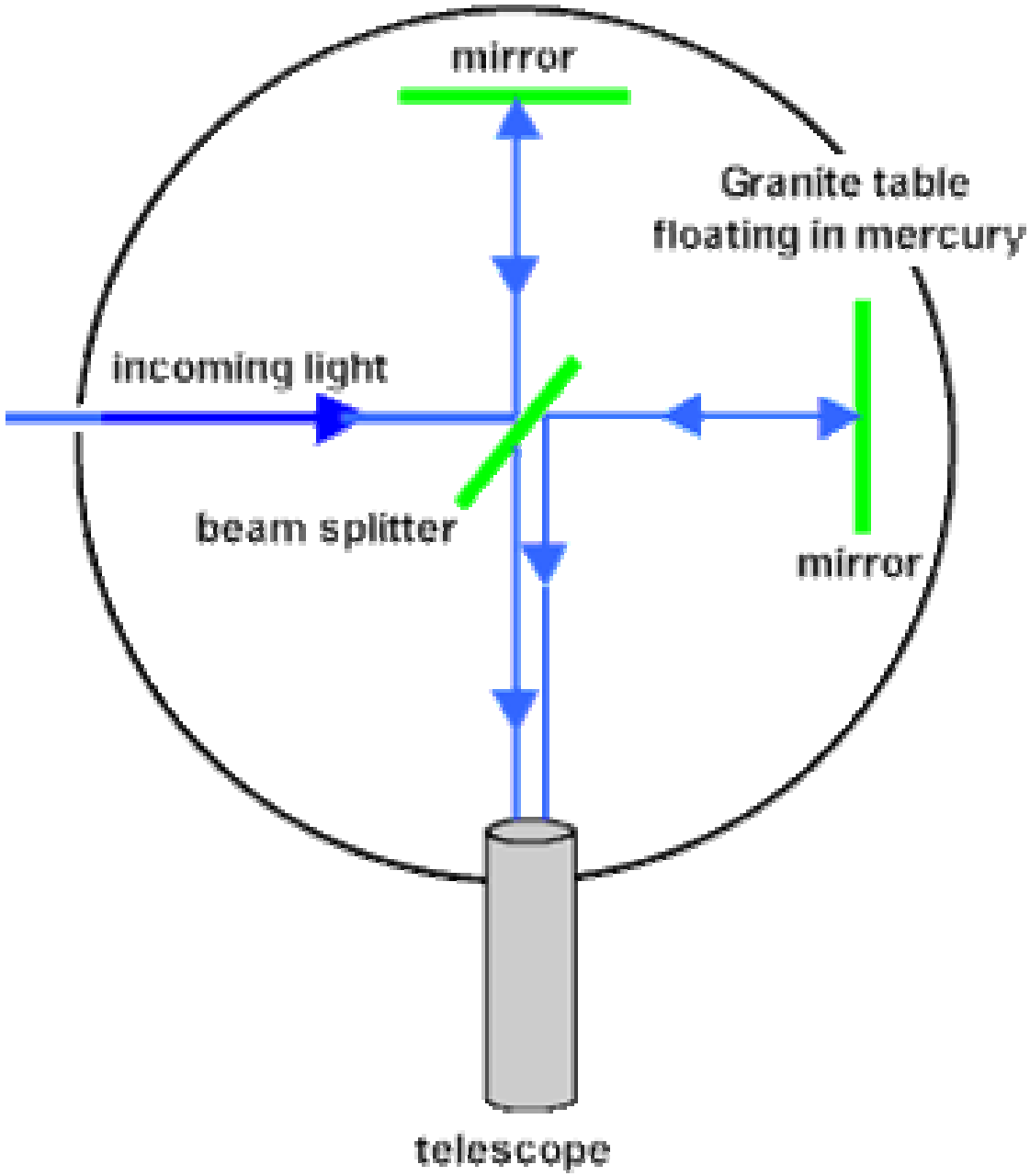

mirror
Granite table
floating in mercury
incoming light
beam splitter
mirror
telescope

The experiment helped to refute the hypothesis that the earth is in motion relative to an ether through which light propagates.

The null results of the experiment indicated that the speed of light is a constant, independent of its direction of propagation.

Another consequence of Michelson-Morley experiment was the building skepticism in the existence of the ether.

In 1907 Michelson was awarded the Nobel Prize in Physics for his work in spectroscopy and precision optical instruments.

Eddington's 1919 Eclipse Experiment

Newton's Theory of Gravitation (1687) is one of the most important theories in the history of science. It is not only able to describe the falling of an apple, but also the formation of a galaxy. The equation of gravitational force is one of the greatest conquests of Humankind:

$$\overrightarrow{F_g} \propto \frac{M \times m}{r^2} \times \frac{\vec{r}}{r} \qquad [1]$$

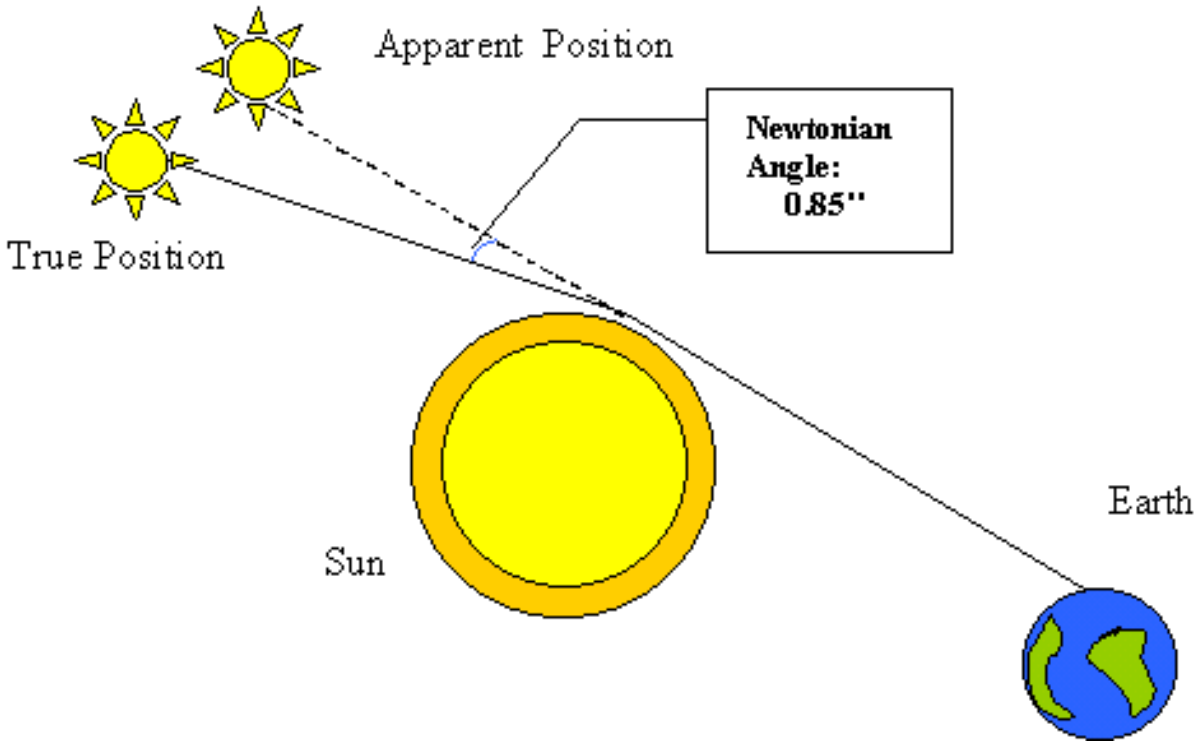
When Newton published “Opticks” in 1704, he beloved in the corpuscular nature of light, and he ensured that it must exist a relation between light and matter, with the form of a gravitational force ruled by equation [1].

