Charles Bennett

Statement

and

Readings

Entanglement, Decoherence, and the fate of Jimmy Hoffa

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Quantum information theory provides a coherent picture of the emergence and obliteration of correlations, even in macroscopic systems exhibiting few traditional quantum hallmarks. It helps explain why the future is more uncertain than the past, and how decoherence causes information to become classical by becoming redundantly replicated throughout a system's environment, a process Zurek nicknamed "quantum Darwinism". The most private information, exemplified by which path a particle takes through an interferometer, evades this replication, and so is evanescent in the sense that after the experiment is over even God does not remember what "happened". Less private kinds of information include classical secrets, facts known only to a few, or information—like the lost literature of antiquity—that once was public but has been forgotten over time. Finally there is information that has been replicated and propagated so widely as to be infeasible to conceal and unlikely to be forgotten. Modern information technology has caused a proliferation of such information, eroding personal privacy while at the same time deterring crime and tyranny. At a fundamental level, one might hope that whenever information is amplified to the point of becoming macroscopic and classical, it becomes permanent and ineradicable. However, by comparing entropy flows into and out of the Earth with estimates of the planet's storage capacity, we conclude that most macroscopic information about the past—for example the pattern of drops in last week's rainfall or rice grains in last night's dinner—is impermanent, soon becoming nearly as ambiguous, from a terrestrial perspective, as the which-path information of an interferometer. Depending on the diligence and forgetfulness of their enemies, the fate of mysteriously disappeared persons such as US labor leader Jimmy Hoffa, thought to have been murdered in 1977, may by now have acquired this ambiguous epistemological status. Finally we discuss prerequisites for a system to accumulate and maintain in its present state, as our world does, a complex and redundant record of at least some features of its past. Not all Hamiltonians and initial conditions lead to this behavior, and in those that do, the behavior itself tends to be temporary, with the system losing its memory as it relaxes to thermal equilibrium.