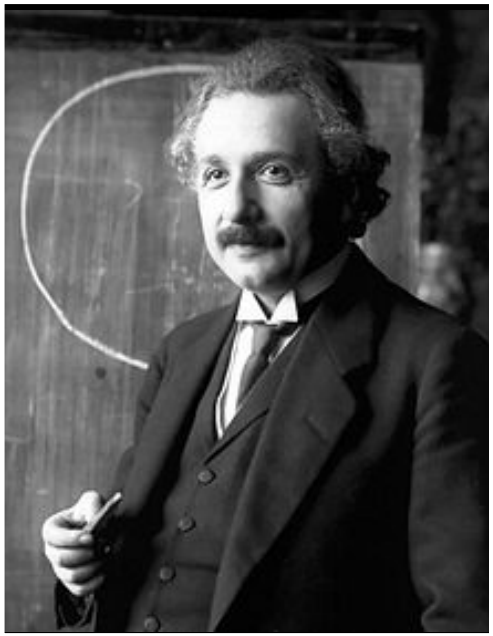
Werner Heisenberg

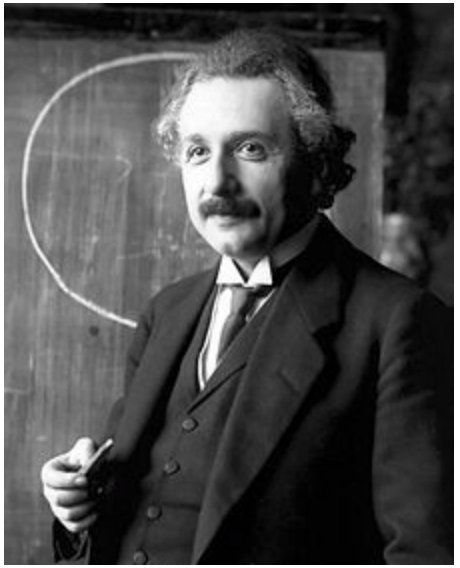


Albert Einstein

Dialogue quoted from *The Age of Entanglement* by Louisa Gilder

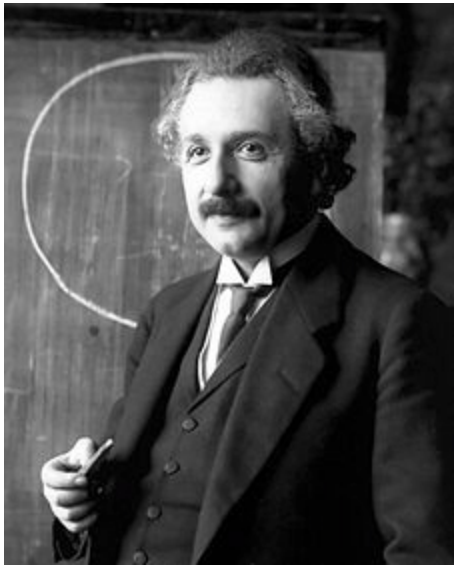
“You do not mention the path of the electron at all, Heisenberg. But yet when you look in a cloud chamber the electron's track can be observed quite directly."

"Don't you think that it's strange to say that there is a path for the electron in the cloud chamber, but there is no path for the electron in the atom? The existence of the path cannot depend merely on the *size* of its container."



"But we have no way of *observing* the electron's path in the atom. What we actually record are frequencies of the light radiated by the atom, but no actual path. And it is rational to introduce into a theory *only* such quantities as can be directly observed."

“"Heisenberg, *every* theory contains unobservable quantities. The principle of employing only observable quantities simply cannot be consistently carried out.”

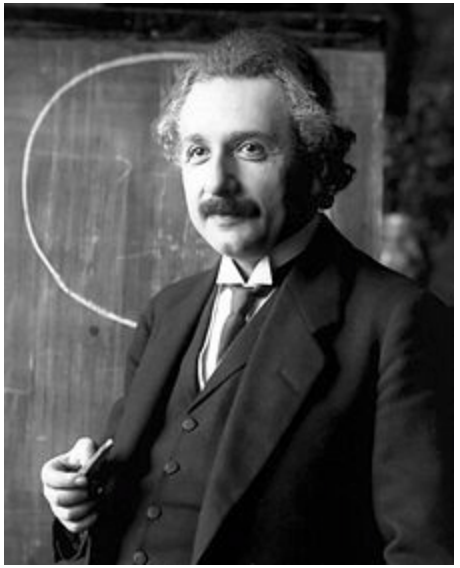


"But isn't that precisely what you have done with relativity?”