In 1804 (two centuries ago), Soldner was the first who calculated that, for small angles, the Newtonian deflection of light by a massive object should be:

$$\alpha_{Newton} = 2\frac{G \times M}{c^2 \times R} \quad [2]$$

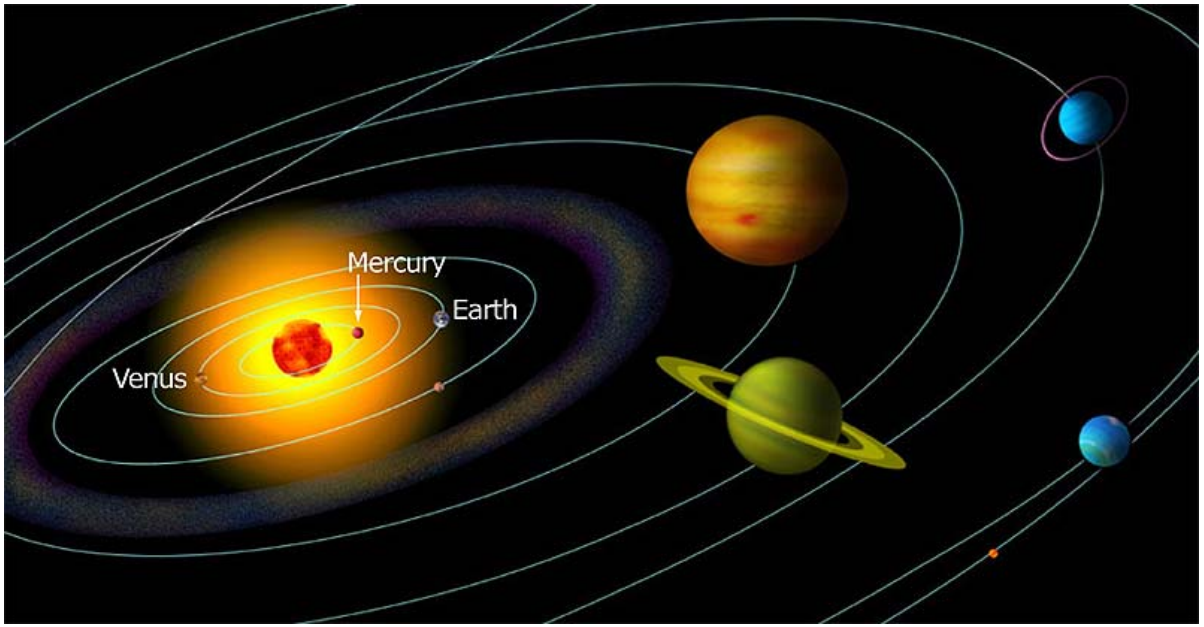
where M is the mass of the deflecting object and R is the deflection impact parameter. For a light ray grazing the Sun this gives a deflection angle ~0.85´´ (a scheme is shown in figure 1).

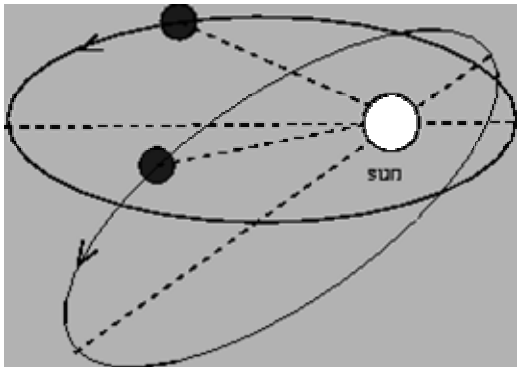
Newtonian angle of deflection of light by the Sun.

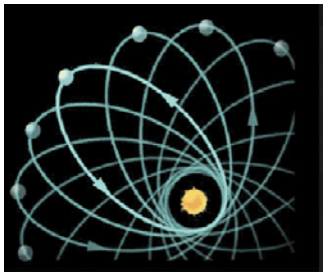


Although Newton's Theory of Gravitation was acepted by scientists along centuries, it was not able to explain several anomalies, the most famous of these being the perihelion shift of Mercury. Classical mechanics could explain the majority of the observed shift, but a residual shift of about 40 seconds of arc per century could not be explained by the gravitational effects of other planets.
(A second of arc is 1/3600 of a degree).

The precession of Mercury's orbit







Most of the effect is due to the pull from the other planets but there is a measurable effect due to the corrections to Newton's theory predicted by the General Theory of Relativity.

