

Post -Critical Facets

Let's start with the renowned mathematician
Descartes. We've heard
of his famous motto:

**"Cogito;
ergo sum"**

**"I think,
therefore I am."**



René Descartes
(1596-1650)

Legend tells us that Descartes often woke up late and spent the cold mornings in a stove-heated room, contemplating mathematics and philosophy. One day he came out and got the idea of

doubt

According to Descartes, we should apply our mind to question everything that is not firmly rooted in “**reason**”.

Thus, to doubt is to think:

“**I doubt, therefore I am.**”

This is referred as *Descartes’ doubt*.



How are these insights related to us?

**The thinkers of that time set out to
`liberate' REASON from
enslavement by AUTHORITY.**

Major ideas propounded:

**(1) Scientific method based on
reason.**

**(2) Freedom and democracy,
replacing dogmatic authority.**

**(3) *Laissez-faire* economy –
open and free market as
an `invisible hand'.**

Adam Smith.

As usual, these ideas initially were rejected and ignored, but later found lives of themselves:

(1) Scientific advances led to the Industrial Revolution, and a world based on machines.



(2) America adopted the representative democratic system. Freedom replaces authority.



(3) Free market and capital system tried in England and France, then spread to other countries.

**But as the ideas grew old,
problems started to appear:**

**(1) Machines brought not
only products but also
pollution.**



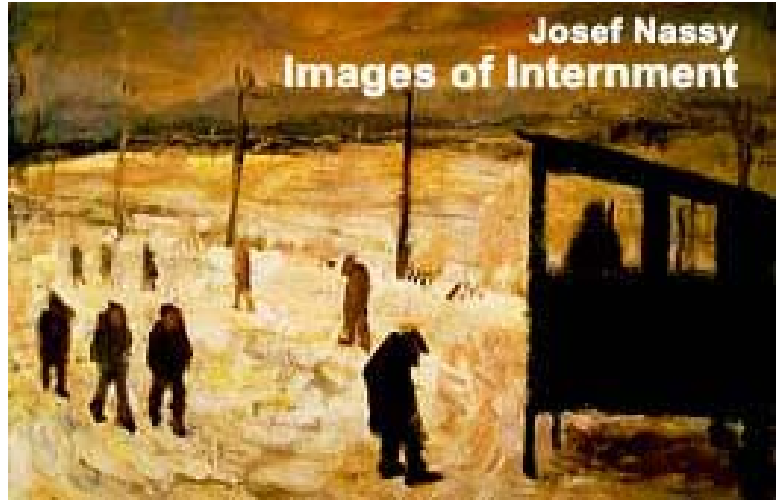
Major cities in Europe were

**covered with smog so that rickets
was widespread.**

**(2) Freedom and reason dispose
all traditionally guiding ideas,
to the extent of being `unscientific`**

**(3) Free market led to a small
amount of `greedy capitalists`,
and a large portion of poor and
oppressed people.**

**The situation was especially
gruesome in the first
half of the 20th
Century:**



**- Two World
Wars,
Holocaust.**

-Communist Countries.

**-Threat of nuclear and chemical
weapons.**

United Nation Chief Kofi Annan, when he delivers the Nobel Lecture in 2001, says

"Distinguished guests: The idea that there is one *people* in possession of the truth, one answer to the world's ills, or one solution to humanity's needs, **has done untold harm throughout history** - especially in the last century."

"We understand, as never before, that each of us is fully worthy of the respect and dignity essential to our common **humanity**. We recognize that we are the products of many **cultures**, **traditions** and **memories**; that *mutual respect allows us to study and learn from other cultures; and that we gain strength by combining the foreign with the familiar.*"

Against this background, people sought to reintroduce humanistic and personal factors into the all mighty REASON.

A particularly influential person is scientist/philosopher Michael Polanyi (1891-1976).

Major works:

Personal Knowledge

Tacit Dimension

He claims that

to doubt is to believe.

