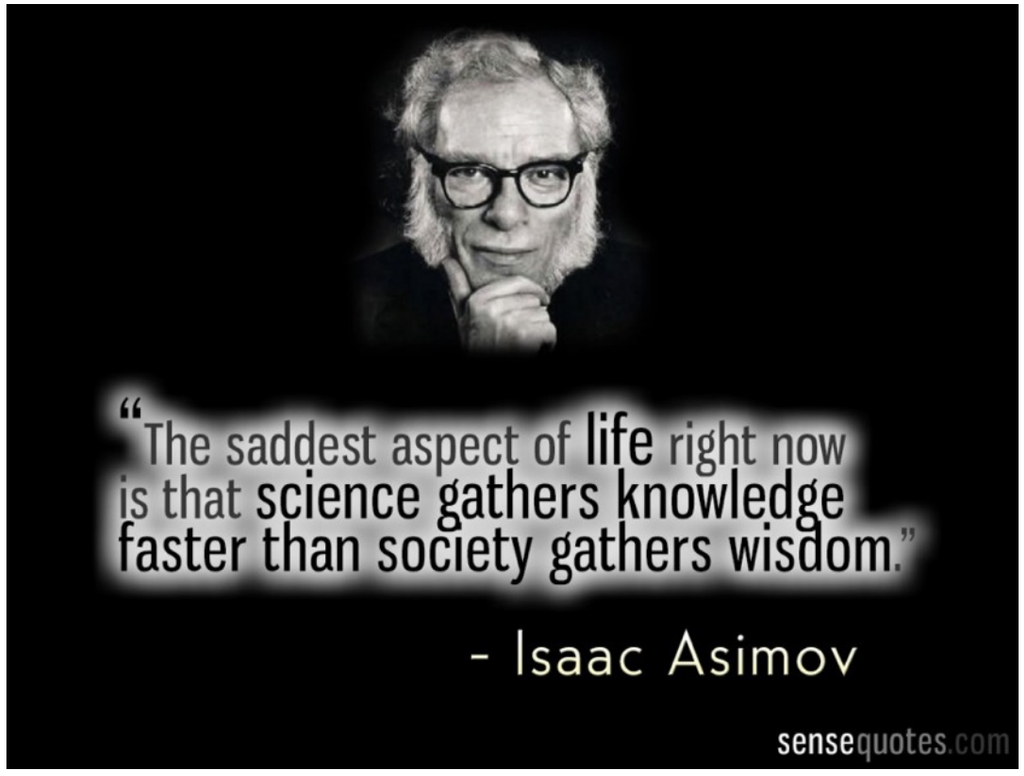
Lecture 9

Science and Society

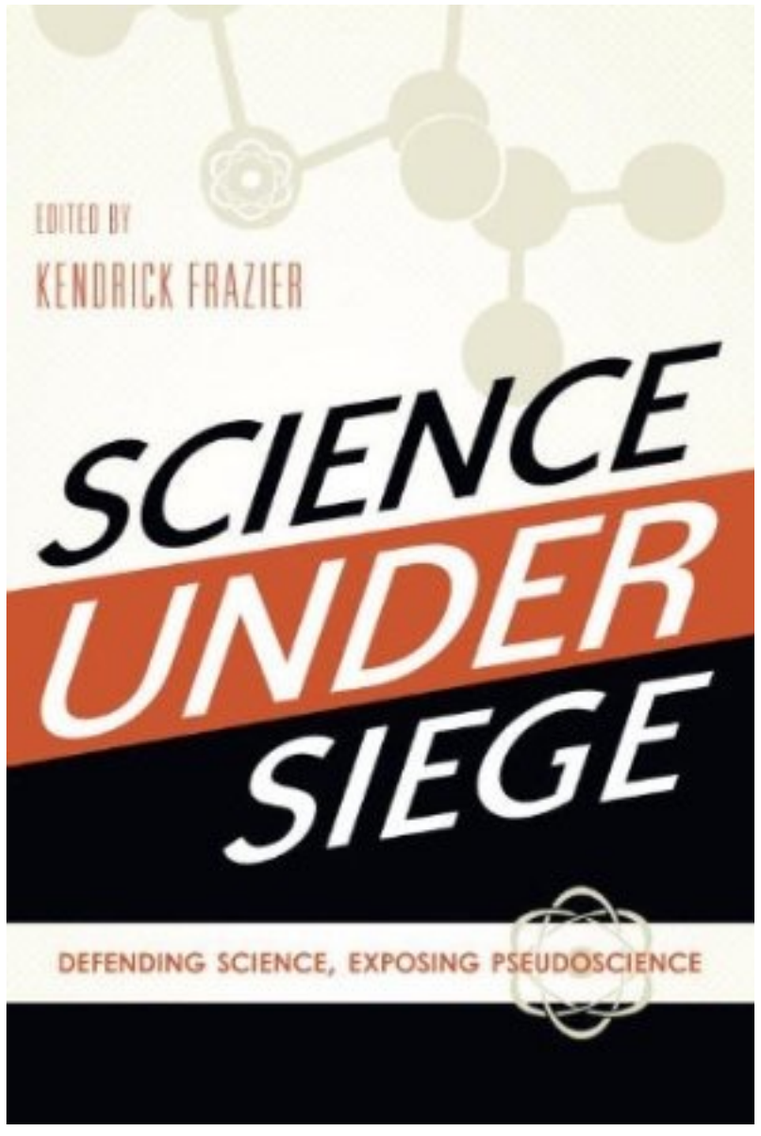


Science in Society

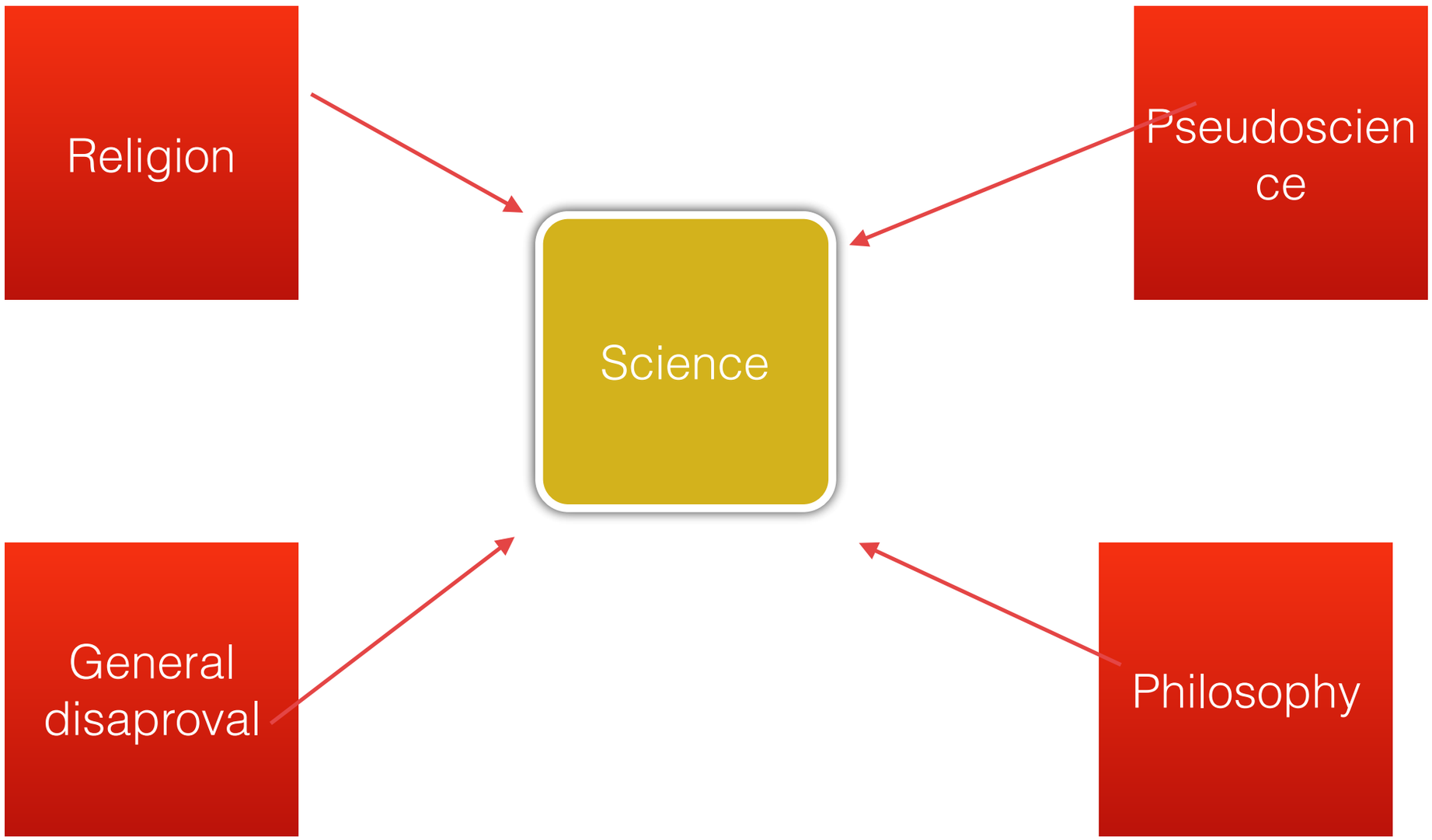
- Generally, science is considered a good thing.
- Science has given us technology, healthcare, space travels and so on.
- Science has given us knowledge and wisdom.
- Science has to some extent satisfied our need to understand the world.
- So who doesn't like science?

Science Under Siege!

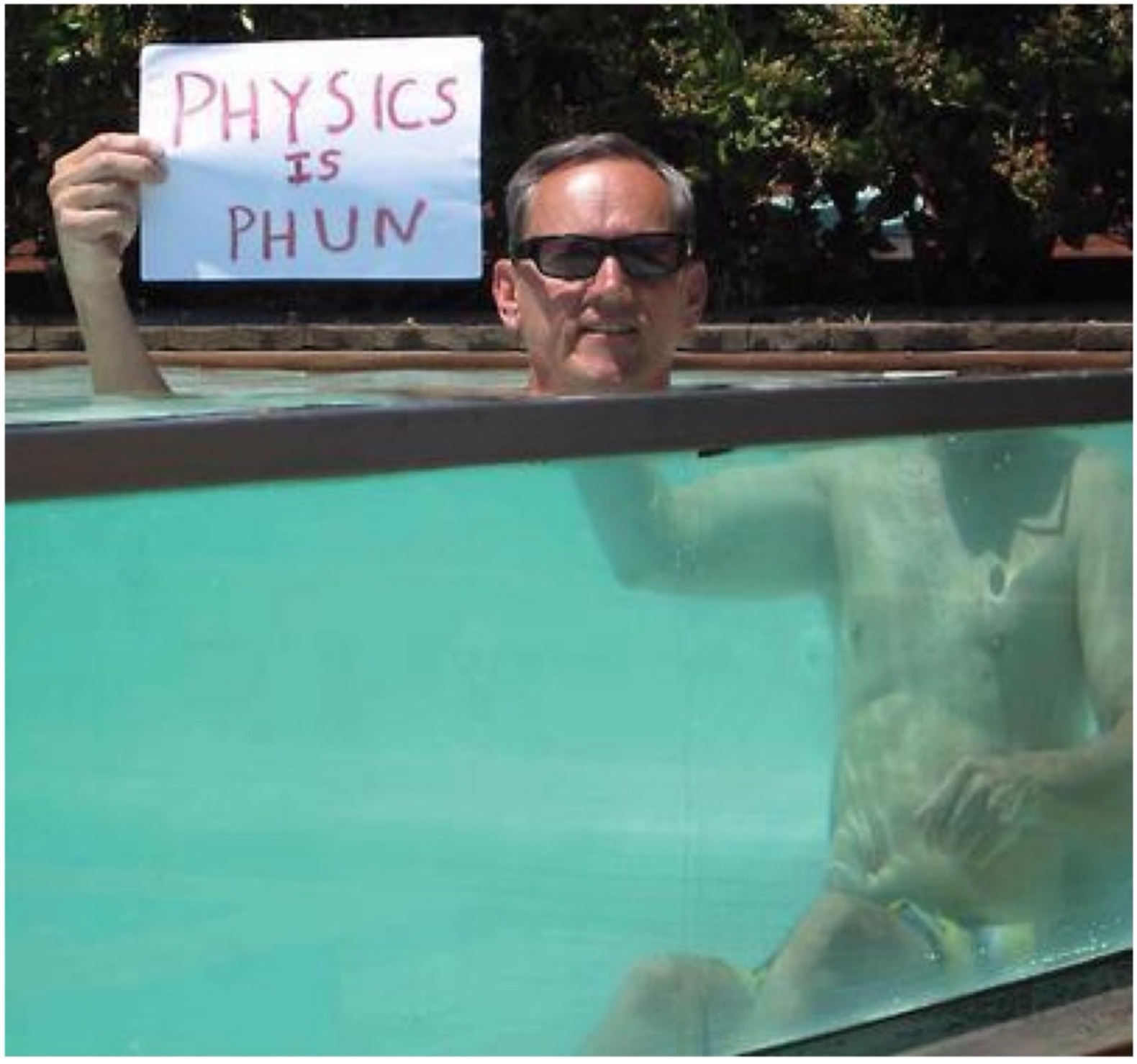
- General disapproval - Science is harmful in a lot of ways
- Religion - Science is sometimes incompatible with religious beliefs.
- Pseudoscience - Other ideas and beliefs also want to get recognition.
- Philosophically disapproval - Scientists are not as smart as they think.