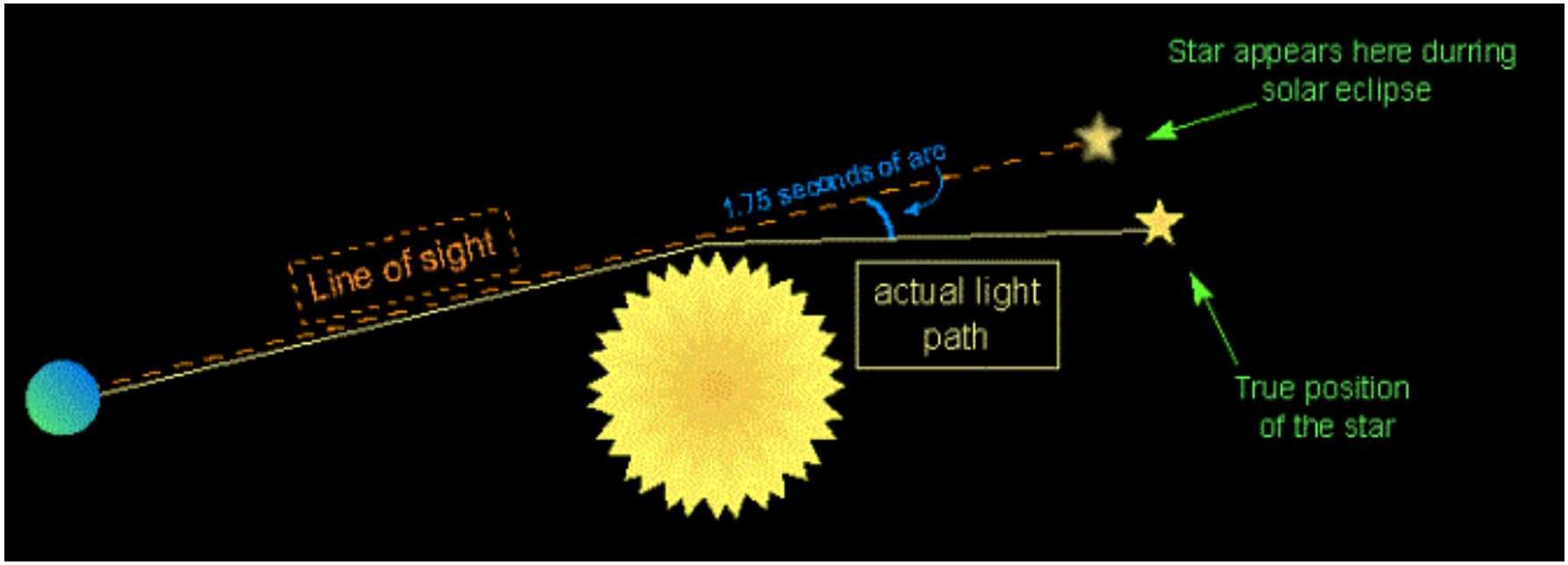
During the earlier part of this century, Einstein extended his Special Theory of Relativity to generalized, or accelerating reference frames. From this study emerged a new description of gravity which saw gravitational force as the curvature of a space-time, the curvature being due to the presence of mass.

General Relativity, as this theory is known, not only explained the residual shift in Mercury's perihelion, but also predicted other effects, including the bending of light in a gravitational field. General Relativity predicts that the bending angle for a light ray in the vicinity of a point mass to be:

$$\alpha_{Einstein} = 4\frac{G \times M}{c^2 \times R} \qquad [3]$$

precisely double the value expected from Newtonian gravity (see equation [2])!

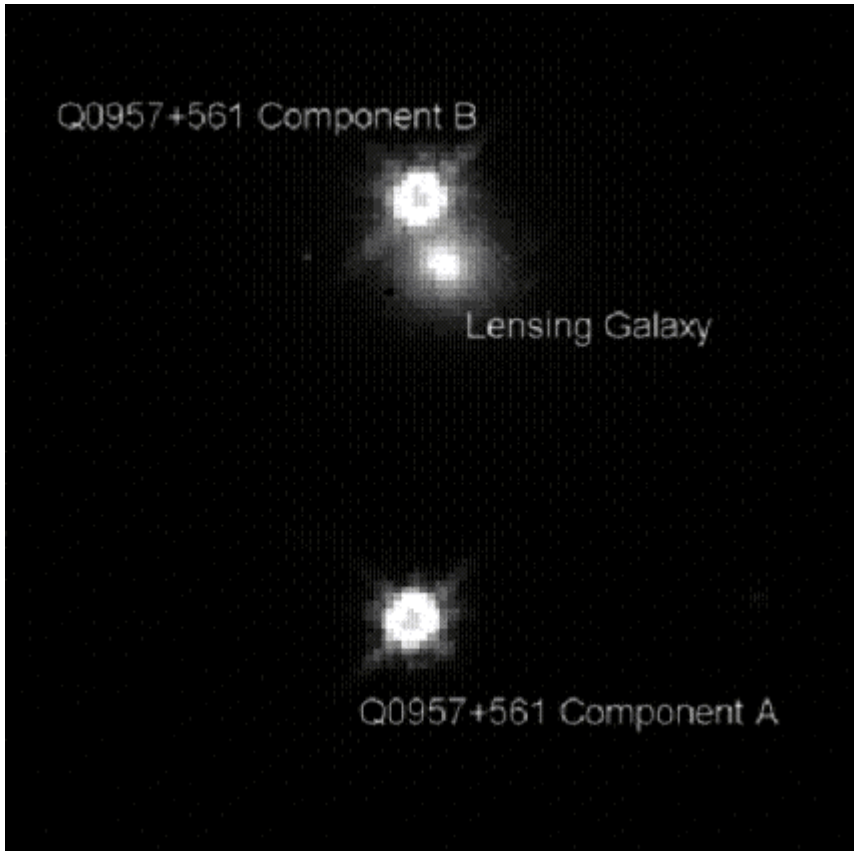
Einstein's angle of deflection of light by the Sun. Eddington's experiment



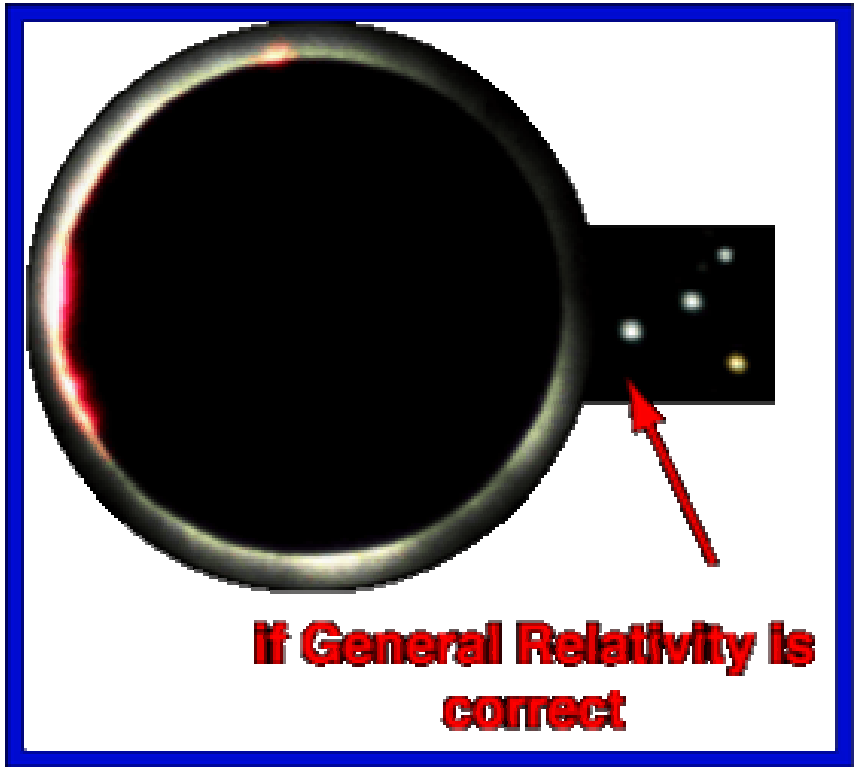
In 1919, Eddington (on Principe Island) and Crommlin (in Brazil), monitored the position of the stelar background during the solar eclipse of the May, and they obtained a value for the deflecting angle of light by the sun of 1.98 and 1.60 seconds of arc respectively, with quoted errors of 0.30 seconds. These results **confirmed** the Einstein's prediction