“ Perhaps I did use such philosophy earlier, perhaps I even wrote it, but it is nonsense all the same."

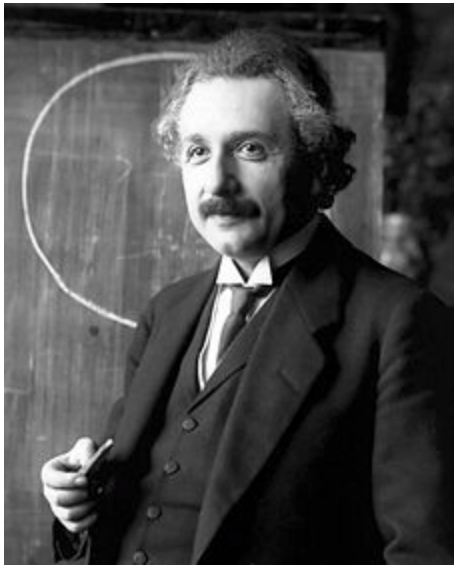
"You know, people talk about 'observation' all the time, but do they know what they actually mean by that? The very concept of 'observation' is itself already problematic."

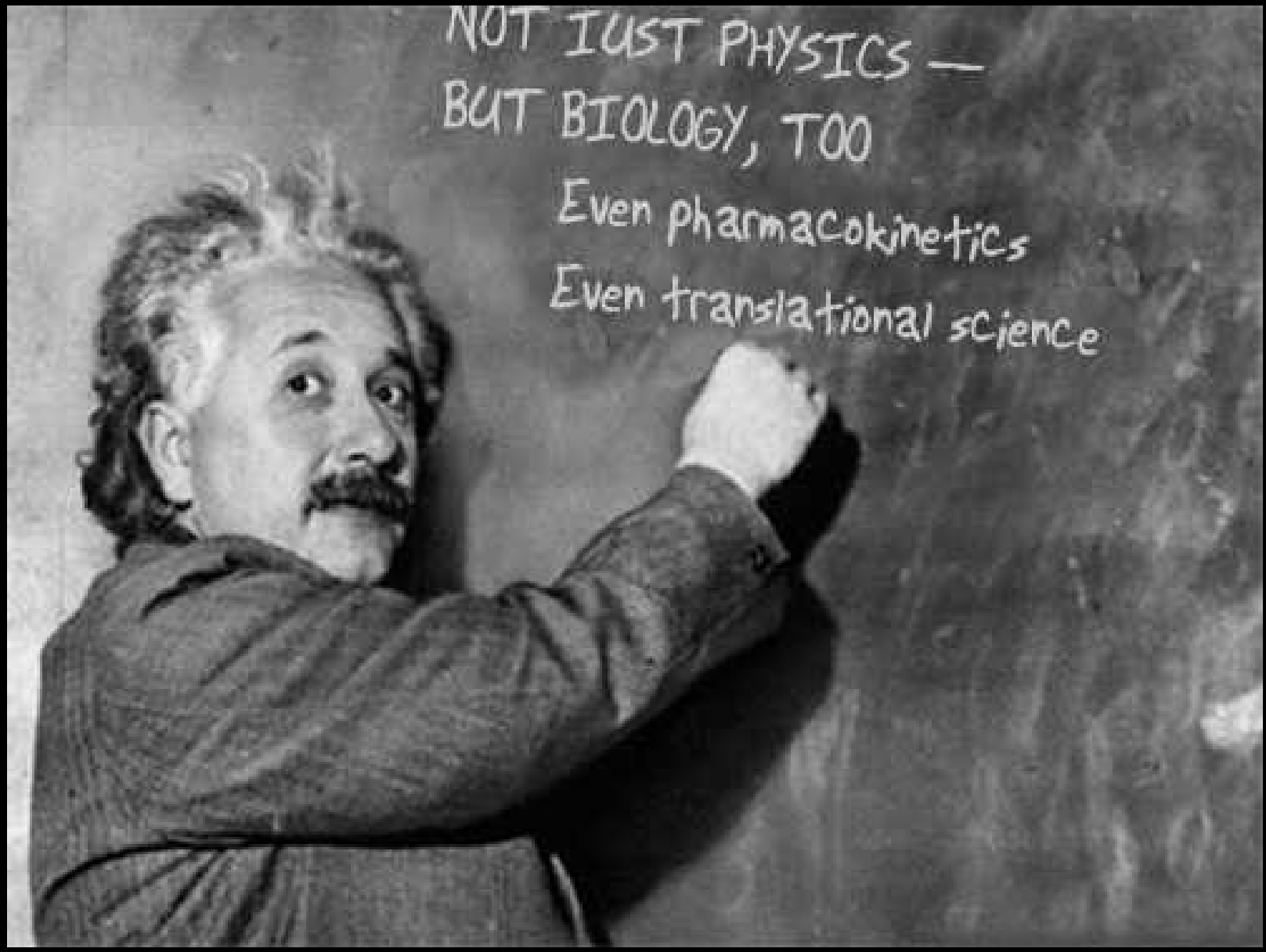
"Every observation presupposes an unambiguous connection between the phenomenon to be observed and the sensation which eventually penetrates into our consciousness. But we can only be sure of this connection if we know the natural laws by which it is determined.”