Science Under Siege!



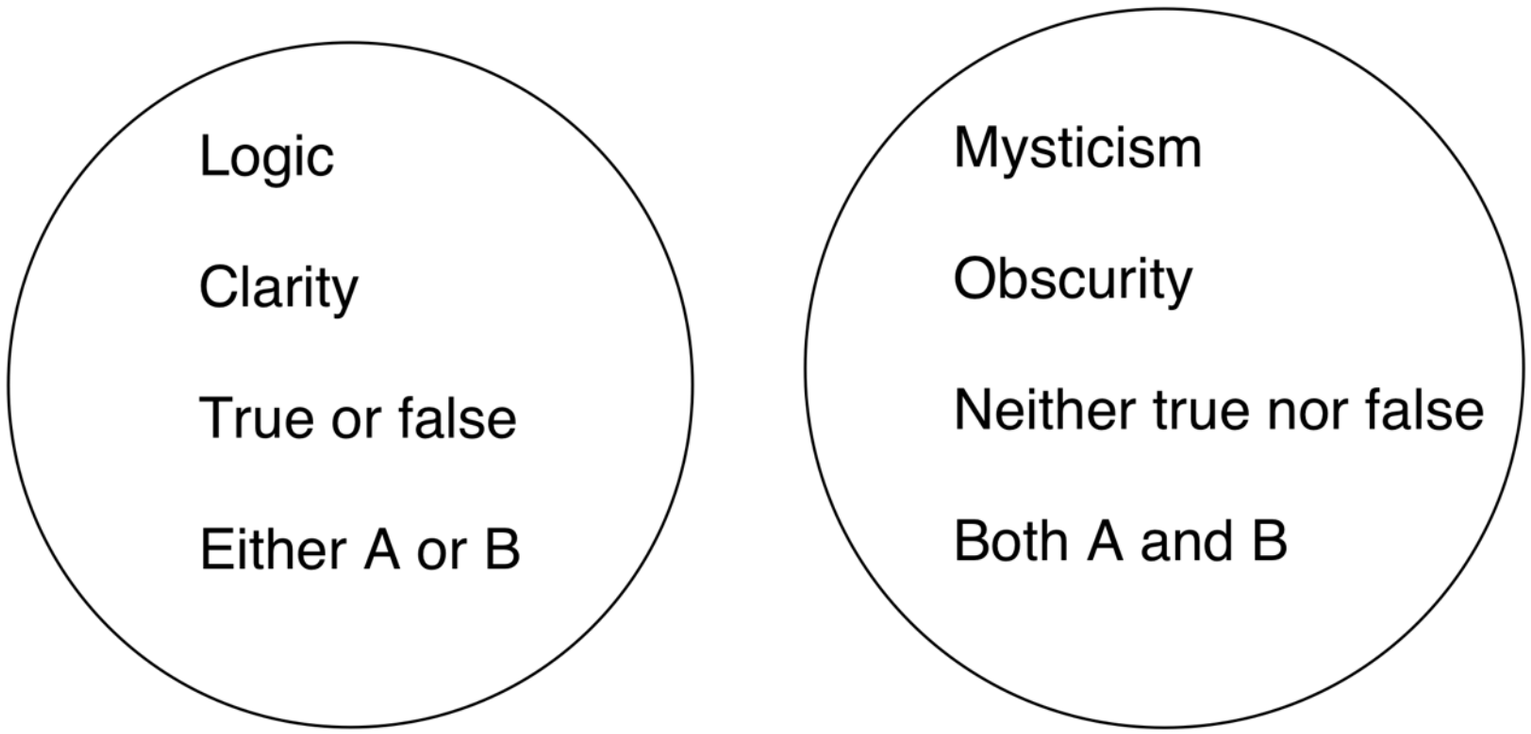
IFLS - We like science!



“Poets say science takes away from the beauty of the stars - mere globs of gas atoms. I too can see the stars on a desert night, and feel them. But do I see less or more? The vastness of the heavens stretches my imagination - stuck on this carousel my little eye can catch one - million - year - old light. A vast pattern - of which I am a part... What is the pattern, or the meaning, or the why? It does not do harm to the mystery to know a little about it. For far more marvelous is the truth than any artists of the past imagined it. Why do the poets of the present not speak of it? What men are poets who can speak of Jupiter if he were a man, but if he is an immense spinning sphere of methane and ammonia must be silent?”

— Richard P. Feynman

Two spheres


Logic
Clarity
True or false
Either A or B
Mysticism
Obscurity
Neither true nor false
Both A and B

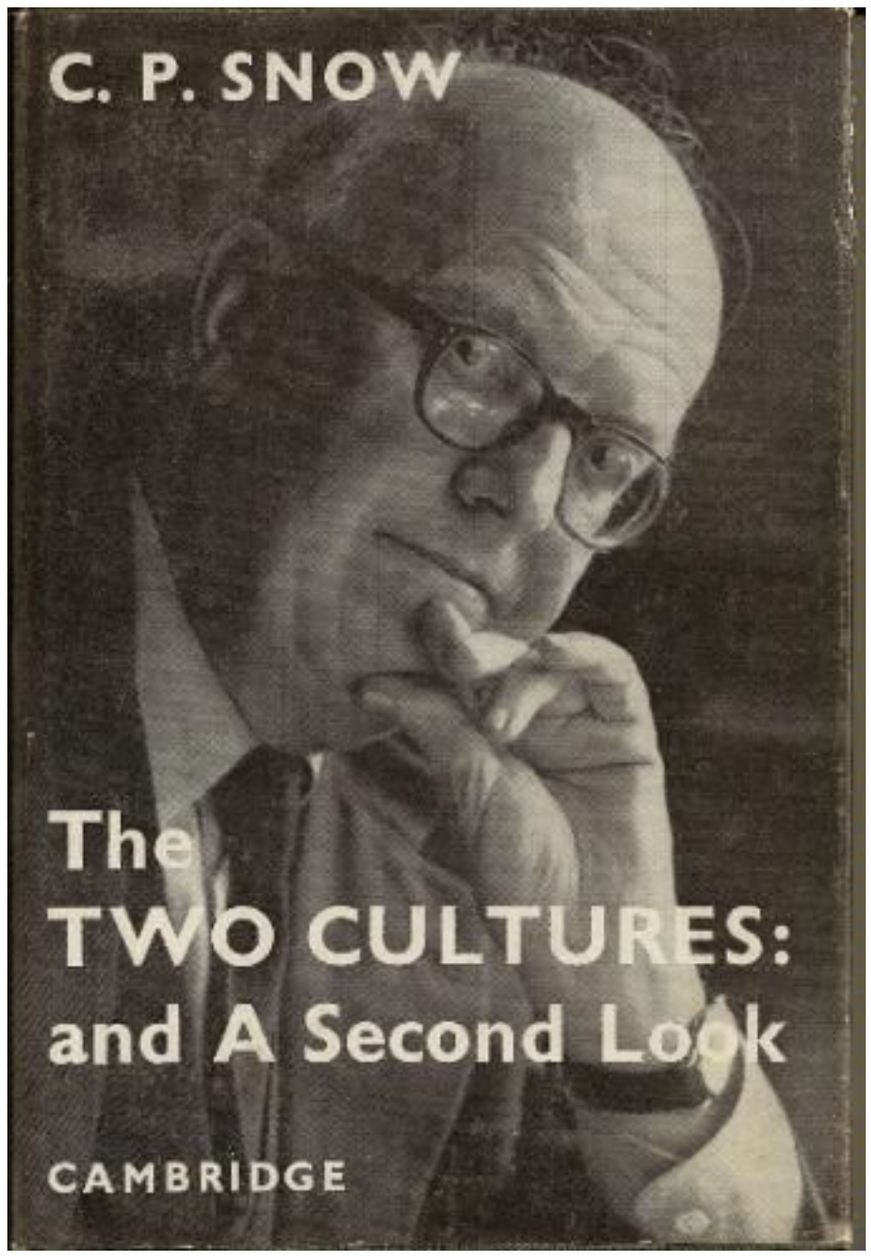
The two cultures

Science - Humanities

Why do we have the division?

Do we want it?

Is it necessary?



Three ways to classify Sciences

- What is the conception of truth ?
- What methods are used?
- What are the goals you want to achieve?

Exemples of sciences

How would we classify the following areas based on the previous questions?

Psychology ?
History?
Political Science?
Literary Theory ?
Economics ?

Mathematics and Natural Science

Truth: An objective truth.

Method: In essence deduction and hypothetical - deductive method linked to experiments.

Objectives: Knowledge of the objectively existing world and the mathematical world .

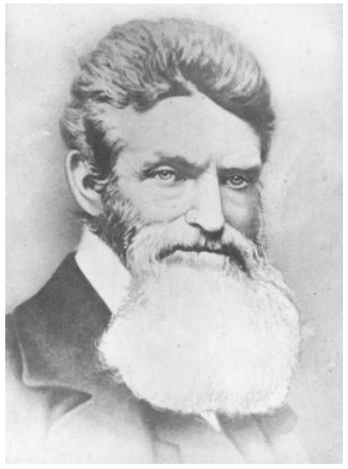
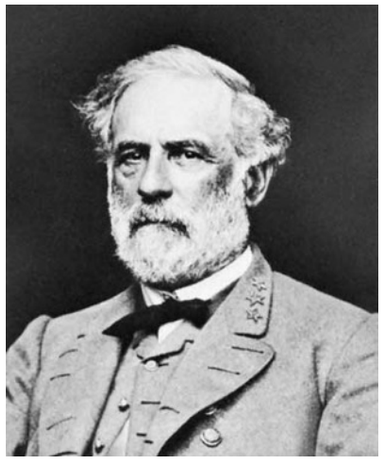
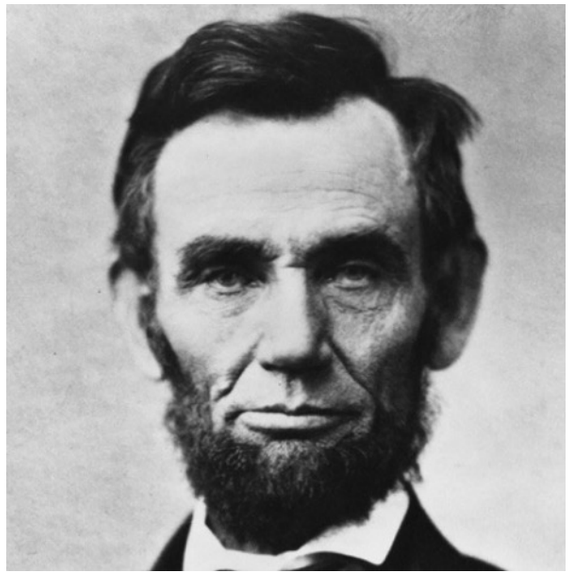
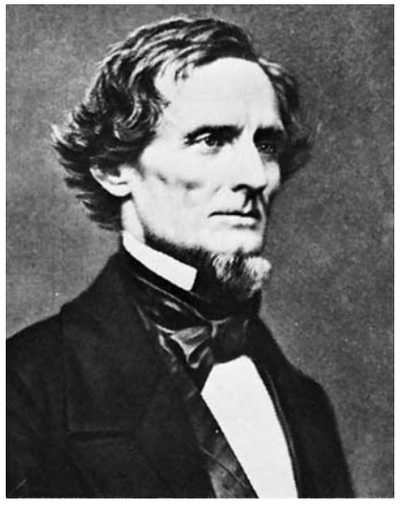
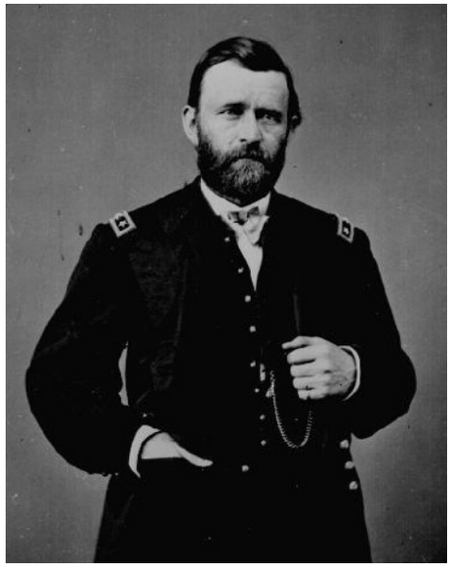
The Humanities

Truth: Very diverse perceptions.

