

Response Options

- Dismiss out-of-hand
- Attempt to replicate
 - Same experiments
 - Similar experiments
 - Other experiments
 - Experiments elsewhere
- Communicate
 - Publish ($>25 + >50$)
 - Speak (>100)
 - Network (SSE, ICRL, Academy)
- Collaborate
 - IGPP
 - ICRL
 - Many others
- Search for Precedents
 - Scientific
 - Physical science
 - Psychology
 - Biology
 - Medicine

Response Options

(continued)

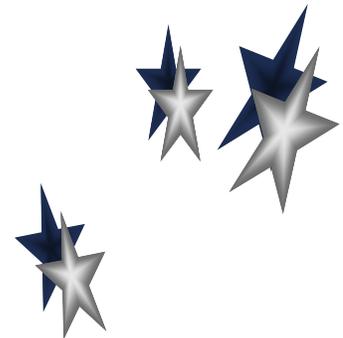
- Other academics
 - Philosophy
 - Anthropology/Sociology
 - Theology/Religion
 - History
- Cultural/Personal (common experience)
 - Religion/prayer/miracles (Bible, etc.)
 - Superstition (Bohr)
 - Hope (private; public)
 - Creativity (Johnson-Laird)
 - Synchronicity/coincidence (Jung/Pauli)
 - Psychic/paranormal/occult (books, TV, games)
 - Literature (Schiller, Poe, Kipling, Shakespeare...)
 - Art (Dali, Picasso, Meadmore...)
 - Music (Strauss, Wagner, Debussy)
 - Subjectivity/individuality (James)



A Brisk History of Natural (Physical) Science and Technology



**(ref. MARGINS OF REALITY,
Section I.3)**



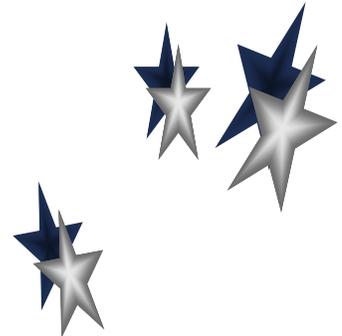
**A Brisk History of
Natural (Physical) Science
and Technology**

- ***Prehistoric (> 3000 BC):***
 - *Accomplishments inferred mainly from artifacts and rock art.*

- ***Egyptian (< 3000 BC):***
 - *Significant achievements in math, astronomy, chemistry, biology, geology, physics, engineering.*

- ***Ancient Babylonian / Arab / Near Orient / Far Orient (< 3000 BC):***
 - *Sophisticated metaphysics (Yoga, Taoism, etc.); good technology.*

- ***Greek (< 2000 BC):***
 - *Articulation of a philosophy of science.*



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- **Roman (< 800 BC):**
 - *Pragmatic application of science; sophisticated technology.*

 - **Byzantine (400 BC – 1400 AD):**
 - *Preservation of the scientific library.*

 - **Dark / Middle Ages (400 – 1500 AD):**
 - *Constraints on free scientific thought by religious dogma.*

(Up to this point, science, metaphysics, mysticism, religion, philosophy were largely indistinguishable and synergistic.)

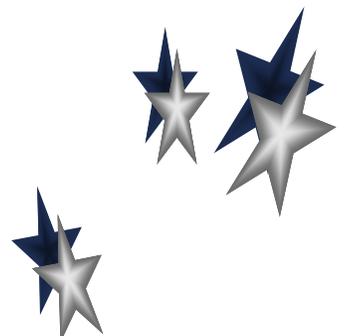


– ***Renaissance (> 1500 AD):***

- *Copernicus, Galileo, Paracelsus, Kepler, etc; -- even Newton:*
 - Rigorous science, expressed in metaphysical (Hermetic) tradition, wary of church influence.

