EPFL Master course
Philosophical perspectives on the exact sciences and their history

Science and metaphysics: What is a law of nature? The scientific and the manifest image of the world

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Primitive ontology & dynamical structure

- primitive ontology: what is simply there, no function; the referent of our theories, what they talk about
- criterion: general & simple
- atomism: indivisible objects, not extended, characterized by their position in space → configuration of matter in space
- change in that configuration as permanent as are the atoms
- dynamical variables to capture that change: initial velocity, mass, charge, forces, energy, wave function, constants of nature, etc.
- dynamical structure of a physical theory: function to determine the evolution of what is simply there; relations that couple the motions of the particles to one another
- claim: primitive ontology theory invariant; dynamical structure varies as we make progress in formulating a simple and informative theory about the evolution of what simply exists
- laws: dynamical structure

Simplicity: ontology vs. dynamics

- simplicity in ontology opposed to simplicity in representation
- most simple ontology: matter points standing in distance relations. BUT nothing in distance relations in given configuration of matter points tells us something about how these relations change

→ law of motion needs more parameters than position

$$\frac{d}{dt}Q_t = v_t(Q_t), \qquad Q_t = (q_1(t), \ldots, q_{N-1}(t))$$

→ dynamical structure; fixes v

Determinism

- task: find parameters that enable formulation of law of motion such that given any configuration Q, the entire evolution of Q is fixed
- & that single out probability measure that enables formulation of propositions about which evolution of subsystems we can reasonably expect under ignorance of exact initial conditions
- determinism structure of physical theory in order to accomplish task of simple & informative representation; no metaphysical proposition about the world

→ no consequence for free will, etc.

Dynamical structure and ontology

- argument: mass, charge, forces, fields, wave functions, etc. answer question why particles move in the way they in fact do
- counter-argument: mass, charge, forces, fields, etc. *defined* in terms of what they do for the particle motion
- ➔ ontological commitment to them no gain in explanation
- drawback surplus structure & artificial problems: How does a particle accelerate other particles in virtue of properties that are intrinsic to it? How does a wave function influence the motion of matter?

Dispositionalism

- **general scheme:**

$$\frac{dx}{dt} = D_1 \ldots D_n$$

- ***dx/dt*** **: explanandum, what the theory seeks to explain**
- $D_1 \ldots D_n$ **: explanans, what does the explanatory work**
- $D_1 \ldots D_n$ **: properties that determine the temporal development of** $x \rightarrow$ **dispositions**
- ***dx/dt*** **: manifestation of properties / dispositions**
- $D_1 \ldots D_n$ **: causes ;** ***dx/dt*** **: effect (→ physical causation without passing of time between cause and effect)**
- **universal, deterministic**

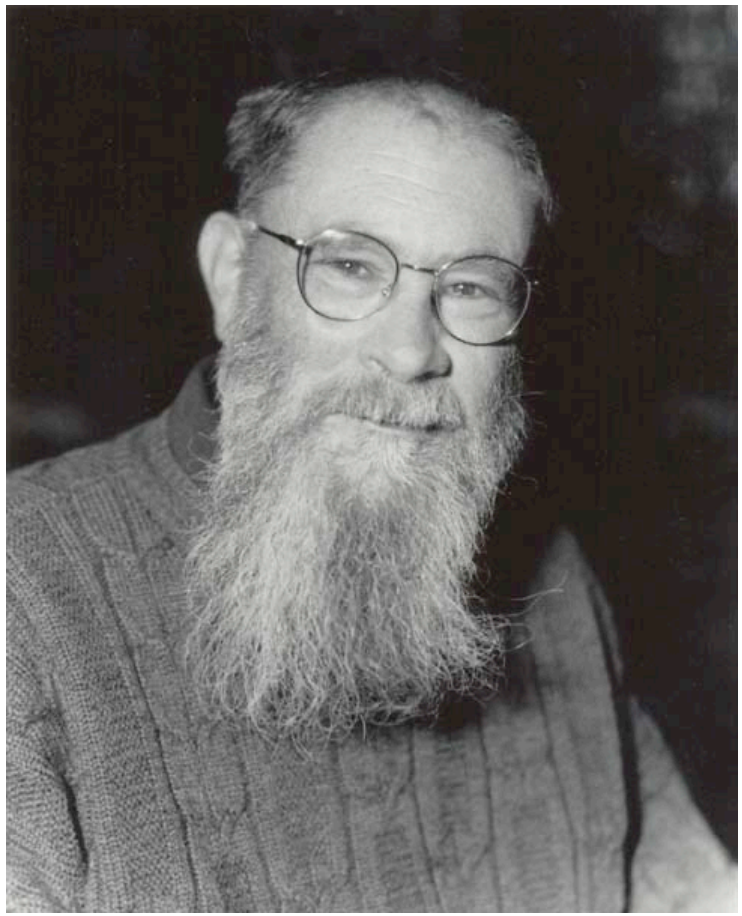
Dispositions and laws

- dynamical laws fixed by dispositions
- dynamical laws reveal the causal roles that the dispositions exert
- *objective modality, necessity*: in any world *w* in which disposition *D* exists, *D* exerts the same causal role