Method: The hermeneutic method
(understanding) seems the most important.

Goal: Very diverse perceptions. Most likely, they are all about understanding the world in all aspects related to humans.

The American Civil War

- What started the war?
- What was it all about?
- Could it have ended differently?

Collectivism versus individualism

To answer the first question , there are different strategies.

Methodological individualism : Analyze what the most important actors in the historical process did and thought .

Methodological collectivism : Analyze the ideas and forces that existed in society and what they led to .

What was the war about?

- It is thought to be about the existance of slavery.

- It could also have been about the federal governments right to control over the states.

- Who is right?

Narration

One view is that a historical explanation must be given by a narration.

Narration = Story (but narration sounds more professional)

An explanation of war must therefore be given through a story about the war.

The story must meet certain logical requirements . What are they?

Demands an a Narration

Are there scientific criteria for a correct story?

The story should have a clear horizon of understanding of background knowledge.

Cause and effect in the story should be clear relative to this horizon of understanding.

Contrafactuals

An example : What if the Confederacy had not lost the Battle of Gettysburg in 1863 ? Would the United States have existed now?

Would there have been a WW2?

Most historians seem the regard contrafactual thinking as an example of ”bad science”.

This is probably because history is not concerned with scientific laws .

Psychology

Modern psychology works with experiments and statistical analysis .

The classical Freudian psychoanalysis seems rather motivated by a story.

The same applies to Jung's psychology .

... But what stories they are!

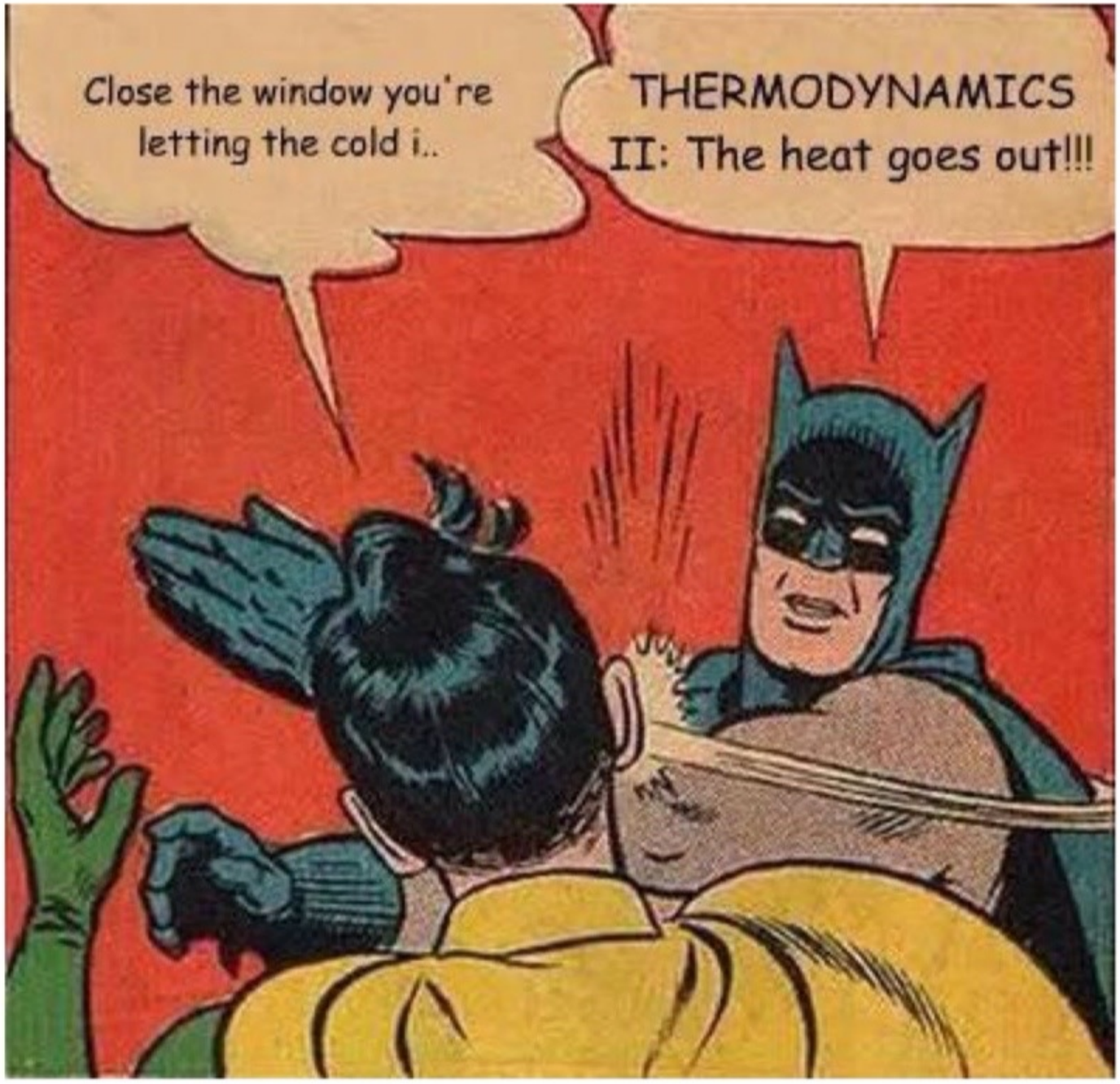
What is the truth here? A controversial question-

Humanities - An overview

Some examples:

Theory of literature
Art History
Parts of Philosophy
History of Ideas
Politics (perhaps)
On the whole, everything that are cultural products.

General disapproval - Scientist are arrogant and cold at hart



Methods for convincing someone

Let us assume that you want to convince someone of the truth of a statement. Basically, there are three ways of doing it:

- Use scientific arguments.
- Use authority.
- Use sympathy.

In science we supposedly should rely on sound arguments. But this might not always be true.

Science is authority

- Some people think that science has a too dominant position in society.
- Scientific truth is the only truth!?
- What about artistic truth?
- The idea that science should be more modest and know its place is called *scientism.*
- It seems as if science sometimes fail to get sympathy.

- Science could be an enemy of ethics and morality.

- It seems difficult to reconcile science and religion.

- Perhaps it is also difficult to reconcile science with a meaningful view of life (?)

- Do humans have a place in a scientific universe?

Religion

Religion gives many people a purpose in life.

Science seems to deprive them of that meaning.

Is that so?

Can science give something in compensation?

Common arguments for religion

Cosmological Argument - How did it all start?

Design Argument - The world must be constructed.

Consciousness Argument - How can the mind and the soul explained?

Creationism and Intelligent Design

Creationism is the belief that the world and all living things in whole or in part is the result of divine intervention or supernatural means. Creationism is consistent with classical Christianity but may also allow other interpretations of the semi-religious character.

Intelligent design is the notion that life on Earth is too complex to have arisen and developed exclusively by random variation and natural selection as biology's theory of evolution says. It is customary to give examples of organs that are irreducibly complex.

This would indicate an element of deliberate, intelligent design at various times during the evolution of life.

They forward the thesis that there are certain phenomena in the universe and among living things that can best be explained with reference to an intelligent cause, not with reference to undirected natural processes such as natural selection.

Examples of pseudoscience

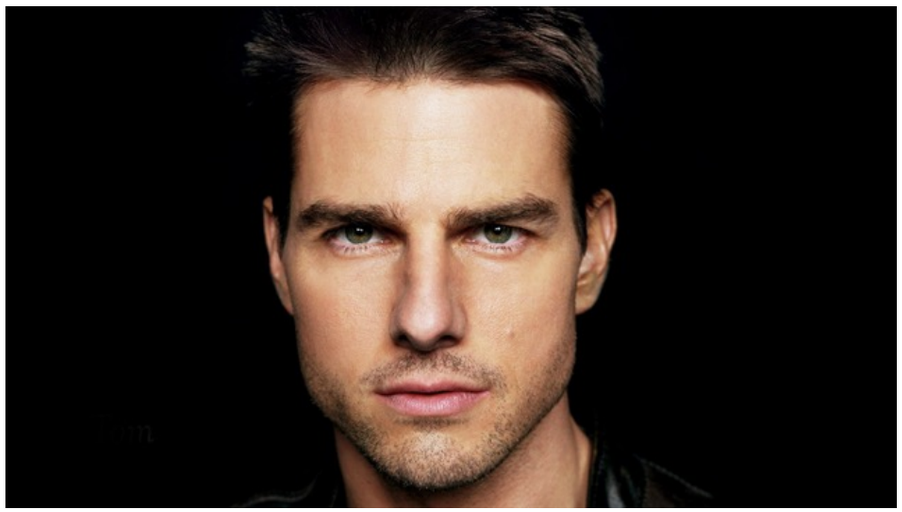
Classic examples of areas that are usually regarded as pseudoscience is:

- Astrology
- Freudian psychology
- Marxist theory
- We shall see more examples

Classification of pseudosciences

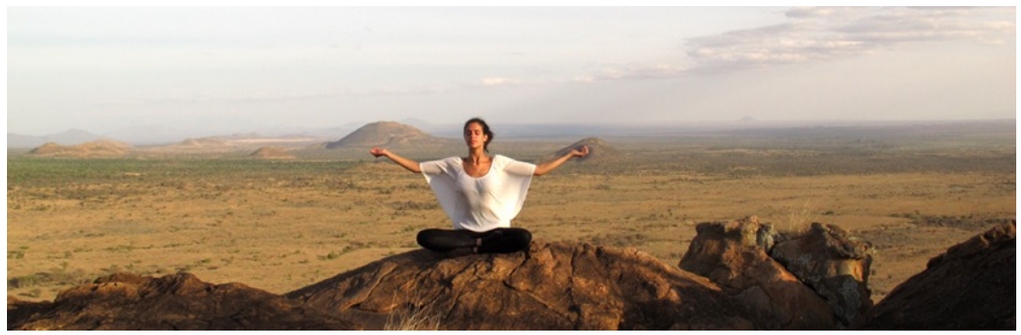
Sven Ove Hansson.Professor at KTH. In his book *Vetenskap och ovetenskap*, he has conducted a review of various forms of pseudoscience

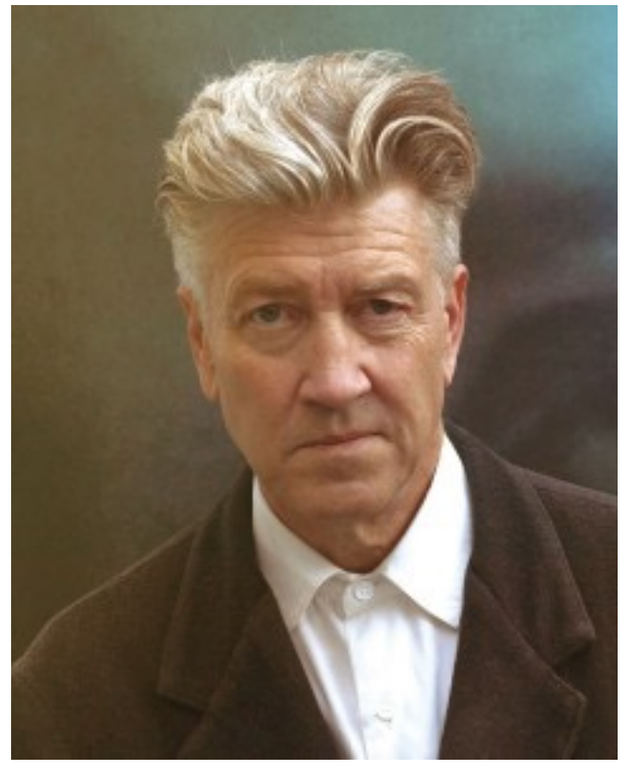
Scientology



Scientology is described by his supporters as a selection of principles and methods used to manage the problems of life and achieve happiness. These methods are taught through by a very large number of courses and treatments that the Church of Scientology provides. The scientologists argue that man is an immortal spiritual being, whose experiences encapsulate all her lifetimes. Furthermore, man is a spiritual being, with (theoretically) unlimited abilities over time, and matter. Man is basically good and can, if she wants, achieve spiritual liberation, provided that she uses Scientology methods and teachings.