The phenomenon is called light deflection or **Gravitational Lensing (GL)**

Concept of "Einstein Ring"


Q0957+561 Component B
Lensing Galaxy
Q0957+561 Component A

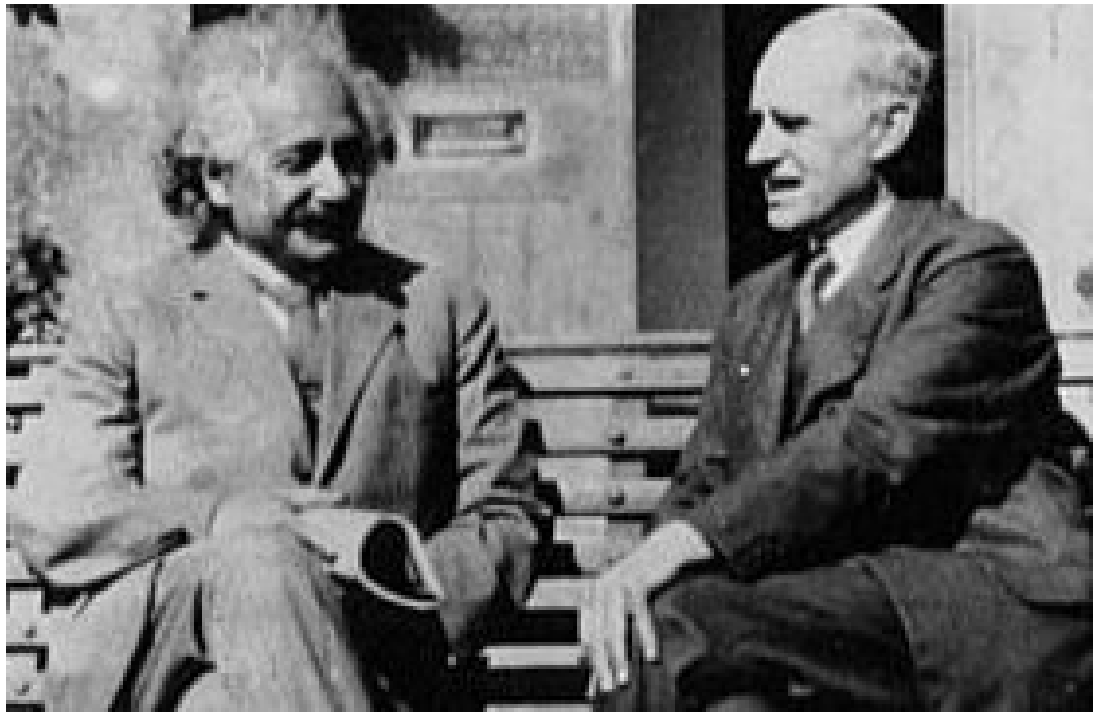
Eddington's 1919 Eclipse Experiment



Eddington found that the star had indeed shifted position, and by the amount predicted by the equations of General Relativity. This apparent shift of a star's light as it passed close to the sun on its way toward us was the first physical evidence in support of Einstein's General Relativity.

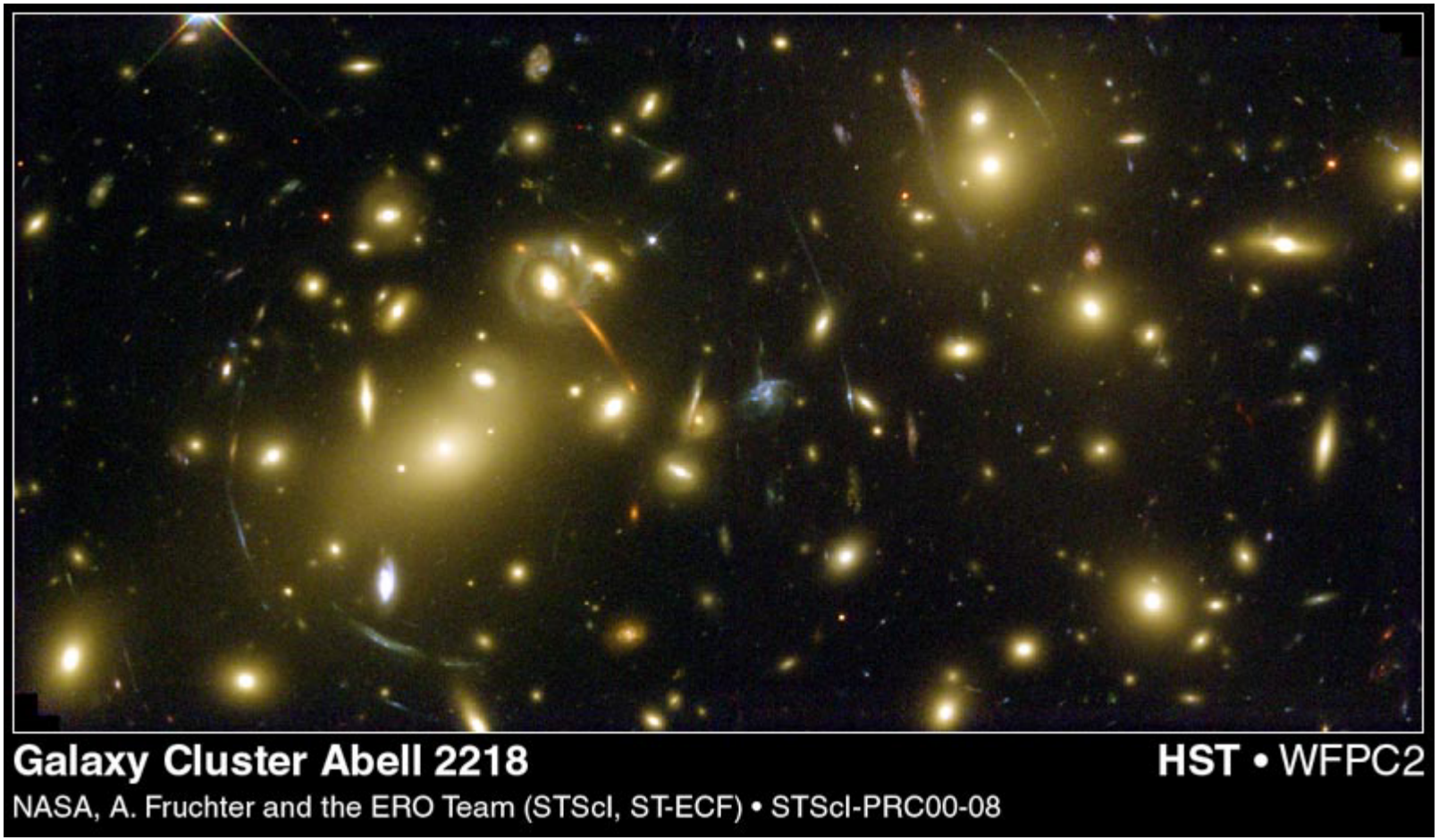
Since Eddington, an enormous number of experiments to test Einstein's theory of General Relativity has confirmed it. Not a single experiment to this day has cast the doubt on the unity of matter and space-time.