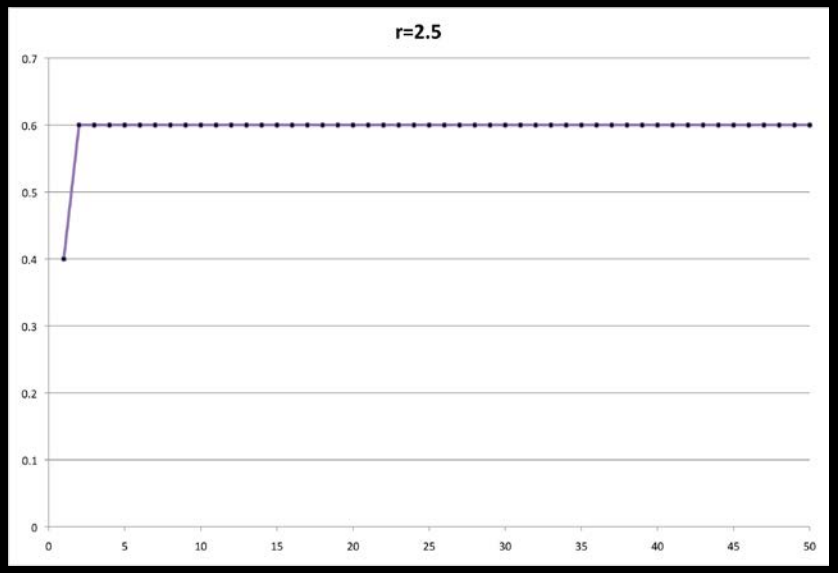
If, however, as is obviously the case in modern atomic physics, these laws have to be called into question, then the concept of 'observation' loses its clear meaning."

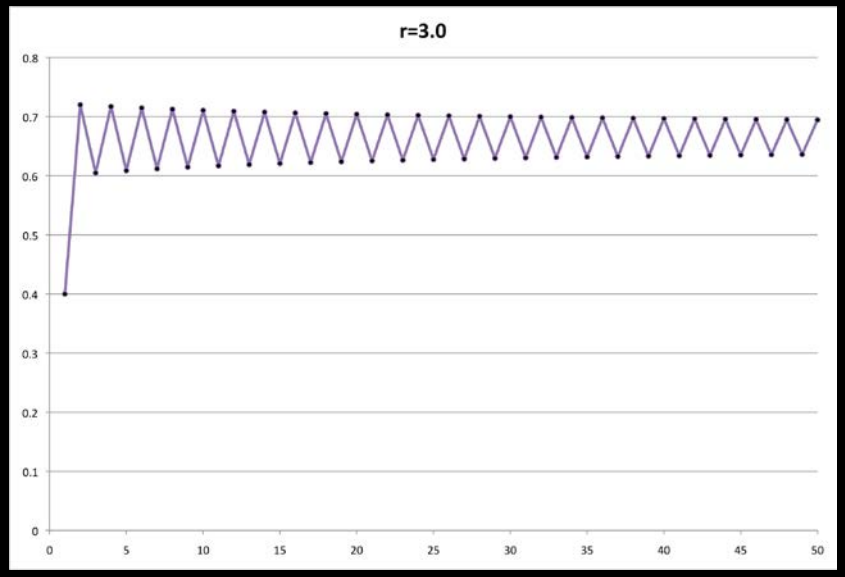
"In that case, it is *theory* which first determines what can be observed."