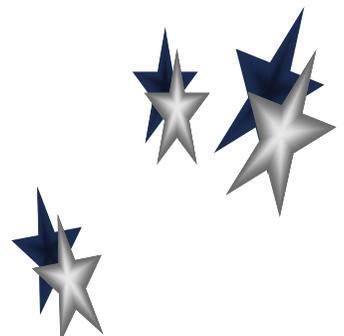
– ***Classical Science (> 1600 AD):***

- *Bacon, Hooke, Boyle, ..., Royal Society of London:*
 - Political separation of Science from Religion; Definition of the “Scientific Method.”
 - But, much metaphysical heritage remains



– ***Secular Science (> 1700 AD):***

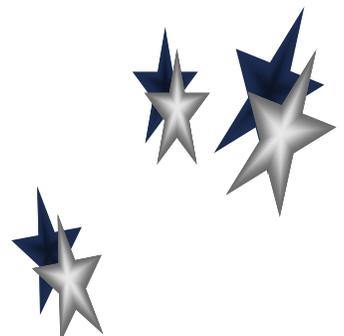
- *Newtonian mechanics;*
- *Physics of solids, fluids, gases;*
- *Acoustics; optics; thermodynamics;*
- *Electricity and magnetism → physical optics → theory of fields → velocity of light*
- *Metaphysics relegated to Philosophy (cf. Descartes, Kant, Bergson, James)*
- *Fat and happy, until the quantum revolution (ca. 1890)*



– Modern Physics (> 1890 AD):

Stimulated by numerous **anomalies**:

- *Black-body radiation* → *quantized oscillators (Planck)*
- *Photoelectric effect* → *quantized light (Einstein)* → *wave / particle duality*
- *Atomic scattering* → *nuclear atom (Rutherford)*
- *Atomic spectra* → *quantized (planetary) atom (Bohr, Sommerfeld)*
- *Electron diffraction* → *matter waves (de Broglie)* → *wave / particle duality again*



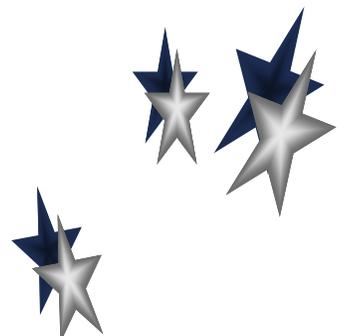
- *Atomic stability* → *wave mechanical atom (Schrödinger)*:

$$\frac{\hbar^2}{2m} \nabla^2 \psi + (E - V)\psi = 0$$

- Steady-state solutions (eigenfunctions) represent stable electronic configurations:

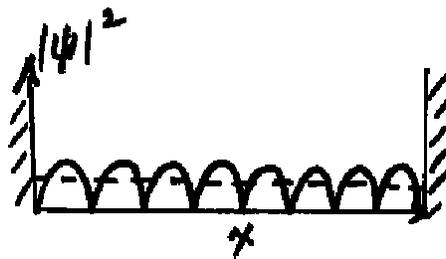
$$|\psi(\vec{r}, t)|^2 \propto \text{"probability - of - observation"}$$

of particle at position \vec{r} , time t

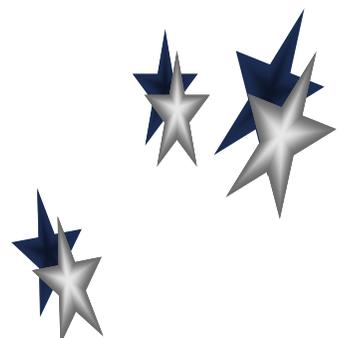
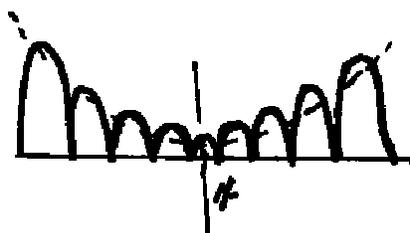


– Modal behavior of physical systems:

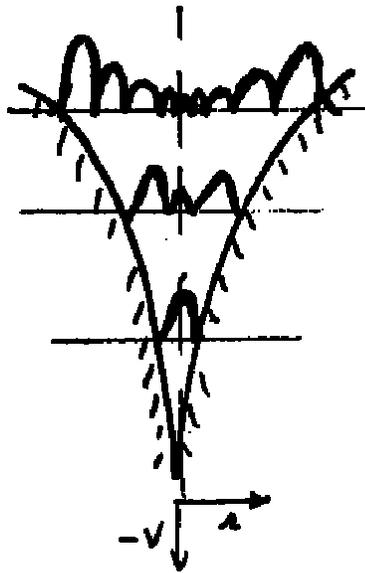
Particle-in-a-box:



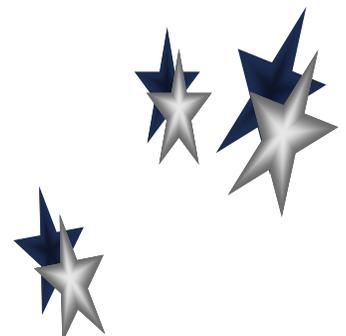
Harmonic oscillators:



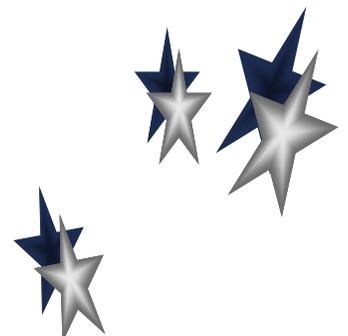
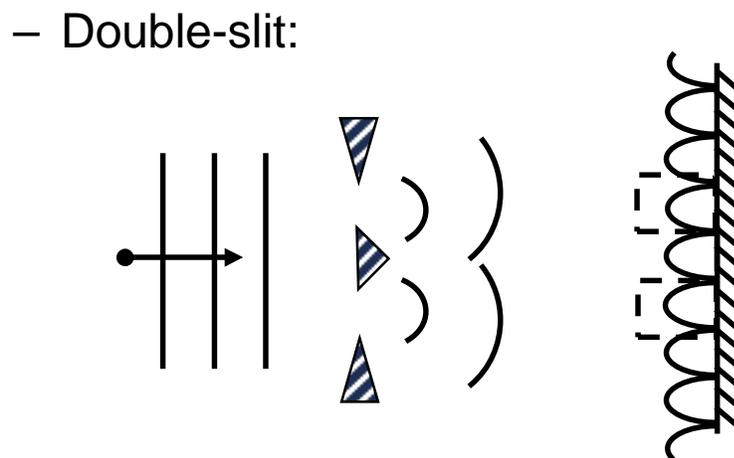
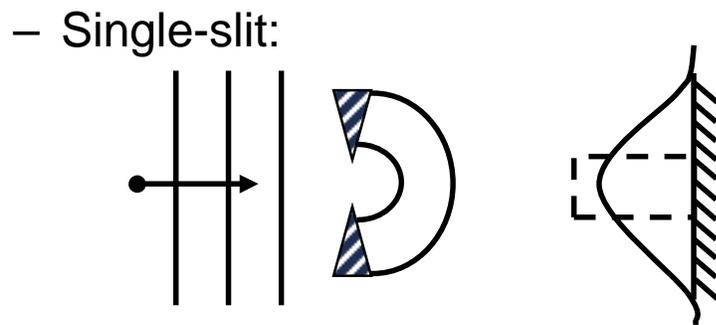
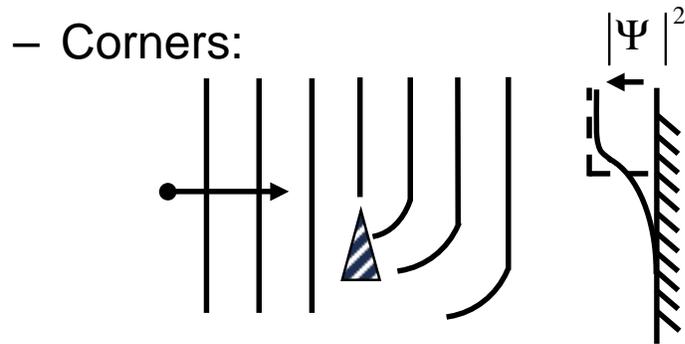
- Inverse-square wells (atomic structures):