And in science, that's saying a lot, because the very nature of scientific endeavor is to challenge the models we have. We are always trying to disprove Relativity, to look for a flaw, an inconsistency, but none has yet been found.



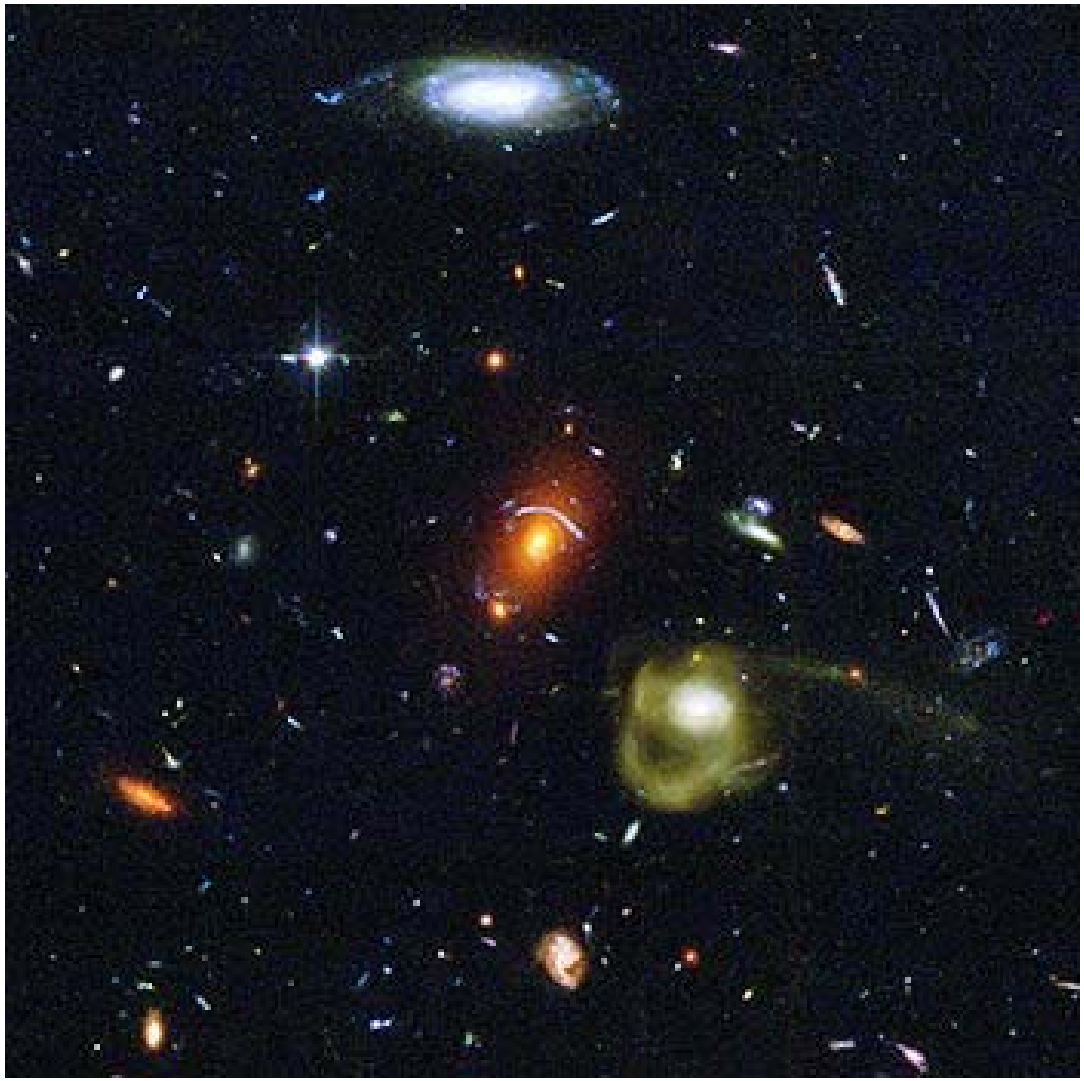
Einstein and Eddington

In this cosmic ‘gravitational lens,’ a huge cluster of galaxies distorts the light from more distant galaxies into a pattern of giant arcs.



Galaxy Cluster Abell 2218 **HST • WFPC2**

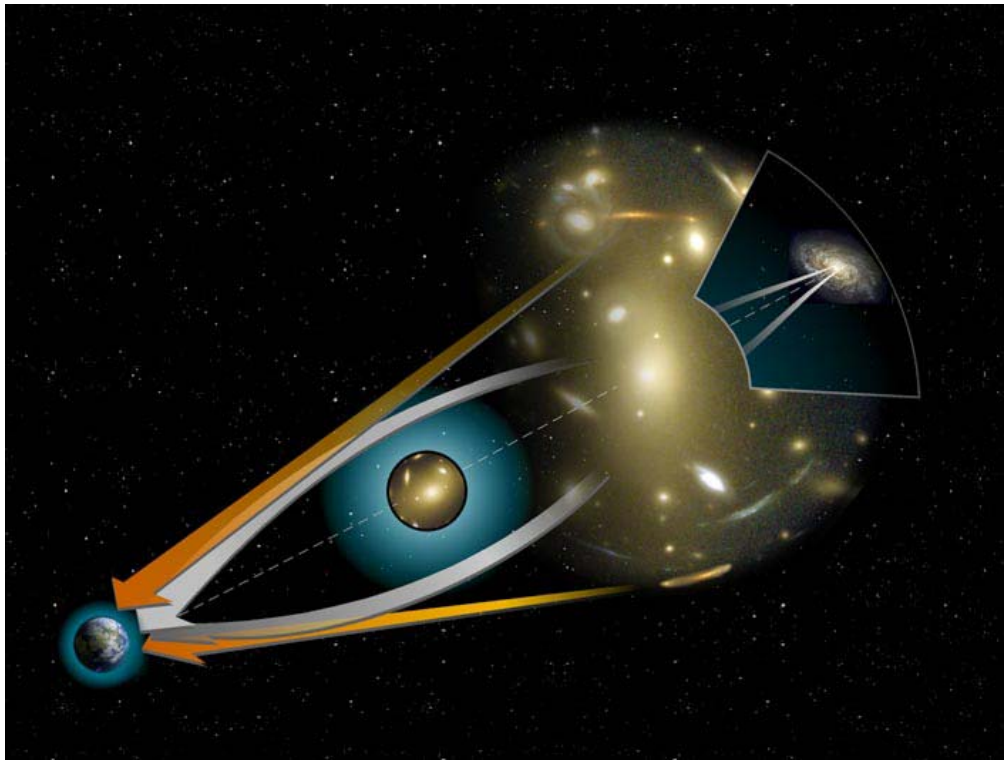
NASA, A. Fruchter and the ERO Team (STScI, ST-ECF) • STScI-PRC00-08