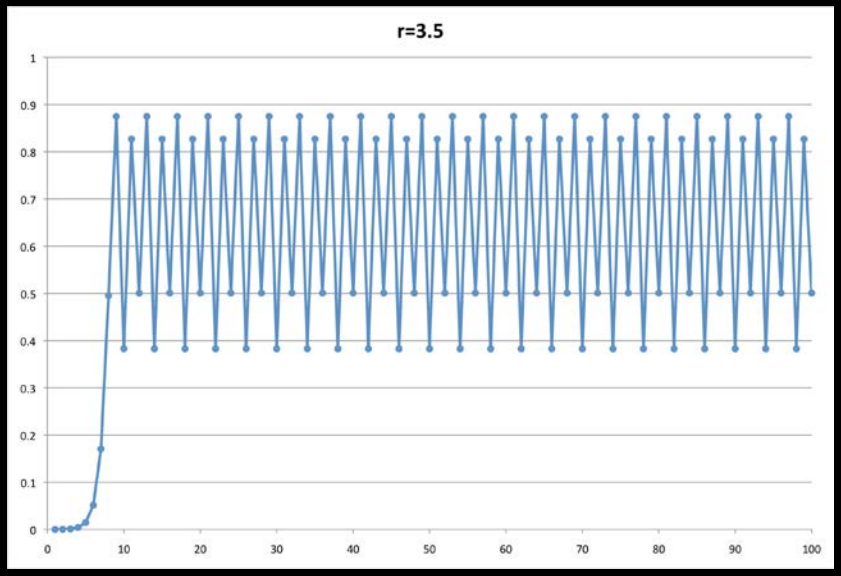


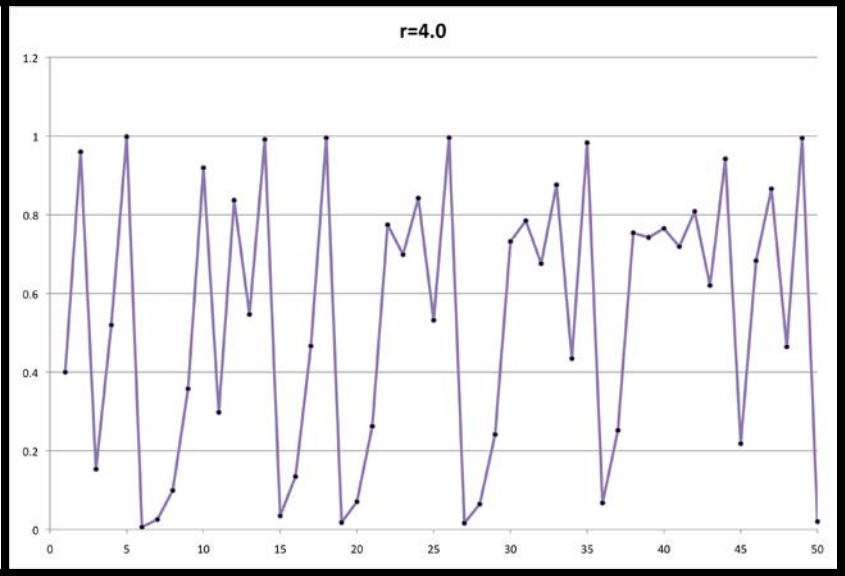

NOT JUST PHYSICS —
BUT BIOLOGY, TOO
Even pharmacokinetics
Even translational science