Transcendental Meditation

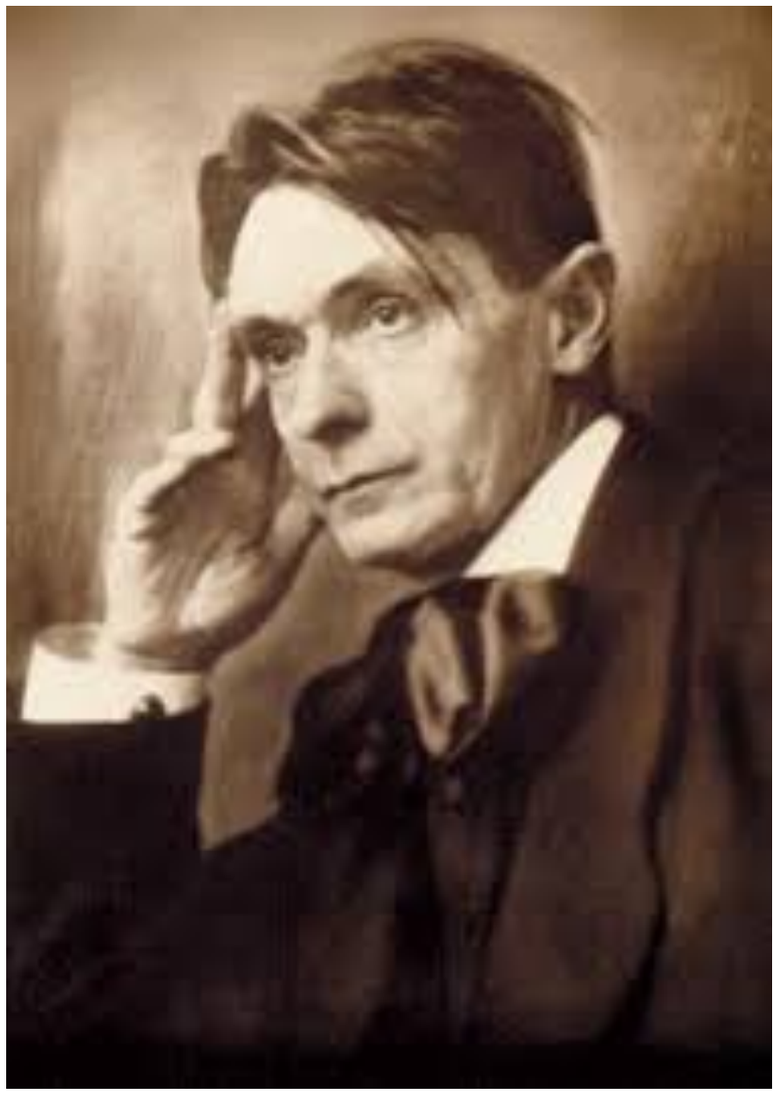




Characteristic of TM include the use of so-called mantras. Within the TM organization one advocate the so-called Ayur-Vedic medicine, a form of alternative medicine. The TM organization, which is non-profit, justifies the relatively high price for a course of this meditation with that TM has unique effects that are considered scientifically well documented .

Anthroposophy

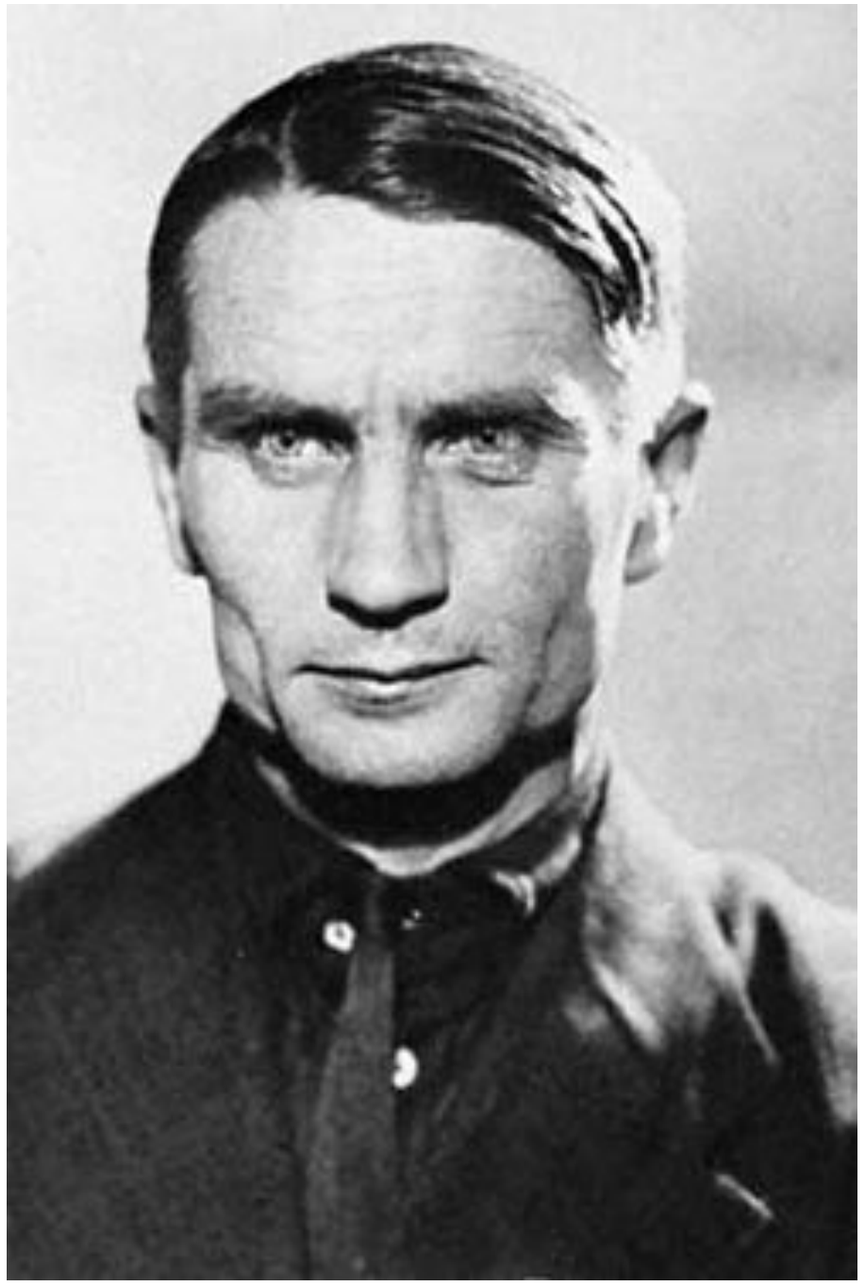
Anthroposophy is a spiritual philosophy founded in the early 1900s by Rudolf Steiner. It postulates the existence of an objective, intellectually comprehensible spiritual world accessible to direct experience through inner development, through conscious cultivation of a form of thinking independent of sensory input



Homeopathy

Samuel Hahnemann

Strange genetic theories



Trofim Lysenko

Theories that say that acquired characteristics can be inherited.

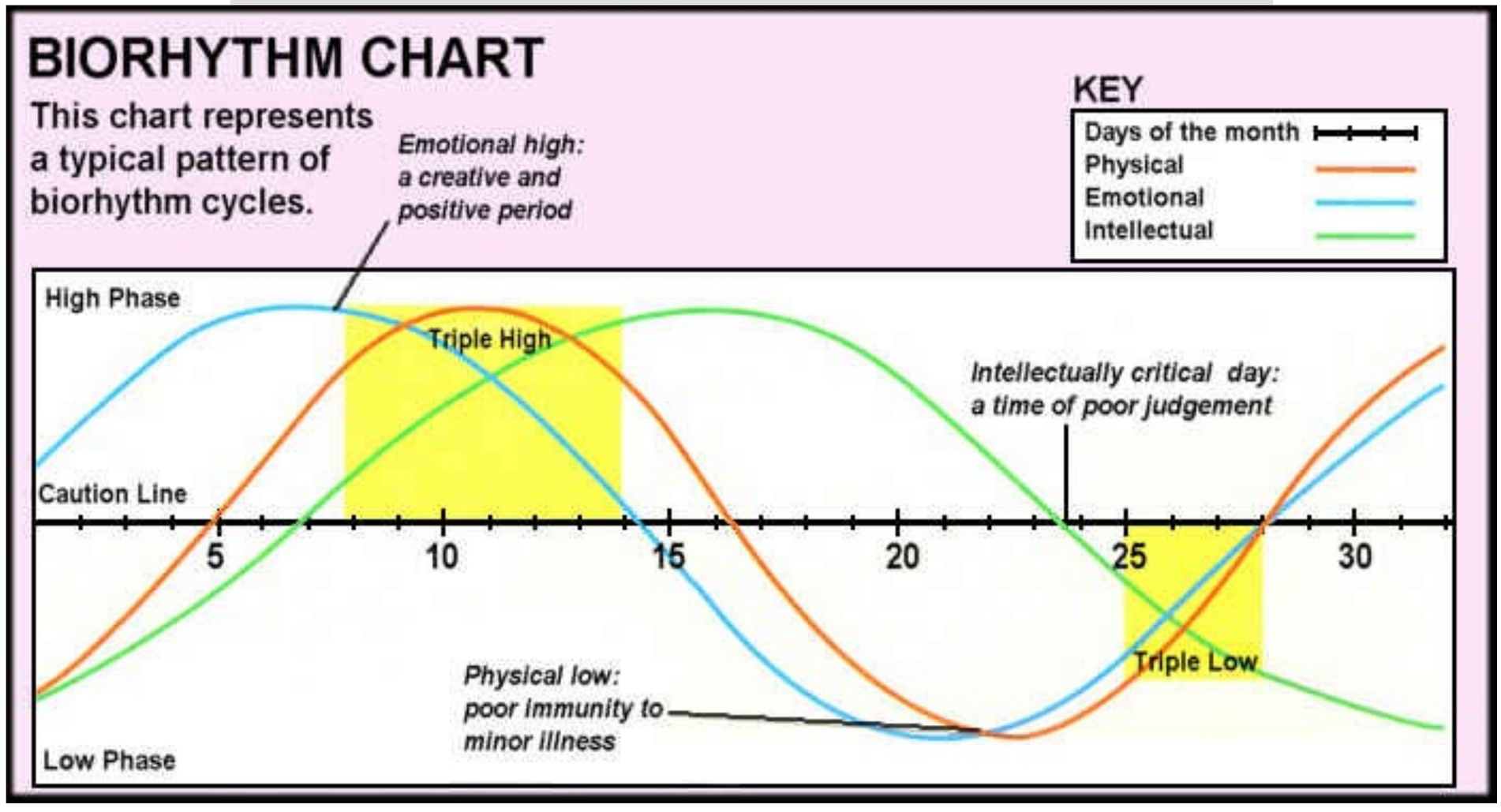
One of the most famous is the theory of is Stalin's biologist Lysenko.

His experiments caused famines in USSR and China.

