

# Emergence and Evolution

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# The Reductionist Program

*" By convention sweet, by convention bitter, by convention hot, by convention cold, by convention color: but in reality atoms and void." (Democritus (460-400?))*

- Popular, dominant world view in the western world. Spelled out in Detail by Lucretius (97-55). Cool fascination
- Varying views in different branches of knowledge: Scepticism in humanics and after fundamental crisis also largely in physics
- Confidence by partial success in life sciences, neurophysiology and brain research, „neuro-reductionism“
- Philosophical position of „naturalism“

# Basic Assumptions of Reductionism

- Simply structured **basic layer**, describable by a small number of “**primary qualities**” having the status of intuitively accessible “**hard facts**”, similar to Classical Mechanics
- “**Secondary qualities**” (e.g. mental) reducible to primary qualities (e.g. neuronal) and **ontologically subordinate**. Reduction may be complicated but is considered possible in principle

# Rational Arguments for Naturalism

- Spectacular success of natural sciences and technology based on them in understanding and handling of the world
- Reduction considered successful for chemistry to physics, thermodynamics to mechanics. Further successes expected
- Partial success in biology and brain research, alliance with victorious Darwinism. “Evolutionary Epistemology” in its extreme naturalist version justifies naturalism as successful adaptation to the physically constituted real world.

## Emotional Reasons for “Naturalist Pathos”

- Closed consistent world view, lending orientation and confidence of being “state of the art”
- Reduction of fear: no spooky uncontrollable elements in the world, exorcism of “evil spirits”
- Related to this: widespread anti-religious resentment (Dawkins)
- Reaction to Copernican, Darwinian and Freudian insults (J. Monod)

# Status of Secondary Qualities

- “Eliminative Reductionism” (Democritus, P. Churchland) as radical solution
- “Emergentism”: Beyond a certain threshold of complexity, systems develop surprising new “emergent” properties, which are legitimate elements of reality but somehow ontologically subordinate. Evolution treats emergence as a process in time.
- Various shadings of emergentism, sometimes as milder form of reductionism, sometimes as resolute antireductionism (Chalmers, Dennet, Metzinger, Churchland, Dawkins,...)

# Questions Related to Emergentism

- Precise ontological status of emergent features (ontic, epistemic,...?)
- Novelty status of emergent features: “fulguration” or manifestation of previously invisible features
- Possibility of causal influence from the emergent on the fundamental layer (“Mental Causation”?)

# Plan

- Examples for possible Emergence
- Conceptual clarifications and definitions: emergence, supervenience, contextual emergence
- Alternatives: Complementarity and extension by adding observables, phenomenal character of the world, non causal relations
- Tentative answers to the aforementioned questions
- Emergence and evolution, evolutionary epistemology



# Examples for Emergence

- a. **Physics:** Thermodynamics, hydrodynamics, materials
- b. **Fluid dynamics:** turbulence, meteorology, tornados
- c. **Biology:** Cellular nucleus, multicellularity, formation of animal states, ecology, plant sociology
- d. **Sociology and culture:** Group dynamics, mass phenomena, styles of art, cultural dynamics
- e. **Economy:** Homo oeconomicus, market laws
- f. **Informatics:** Hardware and software, virtual worlds
- g. **Mathematics:** Decimals of  $\pi$ , „game of life“, Mandelbrot set, catastrophe theory, morphogenesis
- h. **Information, emergence of sense**

Neuroreductionist pathos absent in these examples

# Emergence

- **Modelling** of parts of the world: System, observables, states; more or less formalised
- **Emergence** as a relationship between different modelisations. Primarily epistemic notion
- In general, **one modelisation is considered to be more fundamental** as those “emerging” from it

# Supervenience

- A family **A** of properties is called **supervenient** over a family **B**, if every change in **A** is accompanied by a change in **B** but not necessarily vice versa. (E.g.. **A** psychological, **B** neuronal)
- Contains an element of **class formation and “coarse graining”**
- Distinction between “de facto” and necessary supervenience, and between strong and weak supervenience
- Emergent features can be considered supervenient