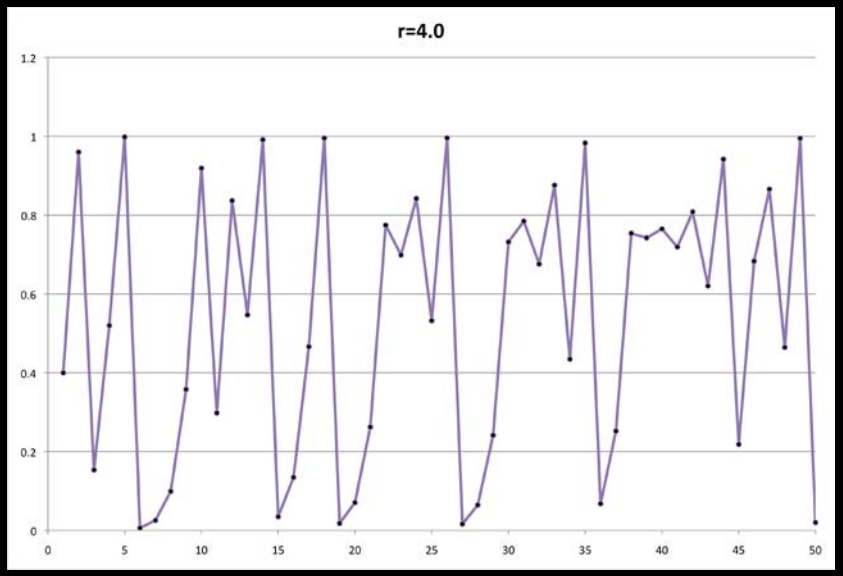
Classic Logistics Equation: $x_{n+1} = rx_n (1 - x_n)$







