

Status of Physical [In]Determinism

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Contents

- ▶ provable [un]provables
- ▶ classical [in]determinism
- ▶ quantum [in]determinism

Provable [un]provables – what is entirely hopeless

- ▶ “Haltung” (“approach”): Freud, 1912: “gleichschwebende Aufmerksamkeit” (“evenly suspended attention”)
- ▶ epistemic method: intrinsic, embedded observers, interfacing, means relativity
- ▶ formal method: reduction to the halting or Rice’s problems or other incompleteness and fixed point theorems (eg, Yanofsky, doi 10.2178/bsl/1058448677)

cntd. Provable [un]provables – what is entirely hopeless

- ▶ general prediction/forecasting problem unsolvable by algorithmic means
- ▶ general induction problem unsolvable by algorithmic means
- ▶ provable impossibility to prove [in]determinism of (finite) phenomenology by algorithmic means
- ▶ nonalgorithmic ineffability may still be possible (Gödel seemed to have believed in this / Turing seemed to have denied it / cf. also recent book by Jonas, doi 10.1057/978-1-137-57955-3 / maybe idealistic self-delusional? Sagan's 1997 movie & novel "Contact" / Definition of love in Plato's Symposium / Stace's Refutation of Realism)

Classical [in]determinism

- ▶ dependent on assumptions; eg. classical (nonconstructive) continua; means relativity
- ▶ deterministic chaos (strong dependence on initial values; “unfolding” of the algorithmic information content therein)
- ▶ instabilities and weak solutions of ordinary differential equations (not Lipschitz continuous): discussion about gaps for free will by Poisson in 1806, Duhamel in 1845, Bertrand in 1878, Boussinesq in 1879, and in 1873 by Maxwell; modern version “Norton dome”
- ▶ exotic constructions: Kreisel, Pour-El & Richards, ...

Quantum [in]determinism

- ▶ single events: creatio continua (spontaneous & stimulated emissions)
- ▶ complementarity
- ▶ value-indefiniteness/contextuality a la Bell, Kochen-Specker
- ▶ entanglement: individuality versus relationality in multipartite situations
- ▶ unitarity (one-to-one-ness permutation) of the quantum evolution versus irreversible (?) measurements: quantum erasure experiments; nesting (von Neumann, Everett, Wigner)

“from the standpoint of our quantum mechanics, there is no quantity which in any individual case causally fixes the consequence of the collision; but also experimentally we have so far no reason to believe that there are some inner properties of the atom which condition a definite outcome for the collision. Ought we to hope later to discover such properties . . . and determine them in individual cases? Or ought we to believe that the agreement of theory and experiment – as to the impossibility of prescribing conditions? I myself am inclined to give up determinism in the world of atoms.”

Einstein in a letter to Born, dated December 12, 1926

“In any case I am convinced that he [the Old One] does not throw dice.”

Planck, 1932

“the law of causality is neither true nor false, it rather is a heuristic principle, a signpost and in my opinion the most valuable signpost we possess, to guide us through the motley disorder of events and to indicate the direction in which scientific inquiry should proceed in order to attain fruitful results.”

Feynman, 1965

... the “perpetual torment that results from [[the question]], ‘But how can it be like that?’ which is a reflection of uncontrolled but utterly vain desire to see [[quantum mechanics]] in terms of an analogy with something familiar.” Therefore, Feynman advises, “do not keep saying to yourself, if you can possibly avoid it, ‘But how can it be like that?’ because you will get ‘down the drain’, into a blind alley from which nobody has yet escaped.”

“The discovery that individual events are irreducibly random is probably one of the most significant findings of the twentieth century. . . . For the individual event in quantum physics, not only do we not know the cause, there is no cause.”

Thank you for your attention!