→same dynamical laws

→necessary connection between disposition and its manifestation

David Lewis (1986)
Humean metaphysics



"It is the doctrine that all there is to the world is a vast mosaic of local matters of particular fact, just one little thing and then another. … We have geometry: a system of external relations of spatio-temporal distance between points. … And at those points we have local qualities … For short: we have an arrangement of qualities. And that is all. … All else supervenes on that."

Humeanism

- distribution of matter throughout space-time: complete history of initial configuration of matter points
- that distribution manifests certain patterns
- Humean best system: the laws of nature are the axioms of the system that achieves the best balance between being simple and being informative in describing the distribution of matter throughout space-time
- ➔ What the laws of nature are is fixed only "at the end of the world". The laws do not determine the temporal development of matter. That development determines the laws.
- laws in our theories: best conjectures that we can make on the basis of our evidence

Super-Humeanism

- primitive ontology of matter in motion: only relative positions and their change
- that change manifests certain patterns or regularities
- laws require fixing of dynamical parameters (mass, charge, fields, etc.) as initial conditions over and above positions (primitive ontology)
- dynamical parameters, geometry and laws all come in as a package to achieve the best representation (most simple & most informative) of the overall change in the configuration of matter

Humeanism vs. objective modality

- **Humeanism:** explanation through unification in fundamental physics: identifying the salient patterns; but no explanation why there are these patterns
- **dispositionalism:** given an initial configuration of matter points, there is something about this configuration that puts a constraint on how it can develop in time; that something expressed in the laws of nature: law-making properties in the universe
- ➔ laws express / reveal modal connections, thereby explanatory
- **problem:** every candidate for that constraint that science can name *defined* in terms of its effect on the development of the configuration of matter

The metaphysics of laws

- **pertinent question: What is the primitive ontology? What is the dynamical structure of a given theory?**
- **How do both explain the evidence?**
- **atomism: point particles individuated through spatial relations & change of these relations; everything else explained in terms of these relations and their change**
- **➔ primitive ontology remains the same, dynamical structure varies as we make progress in representing the actual particle motion**
- **ontological commitment to geometry (absolute space and time) and dynamical parameters surplus structure, in dispute whether explanatory gain (Super-Humeanism vs. dispositionalism)**

Scientific image of the world

- matter in motion primitive
- functionalism: everything else defined in terms of causal role for matter in motion → realised by certain configurations of matter in motion.
- water: not primitive stuff, defined by causal role (thirst-quenching, etc.) → realised by configuration of H2O molecules → certain particle configurations, moving in certain characteristic ways, *are* water.
- living organisms / genes
- mind

Félix Le Dantec (1869-1917)
Scientism

« Je crois à l'avenir de la Science : je crois que la Science et la Science seule résoudra toutes les questions qui ont un sens ; je crois qu'elle pénétrera jusqu'aux arcanes de notre vie sentimentale et qu'elle m'expliquera même l'origine et la structure du mysticisme héréditaire anti-scientifique qui cohabite chez moi avec le scientisme le plus absolu. Mais je suis convaincu aussi que les hommes se posent bien des questions qui ne signifient rien. Ces questions, la Science montrera leur absurdité en n'y répondant pas, ce qui prouvera qu'elles ne comportent pas de réponse. »

Scientific image of the world

Problems:

- **subjective perspective on the world: conscious experience**
- **meaning (semantics)**
- **free will**
- **normativity**

presupposed for doing science

Manifest image of the world

- persons and their experience primitive
- everything else conceived in analogy to persons
- qualities over quantities
- Sellars: pink ice cube
- science instrumental role

Three stances

- scientific image complete: materialism / naturalism, functionalism

  (Hobbes, Lewis, Jackson)
- sophisticated version of manifest image complete: comprehensive ontology of traditional metaphysics

  (Aristotle, Thomas Aquinas)
- dualism of facts and norms / causes and reasons

  (Descartes, Kant, Sellars)