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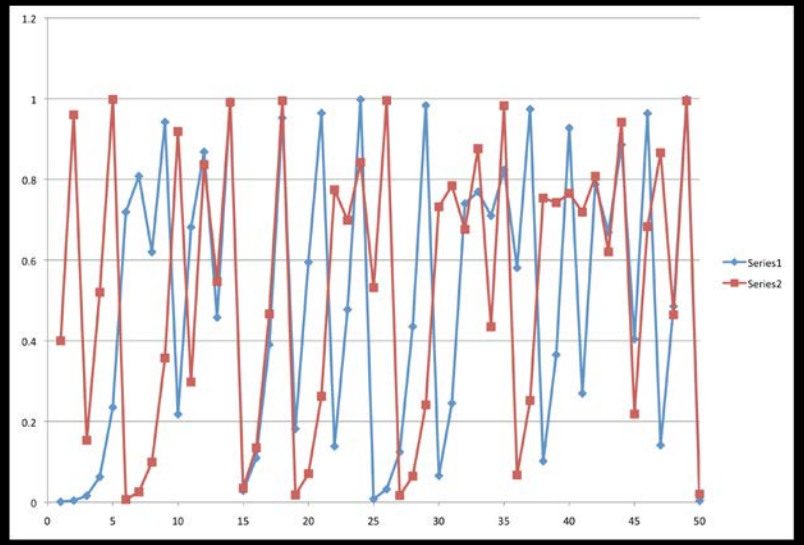
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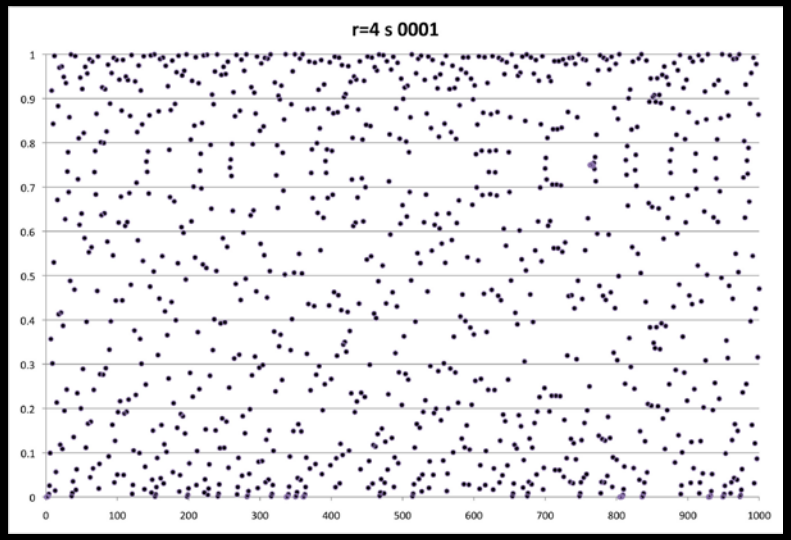
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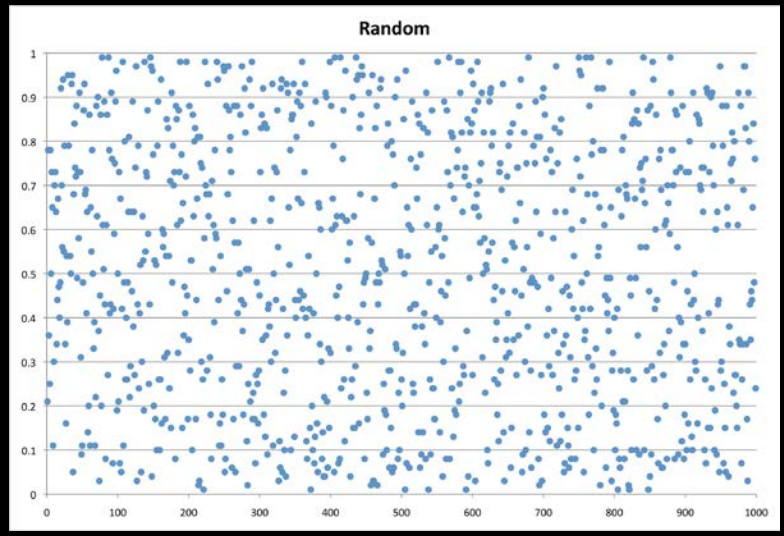
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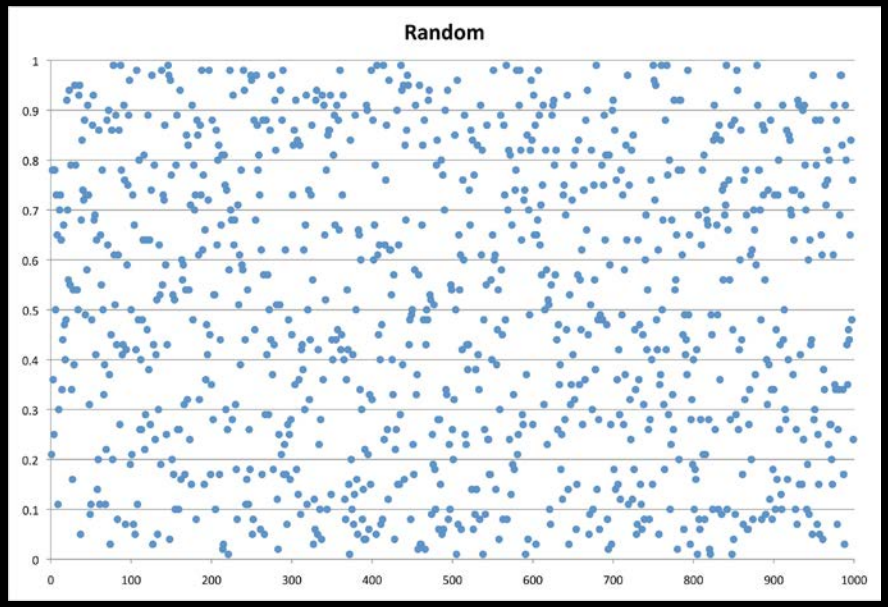
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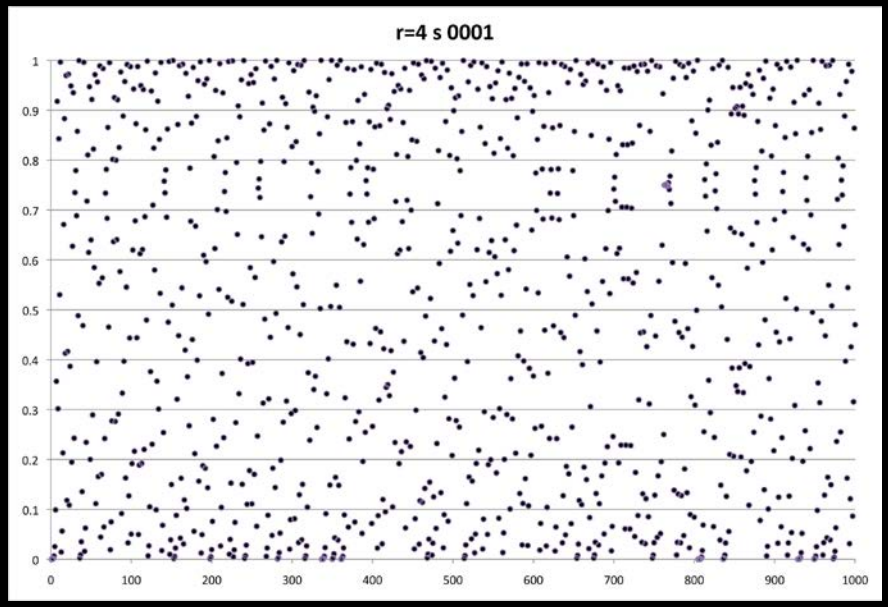