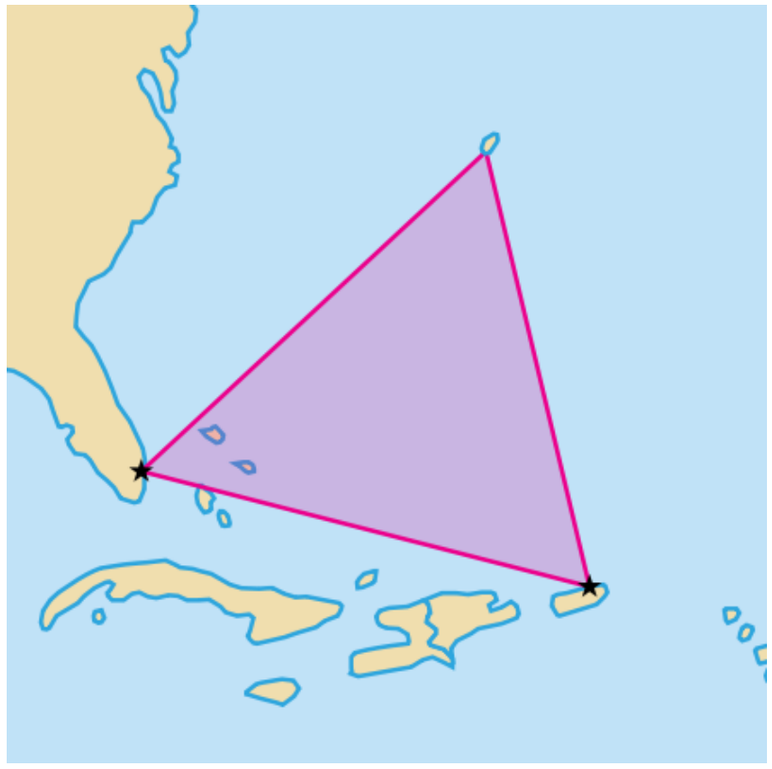
Mind reading, clairvoyance, and the like

Girl with fairies

Biorythms

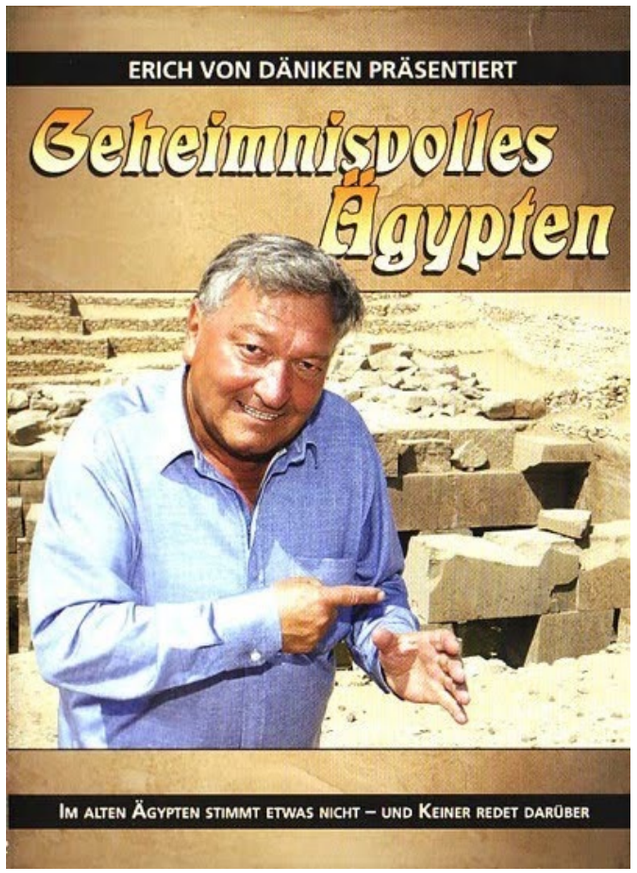

BIORHYTHM CHART
This chart represents a typical pattern of biorhythm cycles.
Emotional high: a creative and positive period
KEY
Days of the month
Physical
Emotional
Intellectual
High Phase
Triple High
Intellectually critical day: a time of poor judgement
Caution Line
5
10
15
20
25
30
Triple Low
Physical low: poor immunity to minor illness
Low Phase

The Bermuda Triangle



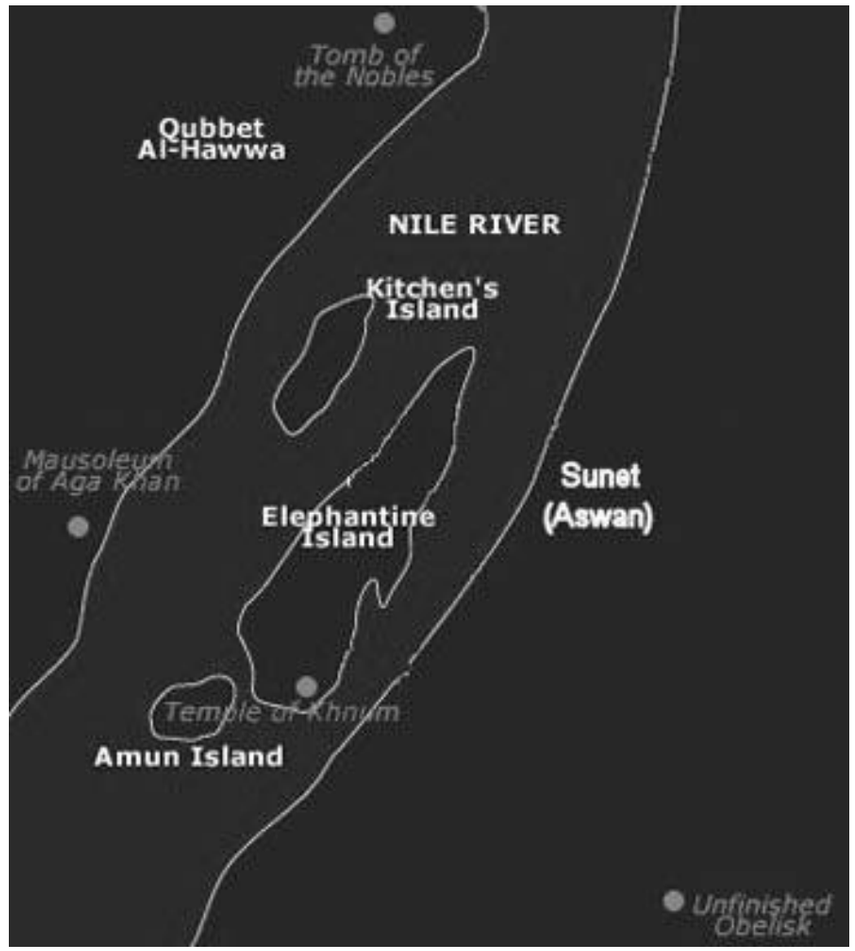
The Bermuda Triangle, aka The Devil's Triangle, The Triangle of Death, The limbo of the lost, is an approximately 1 million km ² marine area in the shape of a triangle with Bermuda, Puerto Rico and Miami, including the Sargasso Sea, located within the triangle boundaries.

Erich von Däniken



Erich von Däniken and UFOs

Erich von Däniken is a popular science writer who has written 26 books. He runs the thesis that aliens often have visited Earth. This can be seen in the archaeological remains and ancient stories of various kinds. In 1968 he published his first book, *Erinnerungen an die Zukunft*. It is also his best selling.



Characteristics of pseudoscience

Sven Ove Hansson proposes seven characteristics.

Authoritarianism: Some people are accorded such great ability to decide what is true and false, that others just have to abide by their judgments.

Experiments that can not be repeated: Pseudoscience relies on experiments performed once and not always possible to repeat.

- Hand-picked examples: One uses hand-picked examples, when a random sample would be possible.
- Reluctance to real testing: One does not really try test the theory against reality, although this would be possible.
- Indifference to contradictory facts: Even-though there are evidence telling against the theory, these are ignored.

- Subterfuges: One demands that the theory shall be tested under such conditions that it can only be confirmed, never contradicted.
- Explanations are abandoned without being replaced: One abandons sustainable explanations without putting something in place so that the new theory leaves more unexplained than the old one.

Another type of characterization

An alternative way to recognize pseudoscience:

- It does not do any real problem solving.
- It has for a long developed to a much lesser degree than other "similar" theories.

SIGN OF PSEUDOSCIENCE	EXAMPLE
Exaggerated claims	Three simple steps will change your love life forever!
Overreliance on anecdotes	This woman practiced yoga daily for three weeks and hasn't had a day of depression since.
Absence of connectivity to other research	Amazing new innovations in research have shown that eye massage results in reading speeds 10 times faster than average!
Lack of review by other scholars (called *peer review*) or replication by independent labs	Fifty studies conducted by the company all show overwhelming success!
Lack of self-correction when contrary evidence is published	Although some scientists say that we use almost all our brains, we've found a way to harness additional brain power previously undiscovered.
Meaningless "psychobabble" that uses fancy scientific-sounding terms that don't make sense	Sine-wave filtered auditory stimulation is carefully designed to encourage maximal orbitofrontal dendritic development.
Talk of "proof" instead of "evidence"	Our new program is proven to reduce social anxiety by at least 50 percent!

Science	Pseudoscience
Willingness to change with new evidence	Fixed ideas
Ruthless peer review	No peer review
Takes account of all new discoveries	Selects only favourable discoveries
Invites criticism	Sees criticism as conspiracy
Verifiable results	Non-repeatable results
Limits claims of usefulness	Claims of widespread usefulness
Accurate measurement	“Ball-park” measurement

Philosophical critique of science

We can see two kinds of criticisms:

- Science is limited. There are many questions it can not answer. These issues must be left to philosophy.

- Science has misunderstood everything. There is no objective truth!

Realism and Anti-realism

Science and Reality

Science ought to describe reality. But what is Reality?

Is what we think we see of reality really real?

If not, what are we then dealing with in science? Is it *representations* of reality?

Philosophical Terms

There are several different attitudes towards reality in philosophy:

- Naive Realism : Reality is more or less as we experience it.
- Critical Realism: Reality exists but we cannot experience it directly. There is, however, a close connection between reality and our experiences of it.
- Idealism: Reality does not exist. The only existing things are our (or just my) experiences.
- Phenomenalism: Reality exists but we can only know it through *constructions* based on observations made by our senses.

In Science

In Science there are two attitudes:

- Realism: The goal of science is to describe reality as it is.
- Anti-Realism: The goal of science is to describe the *observable* part of reality as it is.We cannot say anything about the non-observable part of reality.

What is not observable?

- We can say that electrons are not (directly) observable.
- In a way we can say that atoms are observable. But once they were not.
- Feelings are perhaps just possible to observe subjectively.
- Abstract concepts are not observable.

The anti-realistic attitude

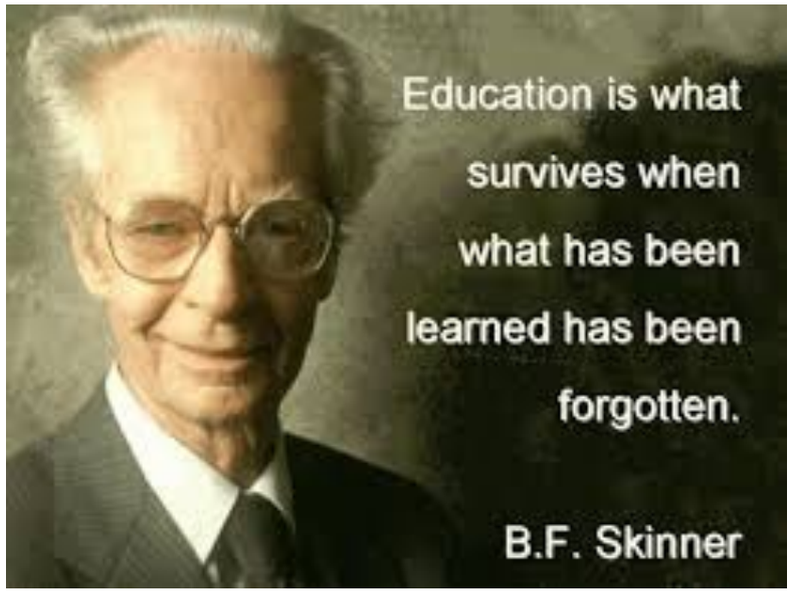
- Although the atoms in a sense, are observable, we should think about this example:
- Thermodynamic properties of gases can be explained by assuming that they are composed of atoms that move.
- According to anti-realists the existence of atoms is just a good fiction that helps us to explain the laws of thermodynamics.

Explanations of observations

- According to anti-realists is the core of science is the set of observable data.
- The purpose of the models is to explain these observable data.
- Anti-realism is also known as *instrumentalism*.

Behaviorism

- A special movement in psychology says that consciousness in a sense is a fiction.
- All scientific statements about consciousness must be based on observation.
- Consciousness is a fiction that describes these observations.
- This is a kind of *reductionism*.

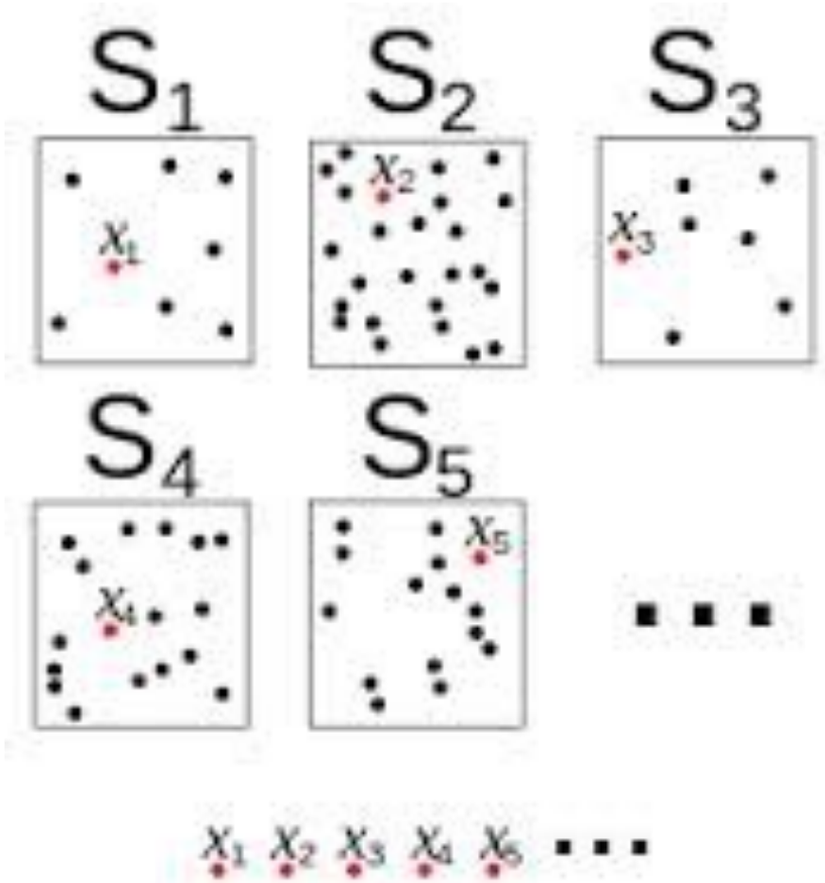


Fiction or not?