The most peculiar-looking galaxy in the image — the dramatic blue arc in the center — is actually an optical illusion. The blue arc is an image of a distant galaxy that has been smeared into the odd shape by a phenomenon called gravitational lensing.

http://hubblesite.org/newscenter/newsdesk/archive/releases/2004/21/

Warping of space



The curvature — or warping — of space was originally proposed by Einstein as early as 1915 in his theory of General Relativity.

It takes rather massive objects, like clusters of galaxies, to make space curve so much that the effect is observable in deep images of the distant Universe. And so far gravitational lenses have mainly been observed around clusters of galaxies. They are collections of hundreds or thousands of galaxies and are thought to be the largest gravitationally bound structures in the Universe.

Newton's Law of Universal Gravitation has Several Flaws

1. It gave the wrong prediction for the precession of the perihelion of Mercury's orbit.
2. It did not explain why gravitational acceleration is independent of the mass or composition of an object.
3. Instantaneous force of gravitational attraction between two objects means information about the location of one object would be transmitted to another object instantaneously by changes in the gravitational force.
4. Incorrect predictions for gravitational lensing

Einstein's General Theory of Relativity

GR solved all three of the above problems, and at the same time it radically altered physicists' view of the Universe. The main features of General Relativity are:

1. Space and space-time are not rigid arenas in which events take place. They have form and structure which are influenced by the matter and energy content of the universe.
2. Matter and energy defines space (and space-time) curvature.
3. Space defines how matter moves. In particular small objects travel along the straightest possible lines in curved space (space-time).

Einstein's General Theory of Relativity

In curved space the rules of Euclidean geometry are changed. Parallel lines can meet, and the sum of the angles in a triangle can be more, or less than 180 degrees, depending on how space is curved.

Einstein's theory gave a correct prediction for the perihelion shift of Mercury.

It also explained why objects fall independent of their mass: they all follow the same straightest possible line in curved space-time.

Finally, in Einstein's theory the instantaneous gravitational force is replaced by the curvature of space-time.

Moving a mass causes ripples to form in this curvature, and these ripples travel with the same speed as light. Thus, a distant mass would not feel any instantaneous change in the gravitational force.

Golem's Critique of Experimental Methods

To understand the true story of how scientific advances occur, Trevor Pinch, Professor of Science and Technology Studies and Professor of Sociology at Cornell University and co-author British sociologist of science Harry Collins, Professor of Sociology, Cardiff University and School of Social Sciences, have studied contemporary descriptions of some historic experiments. The results, they say, do not agree with streamlined, modern views of the experiments.

Take, for example, the test by Eddington, of Einstein's prediction that gravity bends light. Eddington wanted to track starlight passing near the sun, and he used the sun's approximate mass to calculate the deflection predicted by Einstein.

The experimental situation

The measurements had to be precise, since the calculated deflection was a hair-thin ~1/3600-degree.

Since the sun's gravity would be bending the light, Eddington had to measure a star almost directly behind the sun.

Because the sun's glare would normally obscure the star, he had to work during a solar eclipse, meaning he had to set up a small, field telescope in a part of the world under a total eclipse.

Because the comparison pictures (those not affected by the sun's gravity) had to be taken at night, Eddington had to factor in the temperature-induced size changes in the telescope. That tiny increment was about equal to the gravity-induced deflection being sought.

The Sun in the Test Tube: the Story of Cold Fusion

The Golem
(Collins, Pinch)

Advantages of Fusion

Abundant Fuel Supply

The major fuel, deuterium, may be readily extracted from ordinary water, which is available to all nations. The surface waters of the earth contain an essentially inexhaustible supply. The tritium required would be produced from lithium, which is available from land deposits or from sea water which contains thousands of years' supply. The world-wide availability of these materials would thus eliminate international tensions caused by imbalance in fuel supply.

No Risk of a Nuclear Accident

The amounts of deuterium and tritium in the fusion reaction zone will be so small that a large uncontrolled release of energy would be impossible. In the event of a malfunction, the plasma would strike the walls of its containment vessel and cool.

Advantages of Fusion

No Air Pollution

Since no fossil fuels are used, there will be no release of chemical combustion products because they will not be produced.