Consider a statement *S*. To doubt *S* means that either I *believe S* is wrong, or I *believe S* has not been proven.

Polanyi continues to explain that human is not mere machine that responds automatically to REASON and `OBJECTIVE KNOWLEDGE`.

How are these ideas related to us?

What kind of new insights to be added to the Idea-Criticism Model of Mathematics, namely,

“Mathematics is developed by thinking critically and carefully about mathematical ideas, and is propelled by new ideas.”

We will discuss the following facets:

(1) Personal Use of Imagination;

(2) Heritage/tradition;

(3) Connoisseurship;

(4) Conviviality;

(5) Serendipity.

(1) Personal Use of Imagination

Imagination is at the core of learning and thinking about mathematics. Einstein explains:

Science

(and also Mathematics) is not **just** a collection of laws, a catalogue of unrelated facts. ***It is a creation of the human mind, with its freely invented ideas and concepts...***

KNOWLEDGE \neq FACTS

An insightful statement made by the 1986 Nobel Chemistry Laureate John C. Polanyi (son of Michael Polanyi):

"It is only in the popular mind that (knowledge) equates with facts. That is of course flattering, since facts are incontrovertible. But it is also demeaning, since facts are meaningless. They contain no narrative."

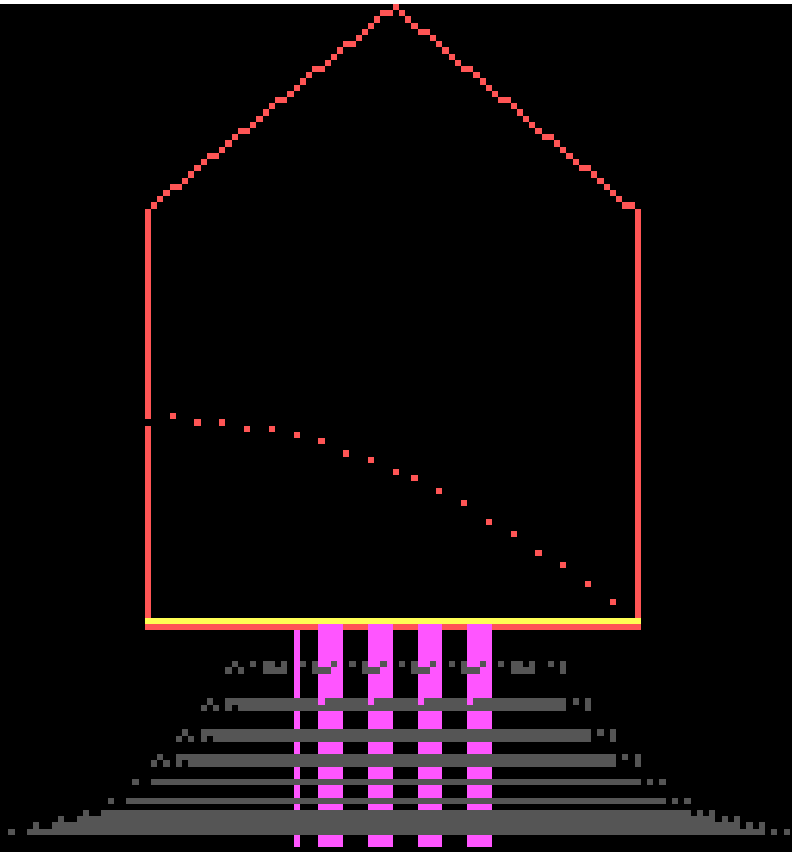
KNOWLEDGE \approx

**FACTS + CREATIVE IDEAS +
CRITICISM**

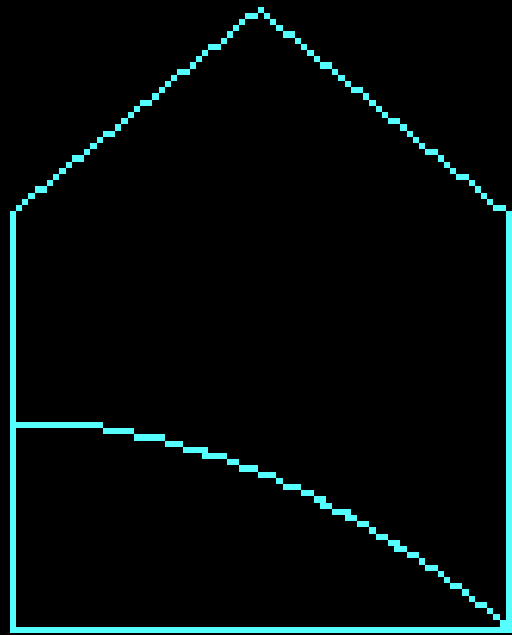
Facts are objective, but inventive ideas tend to be more personal (at least for the inventor).

The same fact can sometime be described by different ideas.

Einstein's Principle of Equivalence:



no gravity
**UNIFORM
ACCELERATION**



GRAVITY

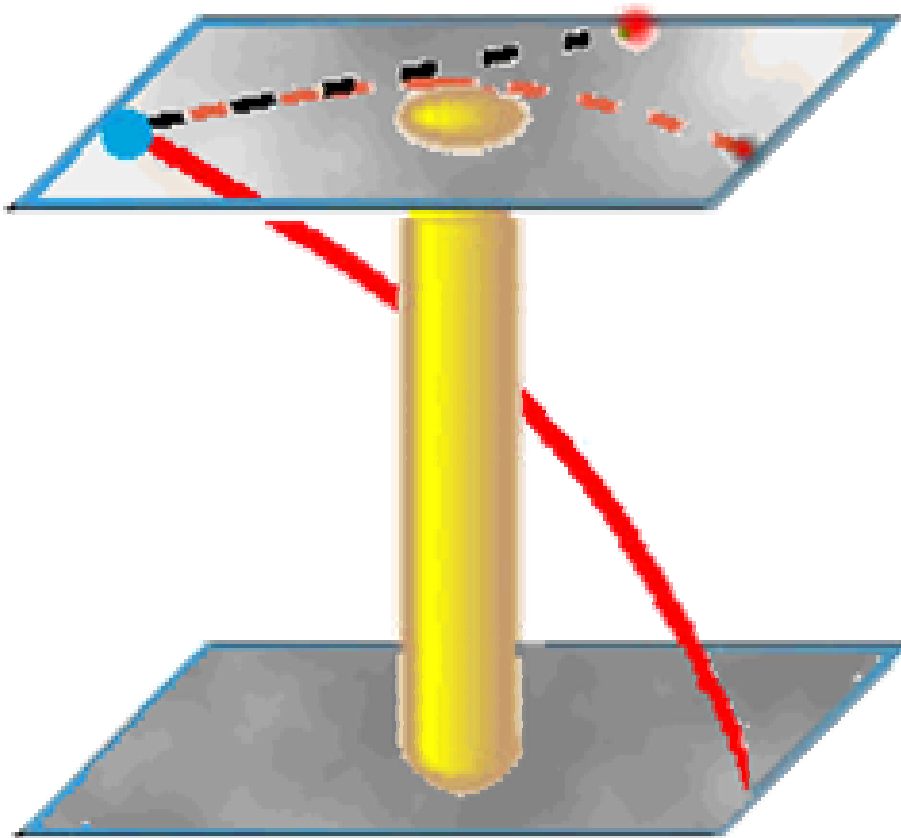
You can't tell which idea is
'better' (than the other one).

While sitting in his office in Bern, Switzerland, in 1907, *Einstein suddenly realized that if he were to fall freely in a gravitational field, he would be unable to feel his own weight.*

Einstein later recounted that this realization was the "happiest moment in his life", for he understood that this *idea* was the key to extend the Special Theory of Relativity to include the effect of gravitation.



The Deflection of Starlight



As students, in your study, you are capable and encouraged to discover and rediscover insights on your own. And imagination is a big help.