- There are actually two forms of anti-realism:
- We can say that theories, such as those concerning atoms, are pure fictions.
- We can say that theories, such as those concerning atoms, might be able to describe reality in a way. But we can never know if they are true. This approach is called agnosticism.
- The latter type of anti-realism is probably the most common.

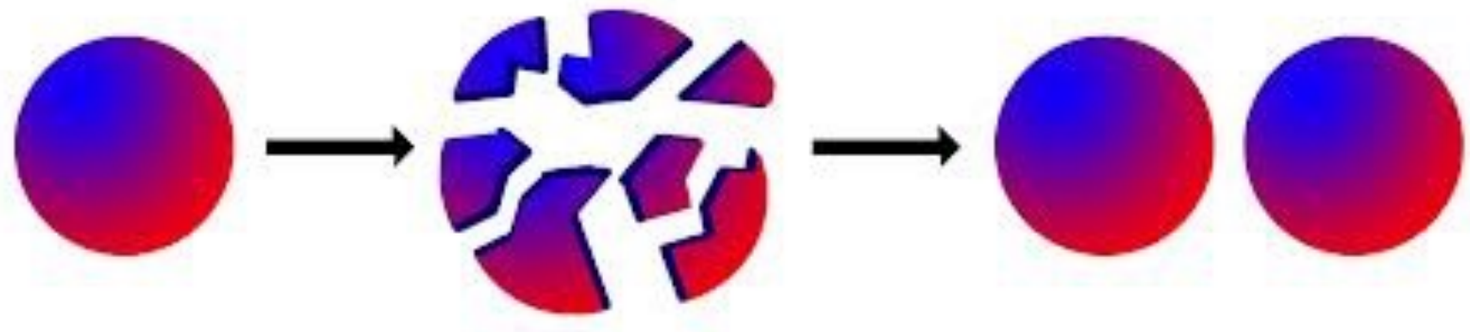
Realism in Mathematics

- The Axiom of choice says that if we have an arbitrary family of sets, we can choose an element from each set in the family.
- The selection is a function from the family of sets. The Axiom of choice says that this function always exists.
- The problem is that it doesn't have to be any explicit way of describing the function.



The status of The Axiom of Choice

- The axiom of choice is accepted by most mathematicians.
- It has many useful and important consequences.
- However, it has some strange consequences such as The Banach-Tarski Paradox.
- The paradox says that it is possible to divide a sphere with volume 1 into a number of parts and put the parts together and form two spheres which both have volume 1!
- The paradox "works" because we can it divide the sphere into parts that do not have measurable volumes.



Is the axiom contradictory?

- There are axiom schemes like The Zermelo–Fraenkel Set system (ZF) that seems to describe the basic math correctly.
- Gödel showed that the axiom of choice can be added to ZF without contradiction.
- Cohen showed that the negation of the axiom of choice can be added to ZF without contradiction.
- The conclusion is that using ZF we can neither prove or disprove the axiom of choice.

What do we do then?

- There are at least three approaches:
- We can believe that there is an objective answer to the question about the axiom of choice is true or not. We must try to understand the mathematical reality better. This approach is called realism.
- We choose to only deal with such mathematics can be proved constructively. We cannot know if The axiom of choice is true. This approach is known as constructivism.
- We can choose to accept the axiom of choice as true or false, depending on what we want. Have it your way! This approach is called formalism.

More details

- Realism: there is a mathematical reality that exists independently of us. Mathematicians are exploring this reality. Also called Platonism.
- Constructivism: the mathematics are designed by us. Only what is constructed or potentially possible to construct is real. This view (or a variant of it) is also known as Intuitionism.
- Formalism: Mathematics is just a sort of game with symbols. Mathematicians examine the consequences of the different rules of the game. Everything that does not lead to a contradiction is allowed. This view is a form of anti-realism.

Strength and weakness of anti-realism

- Gives a certain intellectual sanitation.
- Is quite natural. The reality can never be exactly what we imagine it to be.
- At the same time, it seems that an anti-realist position can limit our ability to speak about things.

Realism vs. anti-realism

- A summary of the positions:
- Realists believe that science is an accurate description of reality, even those parts of it that cannot be observed directly.
- Anti-realists believe that science can only describe the observable parts of reality and that the theories often are only fictions or models about which we cannot say that they are true or false.
- What are the reasons for the different positions?

The "No miracles" – Argument

- This is an argument for realism.
- There are scientific theories that manages to describe the observable part of the reality very well.
- They do so by describing a model for a non-observable reality and explain how this is projecting on the observable reality.
- How do you explain the "miracle" that this description of the non-observable reality works so well?
- No miracle! It works because it is true!

Counter-arguments

- In the history of science, there are many examples of theories that explains observable data very well but still proved to be incorrect.
- One such example is The Phlogistone Theory. (It was observable data that ultimately led to the rejection.)
- A critical example is theories of light nature.

The argument from observability

- This is also an argument against anti-realism.
- Anti-realism is based on the supposed fact that we can divide the world into observable and non observable parts.
- But can we really do that in a consistent way?
- There are, for example. a gradual transition from observability with the eye to observability with electron microscopes. It is the first one a genuine observability but not the other one?

Counter-arguments

- That type of argument really just shows that observability is a vague concept. It does not necessarily mean that it is a meaningless concept.
- We can see that there are clear cases of what is observable and clear cases of things that are not. That's enough for anti-realism.

The argument from under-determination

- This is an argument for anti-realism.
- We imagine that we have a set of observed data. We want to find a theory that explains the data.
- It is possible to realize that there is always a variety of theories that may explain these data. The theories are being under-determined.
- If you are using a theory to explain the data, it is just an arbitrary tool for the explanation.
- That's exactly what anti-realists believe about theories.

Counter-arguments

- Although there are different theories that could explain the measured data, they are not all equivalent.
- It seems natural that there is some kind of selection criterion, for example, choosing the simplest theory.
- It also seems to be a lack of historically interesting examples of under-determination.

Laws

- What is a scientific law?
- It seems natural to interpret it as a regularity in nature.
- But there is a problem: The law of gravity specifies a rule for how bodies fall. It is not literarily true, however, due to air resistance. How can it then be a law?
- Laws should perhaps be interpreted as a tendency? They strike through, depending on strength.

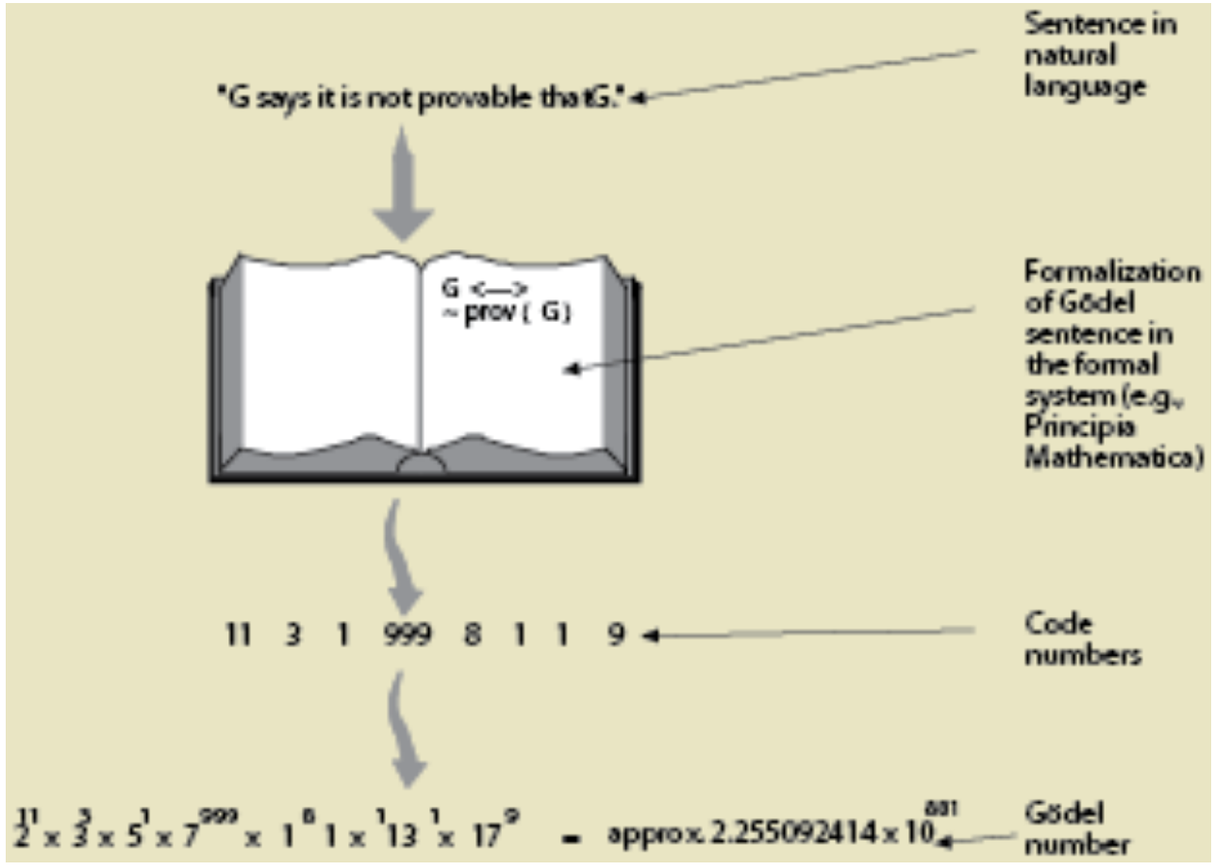
The mystery of laws

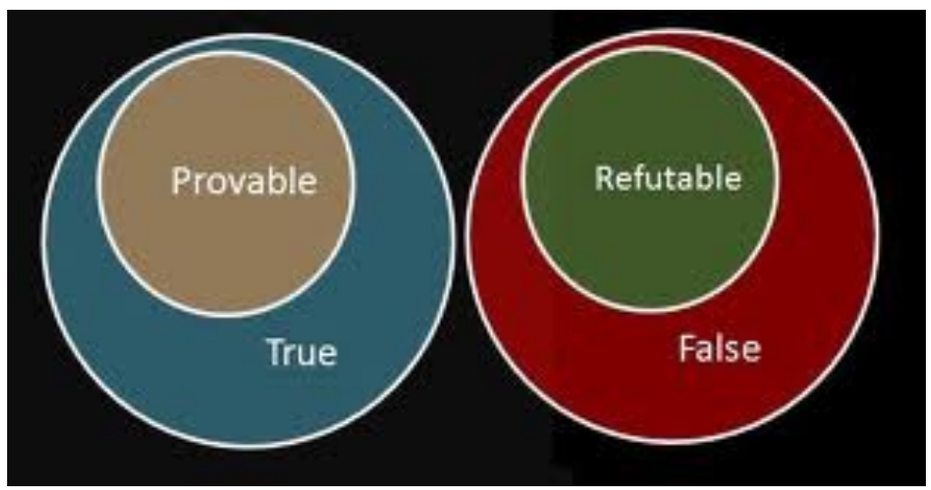
- Why does nature follow laws?
- Does it do that?
- Newton's laws seems to be very successful.
- But is not the concept of force just *defined* in a way that makes it work?
- We may just see the laws that work?

Computer Science

- What are the Computer Science problems relating to realism and anti-realism?
- The problems seems to be the same as in mathematics. But computer science works primarily with discrete mathematics that usually use finite methods. (Not so much of ontological problems.)
- Does the NP-question have to be decidable?
- Maybe the problem of consciousness is an example of the realism / anti-realism character?

Gödel's Theorem





Gödel

- Kurt Gödel studied formal deductive systems of a special kind.

- He showed that all formulas in such a system can be given a so called *Gödel number.*

- He also showed that it is possible to construct a predicate that represents *provability.*

- Then he showed that there are sentences that cannot be proved in the system but still, in some more general sense, are true.

