The Logical Theory of Questions and the Definitions of Natural Kind Terms

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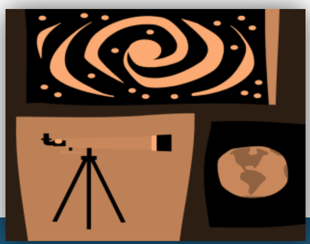
Definitions in science

1. **The importance of defining terms**
2. **A pragmatic analysis of non-formal conditions for a scientifically useful definition [Hempel, Pawłowski]**
3. **Case study: definition of a ‘planet’**



Case study: definition of ‘planet‘

- **Because of new discoveries (KBO, brown dwarfs, free-floating and extrasolar planets) common definition of planet appears neither adequate nor useful.**
- **The most confusing is the fact that Pluto was recognized as one of the many bodies of Kuiper belt and even not the biggest one (2005–Eris).**
- **If Pluto conventionally would be defined as a planet, logically Eris should become a planet either.**

Historical Period	Extent	Formula
About 4th century BC -1th century AD (ancient Greek tradition)	Moon, Sun and naked eye planets: Mercury, Venus, Mars, Jupiter, Saturn	A planet is this object (used with pointing gesture). Evolved to: Planets („wanderers”) are Moon, Sun, Mercury, Venus, Mars, Jupiter, and Saturn [Russo 2004].
II century BC - beginning of XVI century (Ptolemy System, Geocentrism)	Moon, Mercury, Venus, Sun, Mars, Jupiter, Saturn	Planet is a celestial body below stellar sphere, rotating around the Earth on some orbit with the move which represents at least two anomalies [Ptolemy 1913].
XVII - half of XIX century (Copernican System, Heliocentrism)	23 objects	Planet is a celestial object that orbits around the Sun [Copernicus 1854].
After 1852 (Erasure of asteroids from planets)	Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune New discoveries: Pluto (1930), Eris (2005)	Planet is a non-luminous body that orbits a star and is larger than an asteroid [Brown 2004].

Historical definitions of the term ‚planet‘

Author(s)	Proposed definition of a planet
IAU-definition	Celestial body that: (a) is in orbit around the Sun, (b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape,(c) has cleared the neighborhood around its orbit [IAU 2006].
S. A. Stern and H. F. Levison	Any body in space that satisfies the following testable criteria on its mass – if isolated from external perturbations, the body must: (a) be low enough in mass that at no time can it generate energy in its interior due to any self-sustaining nuclear fusion chain reaction; (b) be large enough that its shape becomes determined by gravity in less than Hubble time, so that the body would on this timescale or shorter reach a state of hydrostatic equilibrium in its interior [Stern&Levison 2002].
M. E. Brown	Any body in the solar system that is more massive than the total mass of all of the other bodies in a similar orbit [Brown 2004].
S. Soter	An end product of secondary accretion in a disk around a primary star or substar [Soter 2006].

Currently competing definitions of the term ‚planet‘

Limits of the pragmatic approach

4. Nomological utility of a definition reduced to the explanatory power of the pair: theory - definition [Kuipers, Grobler&Wiśniewski]
5. Limits of the method. The evaluation of alternative definitions is always relative to the theory and background knowledge (version of the Duhem problem).
6. Proposal for further reaserch: defining as a structure of erotetic logic and inferences

Wiśniewski´s logical foundations of erotetic inferences [Wiśniewski 1995]

Non pragmatic concept of the ARISING OF A QUESTION from premises: a question and set of declarative sentences

explicated by

the definition of semantic relation called EROTETIC IMPLICATION : "a question Q implies a question Q* on the basis of a set of declarative formulas X".

Wiśniewski´s logical foundations of erotetic inferences – erotetic implication

Any question Q* implied by a question Q on the basis of a set of declarative formulas X will satisfy conditions:

❖ If the question Q has a true direct answer and all the formulas in the set X are true, then the question Q* must have a true direct answer.

❖For each direct answer B to the question Q* there exists a non-empty proper subset Y of the set of direct answers to the question Q such that Y must contain at least one true answer if B is true and all the formulas in X are true.

Direct answers (DA)

Key idea: logic of questions pay at least as much attention to answers to questions as to questions themselves.

Basic category of possible answers (their logical values are not prejudged) – DIRECT ANSWERS (DA).

Kubiński: DA are "these sentences which everybody who understands the question ought to be able to recognize as the simplest, most natural, admissible answer to this question."

Special case: natural kind terms (NKT)

Two classical questions which arises are:

- about the references of NKT,
- about underlaying theory of meaning.

Consequently, further analysis and reflections will base on so-called *contextual theory of meaning and references* [Odrowaz-Sypniewska 2006].

Concept of defining NKT in notional apparatus of erotetic inferences – as an answer to wh-question

Wh-question Q1: What is *T*?

↓

For NKT: contextual theory of meaning and references as premises (set of declarative formulas).

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Q2: Which properties of *t* determine membership in a given kind *T*?

Theoretical and background knowledge (set of declarative formulas)

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Yes-No questions Q3,...,Qn: Do the properties *x1, x2, x3* … determine membership of *t* in a given kind *T*?

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