Quantum Realism Appendix I

Varieties of Virtualism

Brian Whitworth, New Zealand

Thanks to Tom Campbell and John Ringland for the discussion that led to this appendix.

OBSERVATION LEVELS

Physics studies the physical but other sciences study information, experiences, and social events that aren't physical at all. This is why computer science isn't just about hardware but also software, user experiences, and social technologies (Whitworth & Ahmad, 2014). Science has many fields because we observe more than physical events.

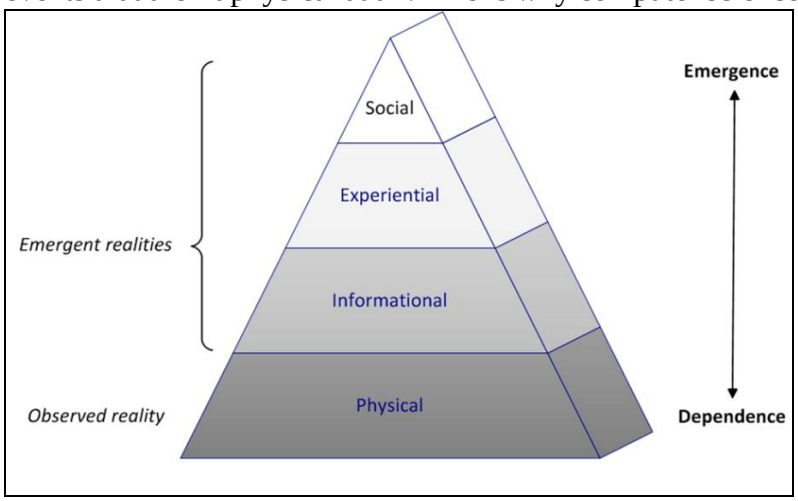

Figure 1. Observation levels of reality

In Figure 1, observed reality can be physical, informational, experiential, or social. Physical observation is of physical things but physical events can also encode information. Brains turn physical sense events into information that we experience as perceptions, thoughts, or feelings. Social constructs like duty then arise when we experience being in a group. Science can study what we observe at any level, as physical events (physics), informational events (computing), experiential events (psychology), or social events (sociology).

Each observation level emerges from the one before, as a higher view of reality, so a physical event seen as a binary choice (Shannon & Weaver, 1949) becomes a yes/no bit of information. Thus, information emerges from physical events, experiences emerge from brain information, and social constructs emerge from the group experience (Bone, 2005).

Figure 1 is founded on physical events but to explain them physics had to invoke imaginary quantum waves, non-physical dimensions, and virtual particles. That scientists need "fairytale physics" (Baggot, 2013) to explain physical events suggests that reality is not just physical.

APPROACHING REALITY

Historically, there have been three classical approaches to reality:

1. ***Physical realism***. Physical realism is that there is one reality and the physical world is it, so:

   "There is nothing outside the physical universe" (Smolin, 2001).

   Bohr's statement that: "*There is no quantum world"* makes quantum states useful fictions, so it follows that quantum theory is a theory of nothing, and light is a wave of nothing:

   "*… we accept as nonexistent the medium that moves when waves of quantum mechanics propagate*." (Laughlin, 2005) p56.

Yet if physical causes explain everything, how can objects be detected without physical touch (Kwiat et al., 1995)? How does light always choose the fastest physical path to any destination (3.6.2)? How can two physical state changes correlate faster than the speed of light allows (Aspect et al., 1982)? Physical causes can't explain these facts and many others.

Implications. If everything is physical, by the second law of thermodynamics, our universe will end as a cold, dark, lifeless emptiness. In this view, we are biological machines with a free will delusion afloat in a doomed universe, so nothing really matters. But if we are cogs in a pointless machine, why do science at all? This approach leads inevitably to nihilism.

2. ***Dualism.*** Dualism accepts the physical body but adds a non-physical mind. It let science coexist with religion but divided scientists into atheists who believe in the physical, theists who believe in a world beyond, and agnostics who don't know. Attributing the unknown to a higher realm gave a God of the Gaps, whose domain shrinks as science expands.