More details

- The Gödel Sentence: $G \leftrightarrow \neg Pr[S](\mathbf{G})$

- Gödel's theorem can be stated in at least two different forms.
- One form is that a sufficiently strong and (efficiently) decidable formal system must contain 'true' sentences which cannot be proved inside the system.
- Another form is that such a system must contain sentences which cannot be proved or disproved inside the system.
- To make things more complicated, there is a *Gödel's second incompleteness theorem* which says that the system cannot be proved to be consistent with methods inside the system.

Implications

- One thing Gödel's proof shows is that self-reference cannot actually be blocked. It is in a certain sense unavoidable.
- It also shows that the powers of formal systems are limited.
- We could of course accept these facts.
- Or we could just give up the idea of using formal systems.
- There are however some related theorems which are even more disturbing.

Tarski

- Alfred Tarski showed that the definition of truth is much more complicated than expected.

- The Tarski type of truth definition is like this: 'Snow is white' if and only if snow is white.

- This type of definition requires a *meta-level.* Truth comes in *layers,* so to say.

- And there is no way to define truth in any effectively decidable way.

Turing

- As we all know, Alan Turing defined the Turing Machine.

- He proved that there are natural problems which cannot be solved in an 'mechanical' way.

- An example is the halting problem.

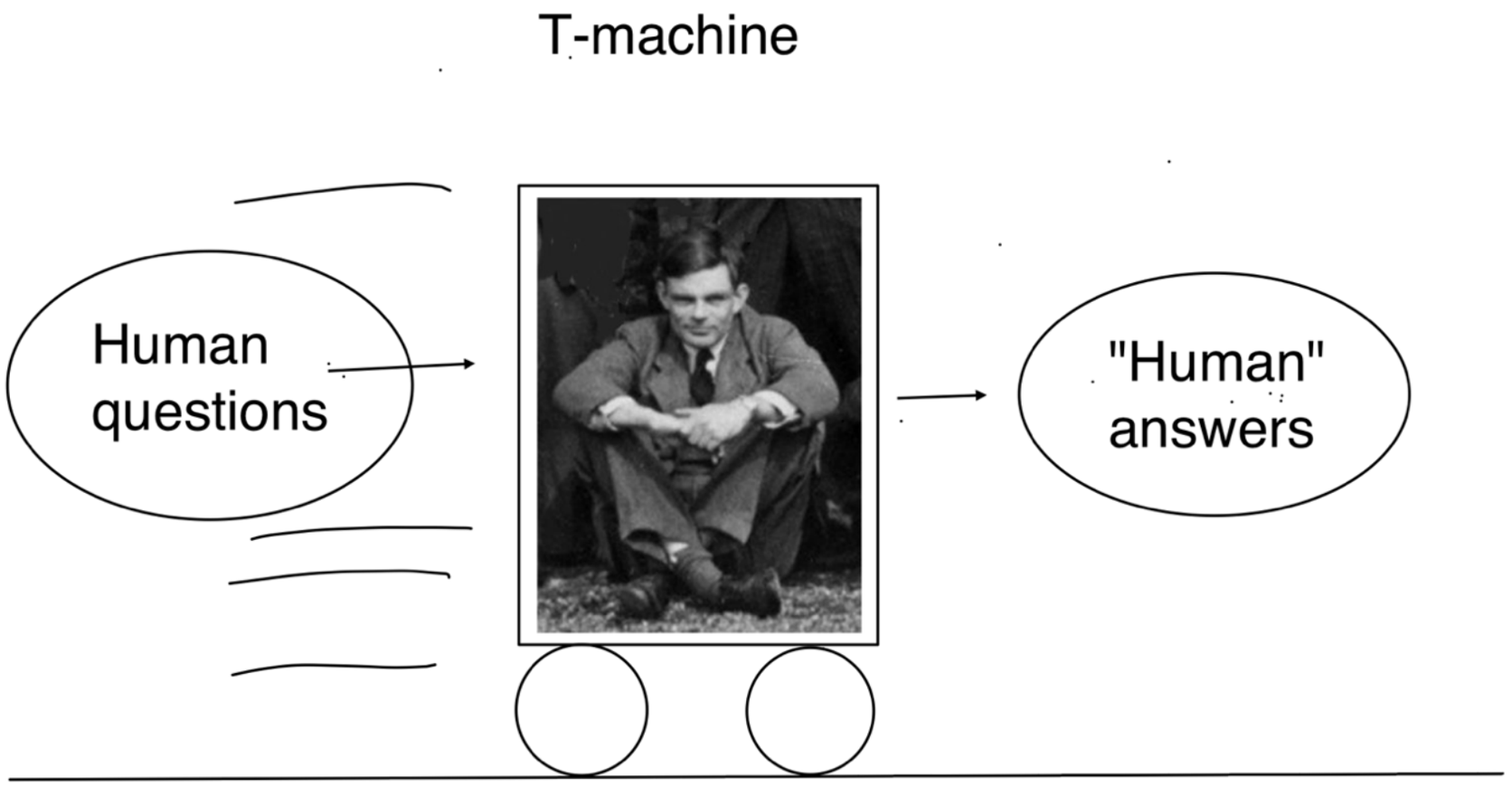
- Another is the problem of finding proofs in first order logic.

The Turing Test

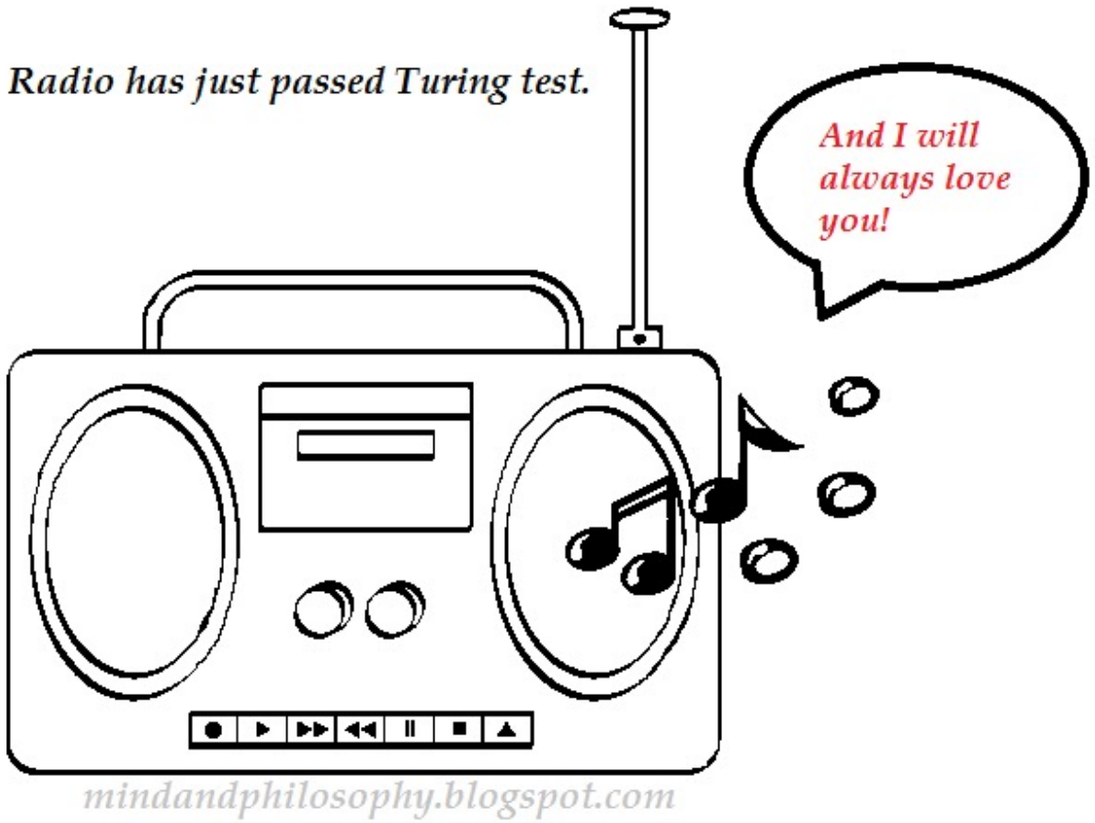
A machine passes the Turing test if it convinces you that it is human.

In that case:

- Is it "like" a human?
- Is it equivalent to a human?
- Is it human?



What is human consciousness?



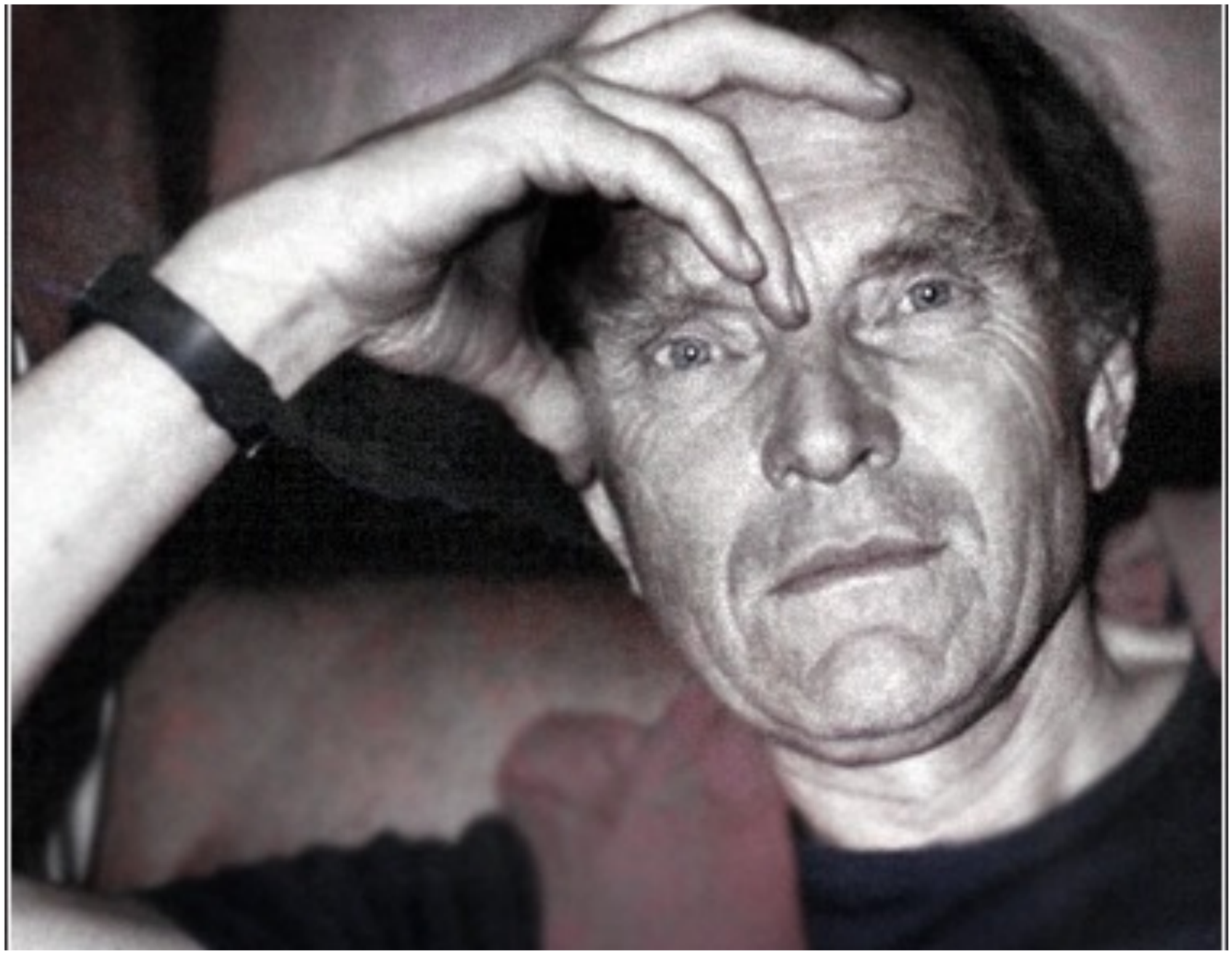
- Can a computer have feelings and consciousness?
- In the same way as humans have?
- Can a computer be you?
- Are you a computer?
- Perhaps consciousness is a convenient fiction?
- Many people think these are interesting and disturbing questions.
- And they are scientific questions (or?)

Who doesn't want objective truth?

Why criticism of objective truth? Some common thoughts are:

- To refer to truth is in a way a misuse of power.
- It is a form of totalitarianism. The dictatorship of science!
- Truth is a rhetorical trick.
- Fanaticism and intolerance is sometimes based on a belief in objective truth.
- Perhaps it is truth without skepticism that is dangerous?