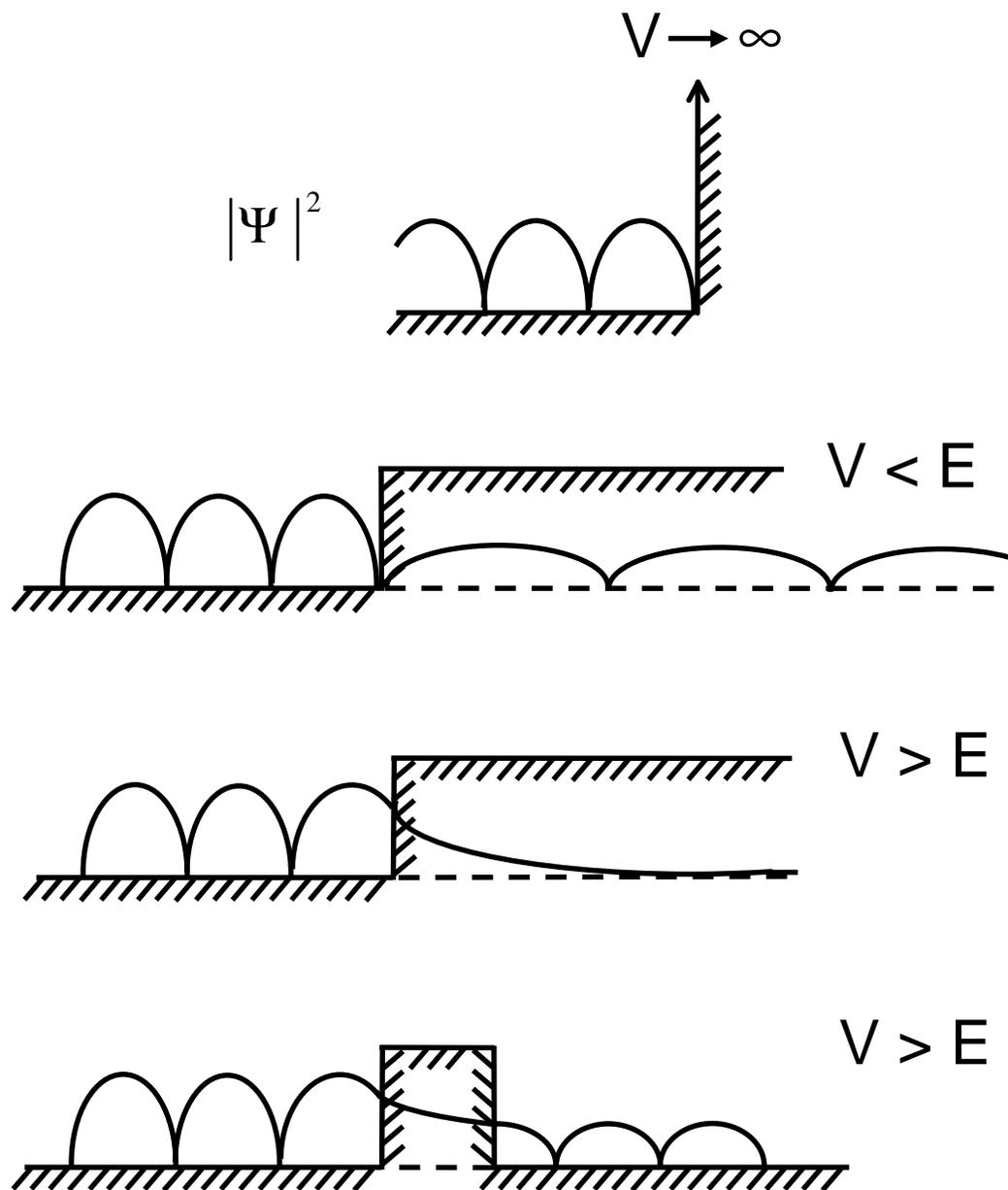
- *Leads to many paradoxes:*
 - How does “particle” cross nodes?
 - Where is it really?
 - What is “zero” energy?



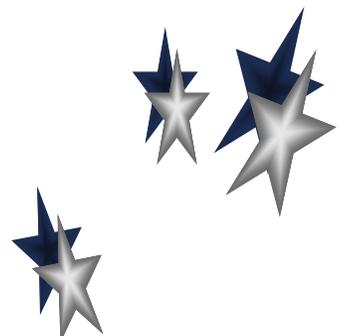
● “Particle” Diffraction / Interference Effects:



• Barrier Penetration:



- *Many other wave / particle paradoxes, accommodated by empirical and theoretical “principles”:*
 - Uncertainty (indeterminacy): $\Delta p \Delta q \sim \hbar$
 - Correspondence: for $\lambda \ll d$;
Q.M. \rightarrow Classical
 - Exclusion (spin-pairing $\uparrow\downarrow$):
[What is “spin?”]
 - Indistinguishability
(Information / Energy)
 - Complementarity
(Triangulation of Reality)



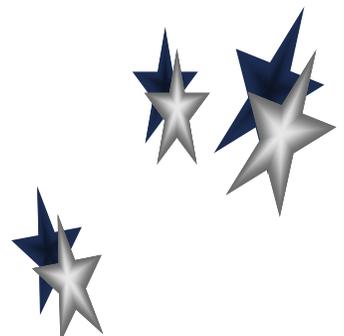
- *Lead to long, heavy philosophical arguments; two schools emerged:*

1. Ontological
Canonical
Deterministic } Einstein, *et al.*
("God does not play dice.")

"We're missing something; when we find it,
everything will be okay."