   Implications. Dualism can't explain how the mind and body interact. If they don't, then each is irrelevant to the other, as what use is a mind that can't affect the body? Or if they do, which is primary? If the mind is a brain byproduct, like steam rising from hot soup, it doesn't affect anything. Or if the mind controls the body, why can't it cure cancer? Or if they both affect results, why isn't there a winner yet? Why hasn't heaven purged earth already, or earth corrupted heaven? Dualism offers a world beyond but it defies logic.

3. **Idealism**. Idealism is Plato's explanation of Socrates view that the physical world depends on something else, as a shadow depends on sunlight. He proposed that physical things represent ideal forms in various circumstances. If ideal forms are the essence of physical things, the physical reality we see is like a divine thought.

   Implications. Idealism struggles to explain how an ideal can manifest physically. Thoughts and shadows don't collide directly so why do matter objects? If physical things are thoughts, why can't they be thought differently? Idealism also offers a world beyond but how an ideal form manifests as a physical thing is unclear.

Virtualism is the more recent theory that the physical world is a virtual reality (Raspanti, 2000), as in a game where when we look left, a left view appears, and when we look right, a right view appears. That physical events are generated from moment to moment implies that:

Nothing in the physical world exists objectively, i.e. of or by itself.

This doesn't deny science, for if some Sims characters started to think, they could test whether their world is virtual by information from it, just as we can. If they found a world of pixels where time bends and space curves, that began at a past instant, as we have, they might wonder if it was virtual. Chapters 1-5 give this argument for our physical world. Given the well-established problems of physical realism, dualism, and idealism, the following sections focus on the varieties of virtualism that have been proposed.

THE VIRTUAL OPTIONS

If our world is a virtual reality, the "other" that generates it has been suggested to be physical, informational, or mental, as follows.

Physical virtualism *(the Matrix option)*

Physical virtualism is that another physical world generates our physical world. In the movie *The Matrix,* AI machines in a post-nuclear world fed data to people in vats about a city they thought was real, which is possible because we only observe nerve information anyway. In Figure 2, the physical world now emerges as well, so physics is a reality view just like the other

sciences. It also places the observer in another reality, outside our physical world. The issues this option faces are:

a. *Performance*. To calculate the quantum activity of even a few molecules:

"*… would need more memory space that there are atoms in the universe as a whole, and would take more time to complete the task than the current age of the universe.*" (Lloyd, 2006) p53.

If a computer the size of our universe can't even calculate the behavior of a few molecules, it is practically impossible for a physical computer to generate our universe.

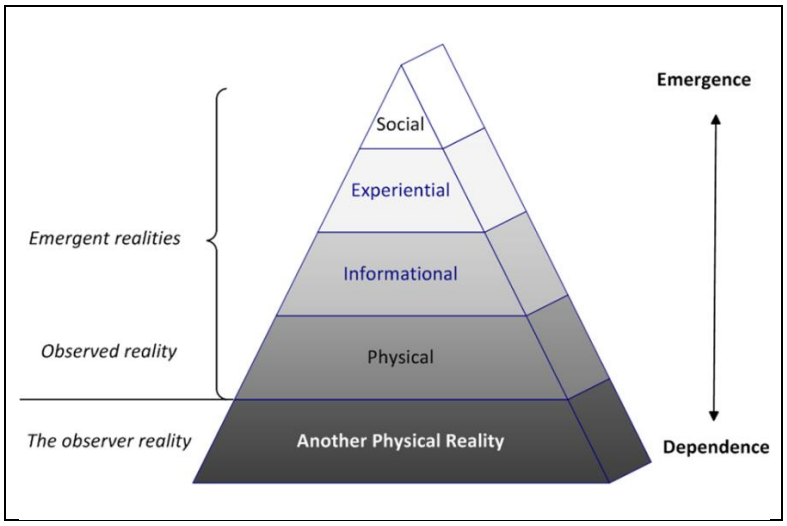

Figure 2. Physical reality emerges from another physical reality

b. Quantum theory. Quantum waves collapse in a way that physical waves cannot, interact faster than the speed of light, and tunnel past barriers no particle can pass, so what generates the physical world can't be physical. This option has to deny that quantum events are real, so it is incompatible with what quantum theory describes.

c. Regression. A physical world that generated ours could be itself generated because processing can stack, to allow an infinite regression (Bostrom, 2002). The other physical reality in Figure 2 can have another below it, and so on, ad infinitum.

d. Consciousness. If our consciousness comes from players in another world, how it arises is deferred to a world we can't see, which adds no value to the study of consciousness.

e. *Testability*. The theory that every physical event is generated in another physical world that we can't access cannot be tested in principle. It is a zombie theory that adds no value to science. The same applies to many worlds theory (Everett, 1957), that every quantum choice creates another universe, in a multiverse machine without choices.