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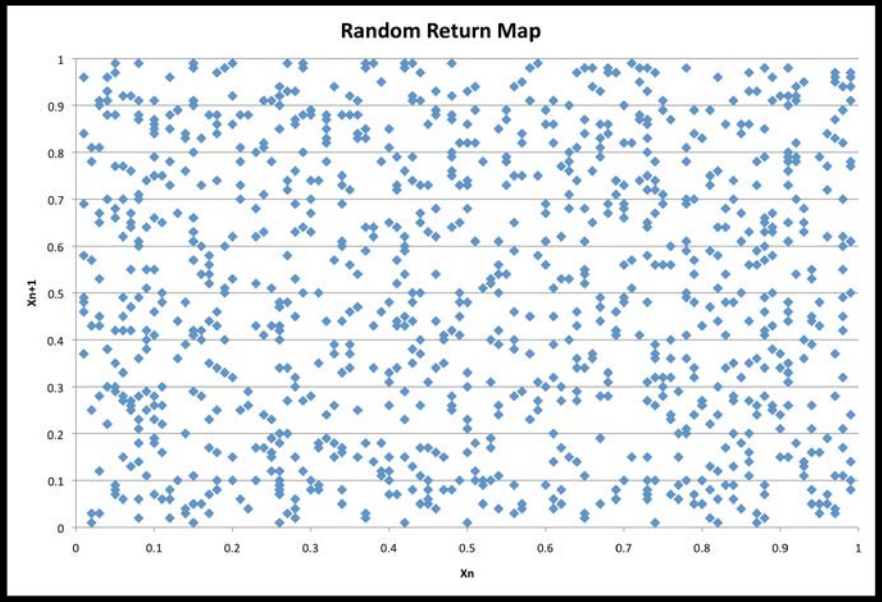
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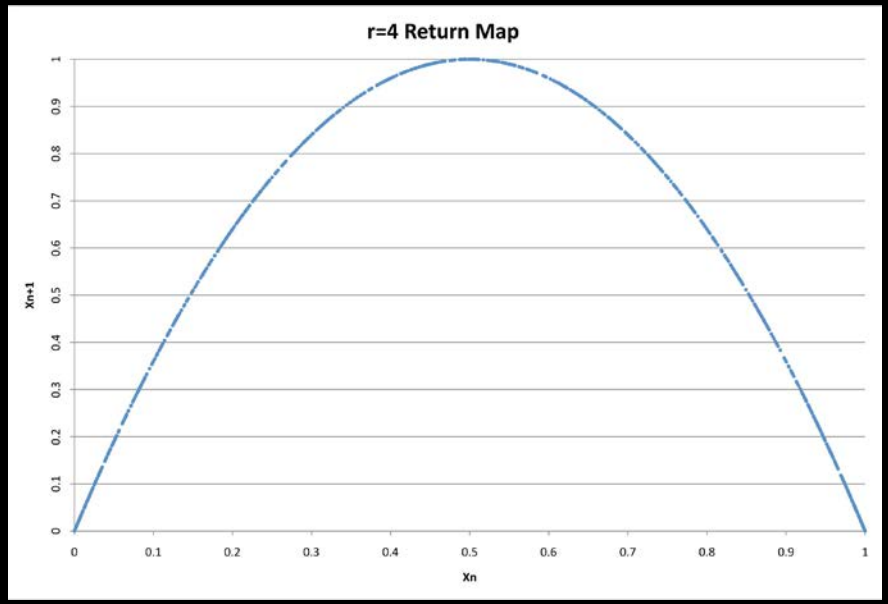
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1

Theories permit consciousness to
'jump over its own shadow,'
to leave behind the given, to
represent the transcendent …

Hermann Weyl