2. Epistemological
Observational
"Copenhagen" } Bohr, Heisenberg, *et al.*:

"Physics of Observation"



- *Copenhagen Interpretation*
(*Observational theory*)

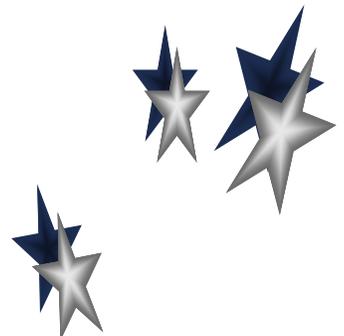
- Heisenberg:

“What we observe is not nature in itself, but nature exposed to our method of questioning...”

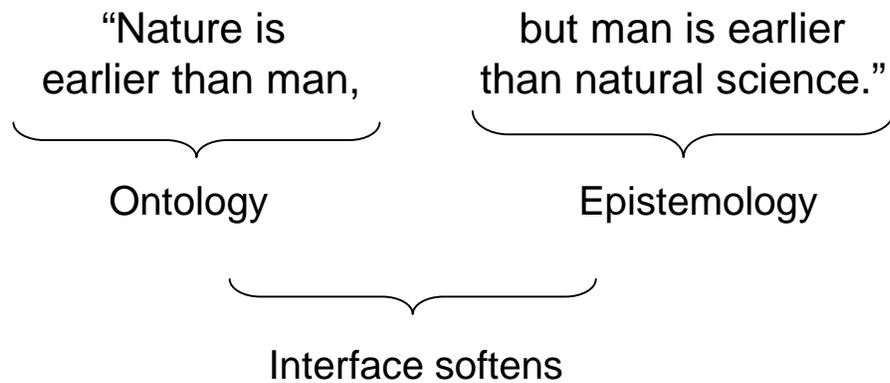
“Therefore, it will never be possible by pure reason to arrive at absolute truth...”

“The *concepts* may, however, be sharply defined with regard to their *connections*.”

”In the Copenhagen interpretation...we cannot disregard the fact that natural science is formed by man... it makes the sharp separation between the world and the I impossible.”



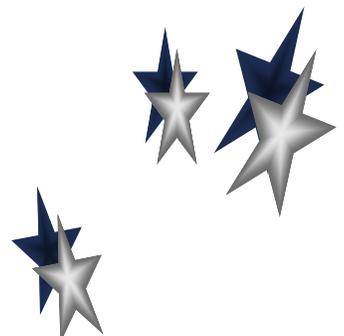
- Von Weizäcker:



- Kant:

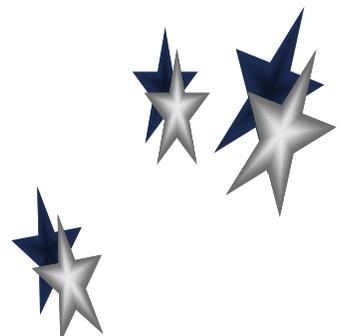
“Thing in itself” is inaccessible by experience or logic

**Subjectivism has crept back into Science,
but how far?**



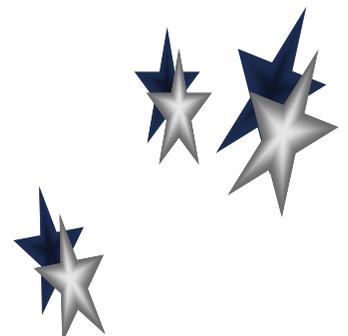
Max Planck

“Once we have decided that the law of causality is by no means a necessary element in the process of human thought, we have made a mental clearance for the approach to the question of its validity in the world of reality.”



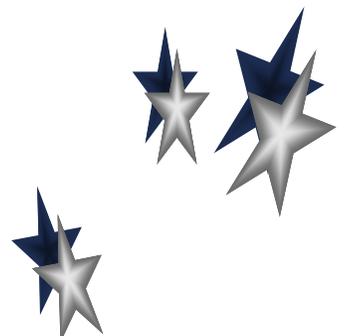
Neils Bohr

“Causality may be considered as a mode of perception by which we reduce our sense impressions to order.”