# Thermodynamics and Contextual Emergence

- Transition from mechanics to thermodynamics in **two steps**:
  - a) Transition to **stochastic description** by “mixed states”, attribution of probabilities to mechanical states
  - b) **Identification of “Macro-Observables”** like volume, temperature and attribution of mixed states to macrostates
- Compatibility of microdynamics and macrodynamics, **requirement of stability** for mixed states
- **Both steps by bringing about and applying a new context, which does not automatically and cogently result from the underlying mechanical context**

# Neuroreductionism as Contextual Emergence?

- Formalisability on neuronal layer given
- Formalisability on psychic layer only achievable by restriction to a small number of easily operationalisable observables, for which reduction becomes almost trivial. In general no classification and overview on psychic observables
- Fulfillment of stability requirement questionable
- Contextuality remains in every case

# Quantum Theory

- Takes into account phenomenal character of the world by pointing out vital importance of measurement. End of naïve realism.
- Quantum state only “catalogue of expectations”, but measurement results have factual validity
- Complementarity, if order of measurements relevant. In general only the result of the last measurement factual
- Entanglement correlations as non causal correlations become important

# Quantum Theory and Emergence

- Considerations about emergence in general tacitly assume a classical ontology like in Classical Mechanics
- This is no longer warranted, if measurements change the state, as e.g. the case for the human psyche from an introspective first person perspective
- Classical features can emerge from a quantum substrate like in modern thermodynamics
- But quantum features can also emerge from a classical substrate like psyche from neurons: Special difficulty of neural emergentism. H.R., H. Walach: Complementarity of Neuronal and Phenomenal Observables; P.beim Graben. H. Atmanspacher: Classical Complementarity

# Supervenience and Complementarity

- **Differences:**
  1. S: two formal systems, C: one formal system
  2. S: asymmetric, C: symmetric
- **Similarities:**
  1. Fundamental property “No change in **A** without change in **B**” holds in both cases
  2. Contextuality given in both cases



# Alternatives to Supervenience and Emergence

- Enlargement of the set of observables by additional complementary or compatible observables/points of view: **Symmetric alternative to S. and E. taking into account contextuality und phenomenality of the world**
- **Abandonment of monopole of causal explanations.** Acknowledgement of the full explanatory potential of Relations of form and sense (E.g. entanglement, angles in triangle)

# Interim Results 1

- Take into account phenomenality of the world and creative role of man as a model building and representing being. Naturalism/naïve realism confuse model and full reality
- Alternatives to emergence and supervenience: complementary or non complementary extension of observables
- Salient importance of contextuality. New contexts do not automatically arise from be basic layer. Their origin is the real problem (mystery of creativity)
- No monopole for causal explanations

# Hierarchical Structure of the World?

Notions like “emergence” and “supervenience” suggest a vertically layered hierarchical organisation of the world, but

- **Complexity**, allegedly related to emergence **is a relative notion** referring to a descriptive framework (Thermodynamics and molecular dynamics)
- **Emergent descriptions are largely independent of their basis**, which may be almost irrelevant
- **The existence of an ultimate fundamental physical layer is highly questionable**

# Ontic vs. Epistemic

- Emergence, Supervenience and Extension of observable set are contextual and, hence, primarily epistemic concepts.
- However a strong ontic element enters:
  - a. “Recalcitrance of nature”: Modelisations may fail. Nature does not pose questions but gives answers
  - b. “Hermaphroditic position” of Quantum Theory. Observables astride on epistemic cut
  - c. Hermaphroditic position of information

# Contextuality and Novelty

- New context do not abruptly pop up. They are not temporally but logically prior and preexistent
- Example: Thermodynamics, angles after increase of complexity from two to three points
- Appearance of novelty frequently ascribed to the work of chance, but chance is only negatively defined as the absence of an explanation in an accepted framework.
- Examples: Randomness in Physics as absence of causal explanation, algorithmic randomness of the digits of  $\pi$
- For good reasons, mathematicians tend to be secretly platonic