Paul Feyerabend



Feyerabend's thoughts

- He published ”Against Method” in 1975.
- He argues that there is no method common for all sciences.
- *Anything goes!*
- He argues for freedom of science in the same way as you can argue for freedom of religion.
- He has been interpreted as a liberal and an anarchist.

Pragmaticism

William James

- American philosopher. One of the founders of Pragmaticism.
- A belief was true, he said, if it worked for all of us, and guided us expeditiously through our semihospitable world.
- James was anxious to uncover what true beliefs amounted to in human life, what their "cash value" was, and what consequences they led to.

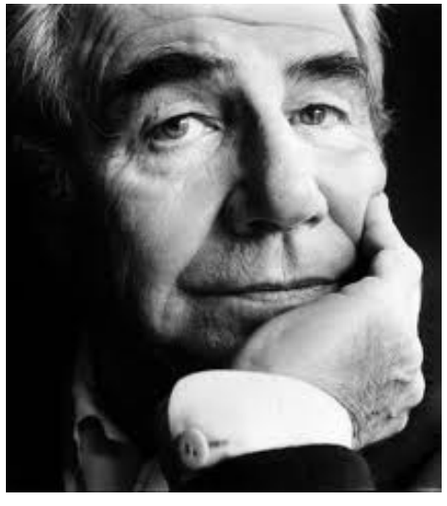
Nietzsche

- Regarded as one of the first to deny that objective truth exists.
- Said that all truth is matter of ideologically driven.
- Said that Christianity is a slave moral.

Is there a Truth?

- The concept of truth has always been problematic. What is truth really? How do we know it?
- These problems are partly technical. How to get a logical functional concept of truth?
- However, there is an ideological interest in denying that truth exists.
- One example is postmodernism.

Postmodernism



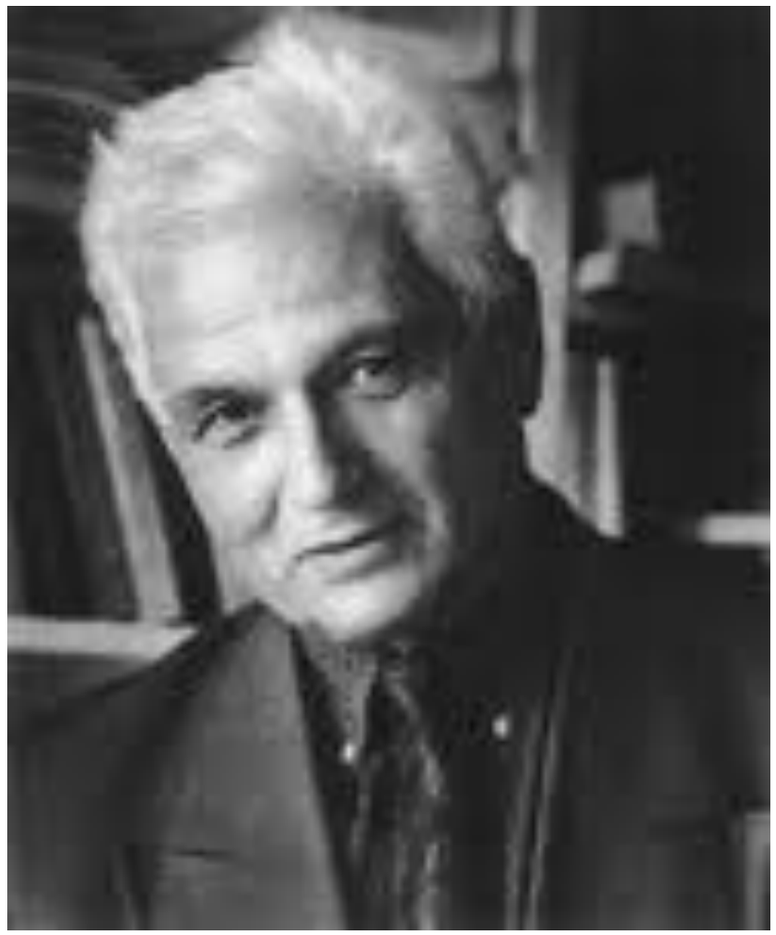
Everything's stories
There is no meta-narrative
Relativism!

Postmodernism

Some basics of postmodern thinking:

- By tradition, it is consider important to distinguish between symbols and reality.
- A new brilliant insight: Everything's symbols!
- All language is a kind of game.
- It's all stories or meta stories!

Deconstruction



Derrida

- Derrida was a critic of the focus on logic in Western culture.
- For instance, he criticized science.
- He created the method called *deconstruction*.

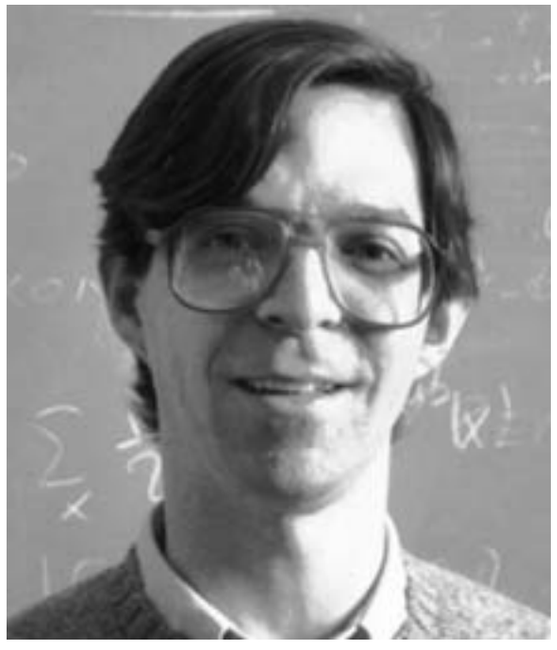
Some thoughts about this

- It is sometimes said that life consists of problem-solving.
- There are two types of problems: those that come from nature and those from humans.
- We seem to be confronted most with the second type of problem.
- The step seems not far to just take an interest in the human-generated problems.

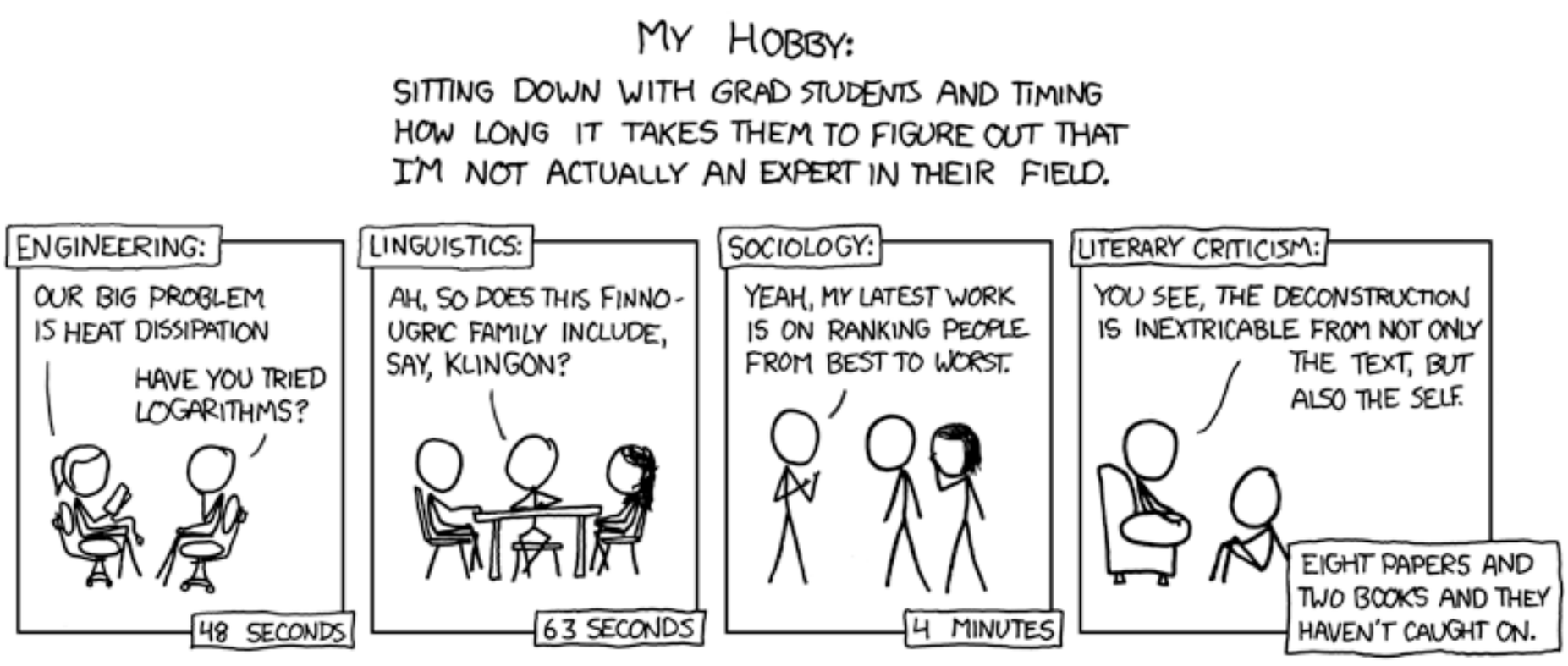
The Sokal Affair

(From Wikipedia)

The Sokal affair, also known as the Sokal hoax,was a publishing hoax perpetrated by Alan Sokal, a physics professor at New York University. In 1996, Sokal submitted an article to Social Text, an academic journal of postmodern cultural studies. The submission was an experiment to test the journal's intellectual rigor and, specifically, to investigate whether "a leading North American journal of cultural studies – whose editorial collective includes such luminaries as Fredric Jameson and Andrew Ross – [would] publish an article liberally salted with nonsense if (a) it sounded good and (b) it flattered



The article, "Transgressing the Boundaries: Towards a Transformative Hermeneutics of Quantum Gravity", was published in the Social Text Spring/Summer 1996 "Science Wars" issue. It proposed that quantum gravity is a social and linguistic construct. At that time, the journal did not practice academic peer review and it did not submit the article for outside expert review by a physicist. On its date of publication (May 1996), Sokal revealed in Lingua Franca that the article was a hoax, identifying it as "a pastiche of left-wing cant, fawning references, grandiose quotations, and outright nonsense...structured around the silliest quotations [by postmodernist academics] he could find about mathematics and physics".



The resultant academic and public quarrels concerned the scholarly merit of humanistic commentary about the physical sciences; the influence of postmodern philosophy on social disciplines in general; academic ethics, including whether Sokal was wrong to deceive the editors and readers of Social Text; and whether the journal had exercised appropriate intellectual rigor before publishing the pseudoscientific article.

Content of the article

"Transgressing the Boundaries: Towards a Transformative Hermeneutics of Quantum Gravity" proposed that quantum gravity has progressive political implications, and that the "morphogenetic field" could be a cutting-edge theory of quantum gravity (a morphogenetic field is a concept proposed by Rupert Sheldrake that Sokal characterized in the affair's aftermath as "a bizarre New Age idea").Sokal wrote that the concept of "an external world whose properties are independent of any individual human being" was "dogma imposed by the long post-Enlightenment hegemony over the Western intellectual outlook".

A few quotes

In the article, there were quotes from famous postmodernists regarding science:

- *The Einsteinian constant is not a constant, is not a center. It is the very concept of variability -- it is, finally, the concept of the game. In other words, it is not the concept of something -- of a center starting from which an observer could master the field -- but the very concept of the game ...*

- *This diagram [the Möbius strip] can be considered the basis of a sort of essential inscription at the origin, in the knot which constitutes the subject. This goes much further than you may think at first, because you can search for the sort of surface able to receive such inscriptions. You can perhaps see that the sphere, that old symbol for totality, is unsuitable. A torus, a Klein bottle, a cross-cut surface, are able to receive such a cut. And this diversity is very important as it explains many things about the structure of mental disease. If one can symbolize the subject by this fundamental cut, in the same way one can show that a cut on a torus corresponds to the neurotic subject, and on a cross-cut surface to another sort of mental disease.*

- *... natural objects are also socially constructed. It is not a question of whether these natural objects, or, to be more precise, the objects of natural scientific knowledge, exist independently of the act of knowing. This question is answered by the assumption of ``real'' time as opposed to the presupposition, common among neo-Kantians, that time always has a referent, that temporality is therefore a relative, not an unconditioned, category. Surely, the earth evolved long before life on earth. The question is whether objects of natural scientific knowledge are constituted outside the social field. If this is possible, we can assume that science or art may develop procedures that effectively neutralize the effects emanating from the means by which we produce knowledge/art. Performance art may be such an attempt.*

Some Final Words