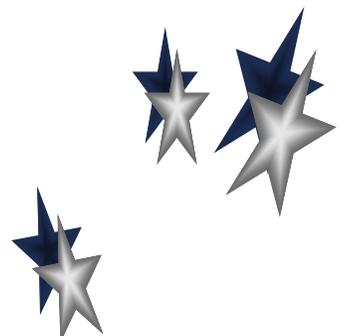
Louis De Broglie

“Even in the most exact of all the natural sciences, in Physics, the need for margins of indeterminateness has repeatedly become apparent — a fact which, it seems to us, is worthy of the attention of philosophers, since it may throw a new and illuminating light on the way in which the idealizations formed by our reason become adaptable to Reality.”



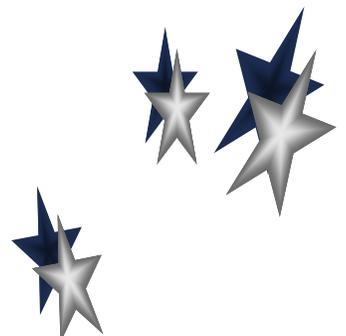
James Jeans

“... the physical theory of relativity has now shown that electric and magnetic forces are not real at all; they are merely mental constructs of our own, resulting from our rather misguided efforts to understand the motions of the particles. It is the same with the Newtonian force of gravitation, and with energy, momentum and other concepts which were introduced to help us understand the activities of the world — all prove to be mere mental constructs, and do not even pass the test of objectivity.”



James Jeans ***(continued)***

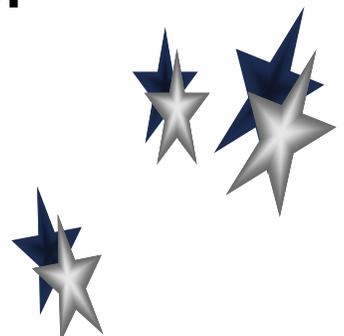
“The concepts which now prove to be fundamental to our understanding of nature... seem to my mind to be structures of pure thought, ... the universe begins to look more like a great thought than like a great machine.”



Albert Einstein

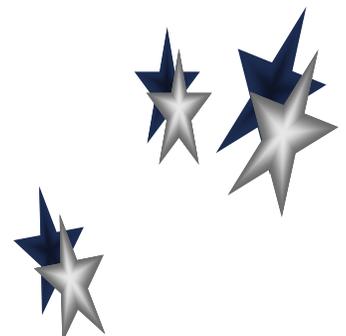
“Concepts which have been proved to be useful in ordering things easily acquire such an authority over us that we forget their human origin and accept them as invariable.”

“The system of concepts is a creation of a man together with the rules of syntax, which constitute the structure of the conceptual systems. ... All concepts, even those which are closest to experience, are from the point of view of logic freely chosen conventions, just as is the case with the concept of causality, ...”



Erwin Schrödinger

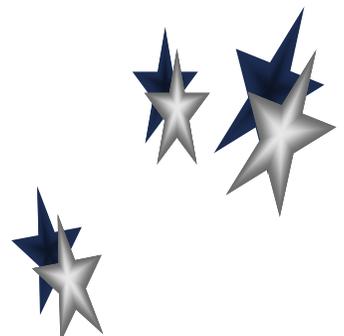
“... the ‘real world around us’ and ‘we ourselves,’ i.e., our minds, are made up of the same building material, the two consist of the same bricks, as it were, only arranged in a different order — sense perceptions, memory images, imagination, thought. It needs, of course, some reflexion, but one easily falls in with the fact that matter is composed of these elements and nothing else. Moreover, imagination and thought take an increasingly important part (as against crude sense-perception), as science, knowledge of nature, progresses.”



Erwin Schrödinger ***(continued)***

“Mind has erected the objective outside world of the natural philosopher out of its own stuff.”

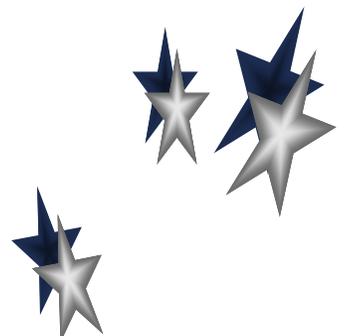
“The only possible inference from these ... facts is, I think, that I — I in the widest meaning of the word, that is to say, every conscious mind that has ever said or felt “I” — am the person, if any, who controls the ‘motion of the atoms,’ according to the Laws of Nature.”