# Mental Causation

- Jaegwon Kim's dilemma: Supervenient mental layer either causally decoupled and helpless or lacking independence in an eliminatory way with respect to basic layer
- Solution: Causal relationship does not exist and is not needed. The correspondence between different contexts is due to their relatedness to the same system but is not causal in its nature. Nobody would call the relation between position and momentum causal.
- Liberation from causal monopole and from causal closure of physics
- Modelisations in physics methodologically constrained to causal connections but often inapplicable or irrelevant.

## Interim Results 2

- Kim's dilemma shows: Physical-causal emergence hardly possible
- Contextuality enables position of a non reductive emergentism
- Hierarchical ontology often questionable and not without alternatives. Relation between different levels may be more symmetric. Complementarity and extension of observables often preferable
- Mutiperspectiveness and equal value of different contexts suggested, even if they are not always equally well developed

# Darwinian Evolution

- Elements of modelling evolution: **Random mutations and subsequent selection** with respect to survival fitness. **Methodological exclusion of all elements of sense or purpose**
- **Fascinatingly simple and enormously fruitful**
- **Emergence as process in time** and not only relationship between different modelisations
- **Heuristic value** in admission of finalistic reasoning in a form acceptable for naturalists
- **Incentive for consequent search** for advantages in fitness
- **Problems with falsifiability** are taken into account



# Further Applications of Darwinism

- **Prebiotic chemical evolution:** promising but still(?) large explanatory gaps
- Pattern formation, especially for cosmological structures by surviving fluctuations: successful
- Economics, social and communication sciences
- **Considerable success in mathematical modelisations.** Interplay of physical and algorithmic randomness, “catastrophy theory”
- **Darwinism does not necessarily exclude observable extension by elements of sense, even if its proponents would reject this.** Complementarity?

# Facets of Darwinism

- **Environment** to which adaptation happens **not rigid** but changes not the least as a result of biological evolution
- **Selection often delayed**. For low evolutionary pressure many variants (“**Pre-adaptation**”), whose fitness value is tested later under stronger pressure
- “**Exaptation**”: “Transfunctioning” change in function of features frequent “strategy” of evolution
- **Co-evolution**, e.g. of insects and cryptogams or predators and preys
- **Intraspecific selection**: Luxury formations like peacock tail and antlers

# Evolutionary Epistemology 1

Undoubtedly, the human system of cognition has undergone evolution and it must help survival. But, in its most naturalist form, E. E. justifies the naturalist world view as successful adaptation to a “mesoscopic” physical environment. But

- Mesoscopic background rigid and inspired by 19th century physics
- Confusion of world model and world
- By naturalist zeal inclination towards dogmatism, thus taking over worst feature of abominated religion

# Evolutionary Epistemology 2

- Naturalistic world view late product of just one culture. Survival mostly ensured by animistic world view. Argument for animism?
- Man is the only „eusocial“ primate (E. O. Wilson). Selection / adaptation rather for social group than for individuum. Precarious balance of egoism and altruism
- For the evolution of the human cognitive system eusocial adaptation is more important than mesoscopic environment (language!).
- Evolutionary pressure low for social evolution. Multiple luxury features
- More viable view not necessarily more true
- Preserve valuable preadaptations rather than monoculture
- No „end of history“. One sidednesses will disappear

# Cognitive Universals

The universals of the human cognitive system not parallel to naturalist world view. They lie deeper:

- Temporality and spaciality as human existentials
- Eusocially evolved **empathy** for other group members, related to this **morality** and **sense for structures**
- Ability for language, symbolisation and contrafacticity
- Going back to animals: **elementary observables** like trees and stones

# Consequences

- Prudent multiperspective attitude instead of reductionist one-sidedness
- Empathy instead of premature subsumption
- Just and balanced appreciation of religious systems beyond crude sociobiological utilitarianism