No High-level Nuclear Waste

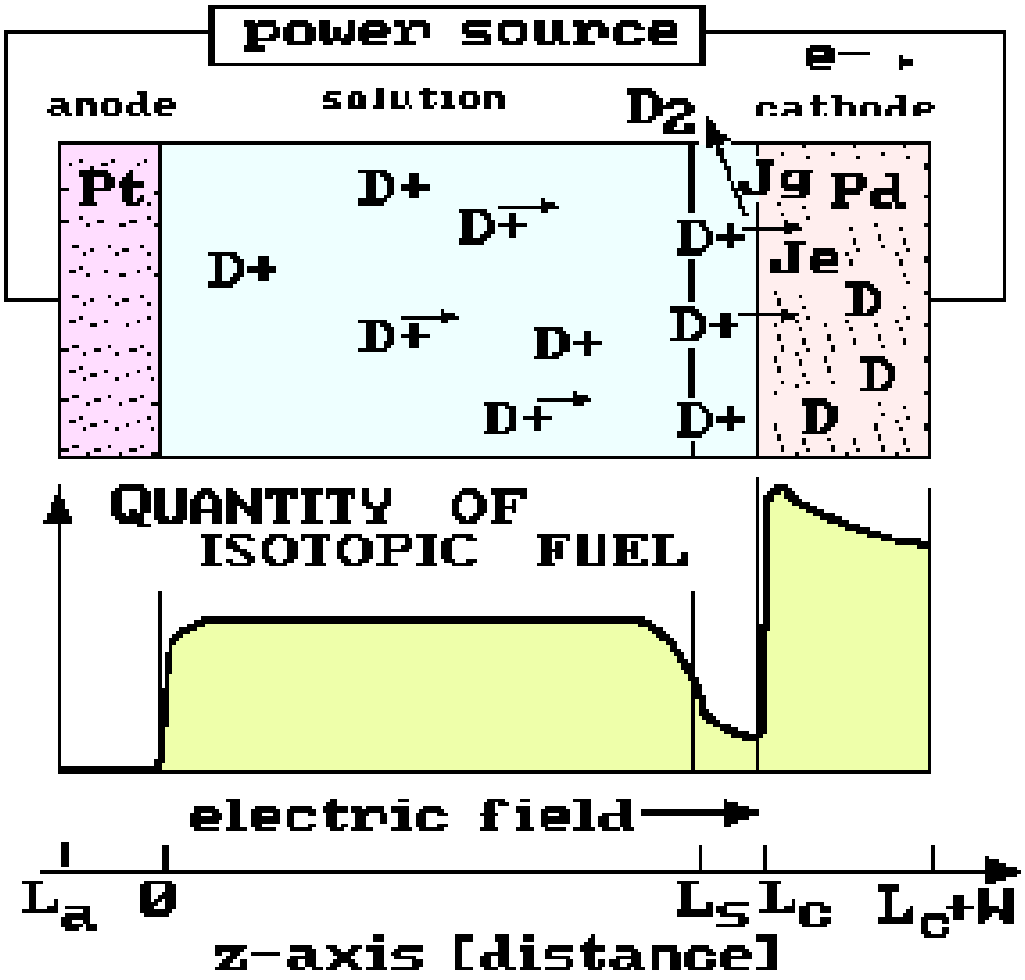
Similarly, there will be no fission products formed to present a handling and disposal problem. Radioactivity will be produced by neutrons interacting with the reactor structure, but careful materials selection is expected to minimize the handling and ultimate disposal of activated materials.

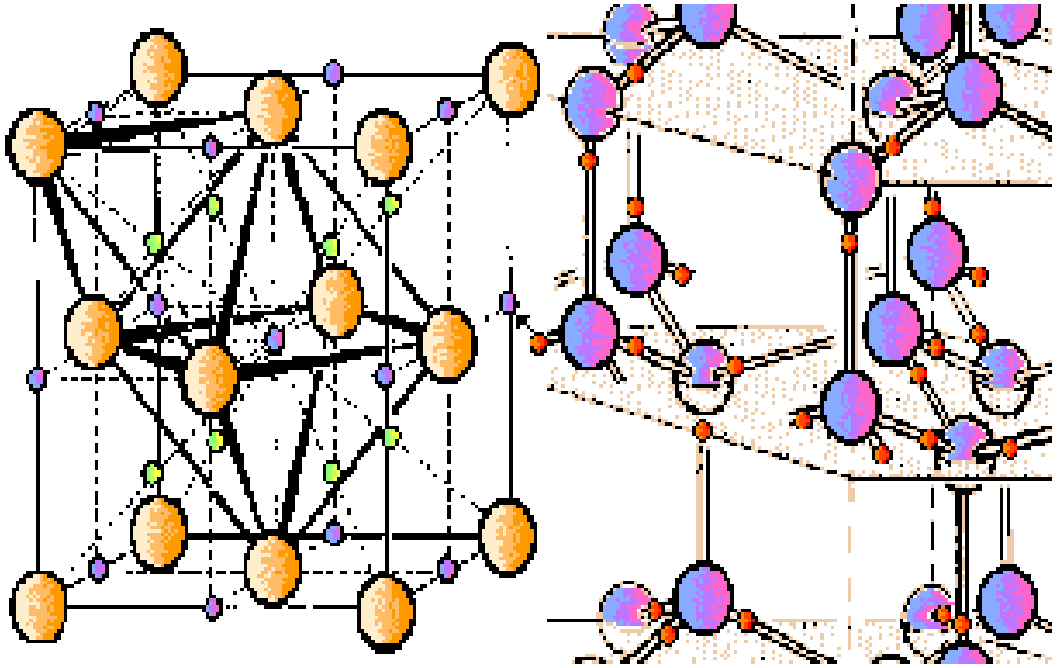
Advantages of Fusion

No Generation of Weapons Material
Another significant advantage is that the materials and by-products of fusion are not suitable for use in the production of nuclear weapons.

Summary
The abundance of raw materials, their wide distribution, and the environmental acceptability of fusion are augmented by the expectation that fusion energy will be an economical source of electricity generation.

The Cold Fusion Reaction





The cold fusion reactions were supposed to follow after successful loading of the metals by an isotope of hydrogen (deuterium).
In the figure on the right, the heavy water is composed of D2O molecules and is used to electrochemically load the palladium.
The metallic palladium is on the left hand side of the figure, and is shown fully loaded.

Cold Fusion Still Alive on the Margins

Tenth International Conference on Cold Fusion (ICCF-10)

Cambridge, Massachusetts 24 - 29 August 2003

The ICCF-10 conference finished on August 29. The conference abstracts and other information on this website has been transferred to a new section at LENR-CANR.org. An electronic version of the proceedings will be established there as papers from the authors are received. This site will be maintained for a few months. NOTICE: The ICCF-10 Steering Committee, in its infinite wisdom, has taken pity on the authors and moved the deadline from Sept. 10 to Oct. 1, 2003. Please repay this consideration with your prompt submission.

Authors contributing papers to the proceedings will find instructions below.

Contents of this web page:

http://www.amasci.com/weird/wcf.html

Weird Research, Anomalous Physics

"Cold Fusion" Links

A Window to the Universe: the Non-detection of Gravitational Radiation

The Golem
(Collins, Pinch)

Gravitational Waves

When a charge undergoes an acceleration there is an emission of electromagnetic waves that propagate in the space with the speed of light and reveal themselves by producing acceleration of other charges.

Similarly, one can say that, when a body with mass undergoes an acceleration, there is an emission of gravitational waves. They also propagate at the speed of light and reveal themselves causing acceleration of masses with respect to other masses.

Gravitational Waves

At the end of the last century, during three decades, we have had the theoretic prediction of the electromagnetic waves (Maxwell, 1864), their laboratory observation (Hertz, 1887) and finally their practical utilization in the radio communications (Marconi, 1896).

About 80 years have passed from the theoretic prediction of gravitational waves (Einstein, 1916) and though there have been huge technological developments during the last decades, there is not yet a direct evidence of their existence.

Gravitational Waves

The reason is that they **interact with matter weakly**: for example, a gravitational wave that goes through the Sun loses only one part out of 10E-16 of its energy. By comparison, neutrinos, that are particles having the weakest interaction with the matter, would lose one part out of 10E-7 of their energy going through the Sun: that is an amount one thousand millions times greater than that lost by a gravitational wave.