Arthur Eddington

“We may look forward with undiminished enthusiasm to learning in the coming years what lies in the atomic nucleus — even though we suspect that it is hidden there by ourselves.”

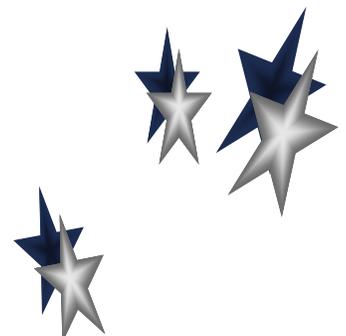
“Not once in the dim past, but continuously by conscious mind is the miracle of the Creation wrought.”



Arthur Eddington ***(continued)***

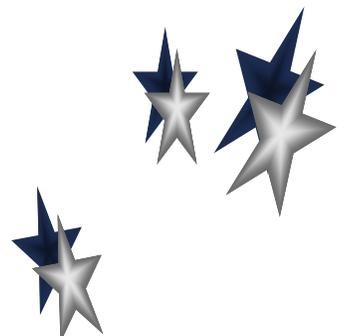
“All through the physical world runs that unknown content, which must surely be the stuff of our consciousness.... Where science has progressed the farthest, the mind has but regained from nature that which the mind has put into nature.

We have found a strange foot-print on the shores of the unknown. We have devised profound theories, one after another, to account for its origin. At last, we have succeeded in reconstructing the creature that made the foot-print. And Lo! It is our own.”



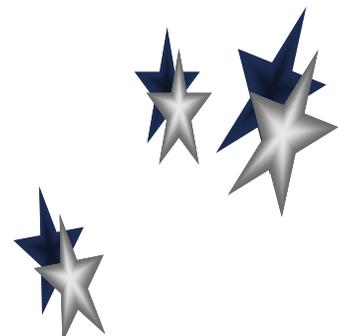
Sigmund Freud

“[The test of science is] fully circumscribed if we confine it to showing how the world must appear to us in consequence of the particular character of our organization. ... [since] our mental apparatus ... itself is a constituent part of that world which we are to investigate.”



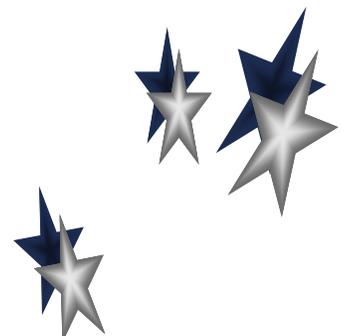
Arthur Schopenhauer

“...a consciousness without object is no consciousness at all. ... Although materialism imagines that it postulates nothing more than this matter — atoms for instance — yet it unconsciously adds not only the subject, but also space, time, and causality, which depend on special determinations of the subject. ...*the intellect and matter are correlatives*, in other words, the one exists only for the other; both stand and fall together; the one is only the other’s reflex. They are in fact really one and the same thing, considered from two opposite points of view; ...”



– Requisites of Contemporary Science

- Objectification
- Quantification
- Replication
- Falsification
- Conceptualization
- Representation
- Iteration
- Communication
- Preservation
- Implementation



– ***Science of the Future***

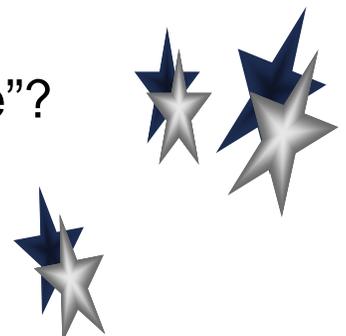
Questions:

- *Is the “Physics of Observation” just a special case of a “Physics of Experience” -- or of a “Physics of Knowledge”?*

- *What is reality?*
 - What “really” is?
 - What we “know”?
 - What we “experience”?
 - All of the above?
 - None of the above?

- *What is the role of consciousness in the physical world:*
 - Attention?
 - Intention?
 - Resonance?

- *Is there a “Science of the Subjective”?*



– Requisites of Future Science

- Proactive Consciousness
- Inclusion of Subjective
 - Concepts
 - Data
 - Analysis
 - Interpretation
- Teleological Drivers
- Role of Resonance
- Transdisciplinary Metaphors
- Replicability Criteria
- Causality vs. Correlation

(cf. “Science of the Subjective,” *Journal of Scientific Exploration*, 11, no. 2, 1997)