For this reason, the experimental **testing of their existence has aimed at the detection of catastrophic astrophysical events, where a great amount of energy can be emitted by gravitational waves**.

Gravitational Waves

Typical examples of the emission processes are supernova explosions, formation of black holes and collision of solid celestial.

The early experiments for the detection of gravitational waves date back to the Sixties, when the American physicist J. Weber built a series of gravitational antennas and recorded the presence of signals that he explained as gravitational pulses. The experiment used cylindrical bars, a few tons of mass, operating at room temperature and whose vibrations were detected by piezoeletric ceramics; it was repeated by other groups but it was not confirmed.

Gravitational Waves

Gravitational Waves

In spite of that, in the seventies other groups started this research developing new technologies though they knew that, if the sources of gravitational waves had been the ones foreseen by General Relativity, it would have taken decades before reaching the goal.

Gravitational Waves

Particularly, the groups of Stanford, Louisiana and Rome Universities started to design cryogenic antennas (operating at very low temperature), while groups at MIT, Max Planck in Munich and Glasgow University started the study of laser interferometers.

The interferometers have the ability to measure the gravitational wave induced strain in a broad frequency band (expected to range from 10 or 100 Hz up to perhaps 5 kHz), while the bars measure the gravitational wave Fourier components around the bar's resonant frequency, usually near 1 or 2 kHz.

Gravitational Waves

Nowadays, there are research groups that develop cryogenics antennas in USA, Japan, Australia, China, Russia and Italy.

Likewise there are other groups that are carrying out big ground laser interferometers: the MIT-Caltech, Pisa-Orsay and Max Planck-Glasgow cooperations, and the Japanese and Australian national programs.

Harry Collins's Gravitational Wave Project http://www.cf.ac.uk/socsi/gravwave/ Gravity's Shadow The Search For Gravitational Waves

Collins and the Experimenters' Regress

Stanford Encyclopedia of Philosophy

Harry Collins, is well known for his skepticism concerning both experimental results and evidence. He develops an argument that he calls the "**experimenters' regress**".

What scientists take to be a correct result is one obtained with a properly functioning experimental apparatus. But a good experimental apparatus is simply one that gives correct results.

Collins and the Experimenters' Regress

Stanford Encyclopedia of Philosophy

Collins claims that there are no formal criteria that one can apply to decide whether or not an experimental apparatus is working properly. In particular, he argues that calibrating an experimental apparatus by using a surrogate signal cannot provide an independent reason for considering the apparatus to be reliable.

Collins and the Experimenters' Regress

Stanford Encyclopedia of Philosophy

In Collins' view the regress is eventually broken by negotiation within the appropriate scientific community, a process driven by factors such as the career, social, and cognitive interests of the scientists, and the perceived utility for future work, but one that is not decided by what we might call epistemological criteria, or reasoned judgment.

Thus, Collins concludes that his regress raises serious questions concerning both experimental evidence and its use in the evaluation of scientific hypotheses and theories. Indeed, if no way out of the regress can be found then he has a point.

Collins and the Experimenters' Regress

Stanford Encyclopedia of Philosophy

Collins strongest candidate for an example of the experimenters' regress is presented in his history of the early attempts to detect gravitational radiation, or gravity waves.

In this case, the physics community was forced to compare Weber's claims that he had observed gravity waves with the reports from six other experiments that failed to detect them.

Collins and the Experimenters' Regress

Stanford Encyclopedia of Philosophy

On the one hand, Collins argues that the decision between these conflicting experimental results could not be made on epistemological or methodological grounds.

He claims that the six negative experiments could not legitimately be regarded as replications and hence become less impressive.

On the other hand, Weber's apparatus, precisely because the experiments used a new type of apparatus to try to detect a hitherto unobserved phenomenon, could not be subjected to standard calibration techniques.

Collins and the Experimenters' Regress

Stanford Encyclopedia of Philosophy

The results presented by Weber's critics were not only more numerous, but they had also been carefully cross-checked.

The groups had exchanged both data and analysis programs and confirmed their results. The critics had also investigated whether or not their analysis procedure, the use of a linear algorithm, could account for their failure to observe Weber's reported results.

Collins and the Experimenters' Regress

Stanford Encyclopedia of Philosophy

The critics had used Weber's preferred procedure, a nonlinear algorithm, to analyze their own data, and still found no sign of an effect. They had also calibrated their experimental apparatuses by inserting acoustic pulses of known energy and finding that they could detect a signal.

Weber, on the other hand, as well as his critics using his analysis procedure, could not detect such calibration pulses.

Collins and the Experimenters' Regress

Stanford Encyclopedia of Philosophy

There were, in addition, several other serious questions raised about Weber's analysis procedures. These included an admitted programming error that generated spurious coincidences between Weber's two detectors, possible selection bias by Weber, Weber's report of coincidences between two detectors when the data had been taken four hours apart, and whether or not Weber's experimental apparatus could produce the narrow coincidences claimed.

Collins and the Experimenters' Regress

Stanford Encyclopedia of Philosophy

It seems clear that the critics' results were far more credible than Weber's.

They had checked their results by independent confirmation, which included the sharing of data and analysis programs.

They had also eliminated a plausible source of error, that of the pulses being longer than expected, by analyzing their results using the nonlinear algorithm and by explicitly searching for such long pulses.

They had also calibrated their apparatuses by injecting pulses of known energy and observing the output.

Collins and the Experimenters' Regress

Stanford Encyclopedia of Philosophy

Contrary to Collins, I believe that the scientific community made a reasoned judgment and rejected Weber's results and accepted those of his critics. Although no formal rules were applied, i.e. if you make four errors, rather than three, your results lack credibility; or if there are five, but not six, conflicting results, your work is still credible; the procedure was reasonable.

Collins and the Experimenters' Regress

Stanford Encyclopedia of Philosophy

Scientific communities tend to reject data that conflict with group commitments and, the opposite, to adjust their experimental techniques to tune in on phenomena consistent with those commitments.

The emphasis on future utility and existing commitments is clear. These two criteria do not necessarily agree. For example, there are episodes in the history of science in which more opportunity for future work is provided by the overthrow of existing theory.

Golem Conclusion

History, Collins and Pinch argue, shows that science is not a purified, hyper-logical pursuit, but rather a form of human expertise that is subject to some of the same limitations affecting other areas of expertise.

Loosing the ambition to represent THE ABSOLUTE TRUTH does not however mean science and myth are systems of thought of commensurable nature. They are NOT. Myths are deeply and profoundly CONSERVATIVE. Science is in its grounds PROGRESSIVE.

That is why SCIENTIFIC PROGRESS must be very carefully analyzed and critically reflected upon. That is among others done within ETHICS.