Implications. If our world is a virtual reality made by machines, aliens, or ourselves from the future, why did they bother? Nuclear plants give more energy for less work than people in vats. We create virtual games because they benefit us, but what is the benefit here? Physical virtualism suggests alien conspiracies that make no sense, as well as being practically impossible.

Information virtualism *(the big program option)*

Information virtualism is that the physical universe is the output of a big program, as Wheeler's It from Bit proposal implies (Campbell, 2003). Unlike the last option, the program coder need not be physical. In Figure 3, physical reality again emerges, and the observer/player again exists in another realm. The issues now are:

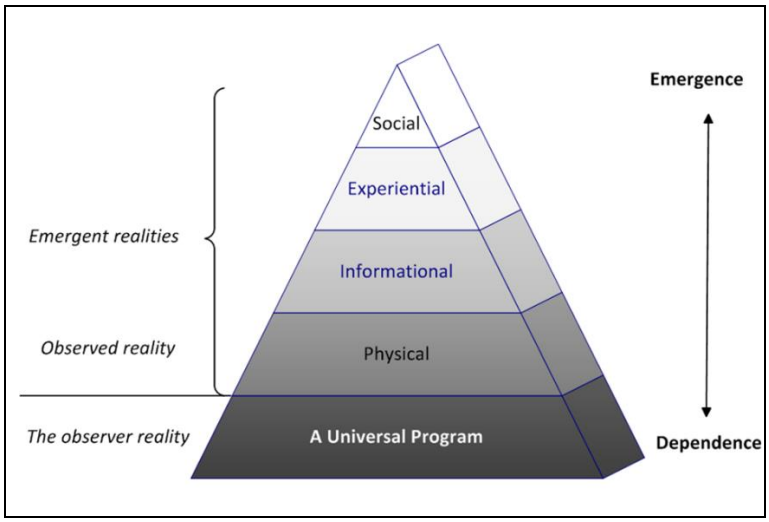

Figure 3. Physical reality emerges from a universal program

a. *Performance*. Classical programs can simulate quantum logic to cause quantum effects but to compute the collapse of one electron whose quantum wave has spread over a galaxy is beyond any computer on earth today[1], so this option is practically impossible.

b. *Quantum theory*. A classical bit is a choice between two physical states but a qubit can be both states at once. Classical processing can emulate quantum processing but can't operate like it because it works differently, so this option also denies that quantum theory is real.

c. *Regression.* A classical bit by definition is one physical state relative to one not chosen, so it must have a physical context (McCabe, 2005). If Figure 3 has a physical level below it, this theory also leads to an infinite regression.

d. *Consciousness.* A game world can change pixels to allow "miracles" within it but it can't change the players. Its actors divide into those run by people and non-player-characters (NPCs) run by the program. But if we are players in a multi-player game, what about dogs, insects, plants, cells, or rocks? If any of these are NPCs, how did matter become conscious, or how did we become conscious from a single cell growing? Conversely, if every actor is a player, who got to play a rock that sat on Mars for a million years? Either way, this option doesn't add to our knowledge of consciousness or its evolution.

e. *Testability*. Our world has some simulation properties but to cherry-pick cases to support simulation theory (Wolfram, 2002) is an old kind of error not a new kind of science. This theory must explain all physics, including space, time, light, energy, matter and charge, which it hasn't done, so this option hasn't been tested by science.

Implications. If our world is a program output, was it a beta release that let evil prosper? Did the great coder set some parameters just right before starting it up (Davies, 2006)? Did (S)He sit back to watch creation unfold for billions of years, like the ultimate voyeur, or tweak it by an occasional miracle or divine avatar? Either way, this implies an imperfect world whose glitches we can discover, but none have been confirmed. And it is also impossible in practice.

[1] A Milky Way volume of 1.6 $x10^{60}$ cubic meters divided by a Planck volume of 4.2 $x10^{-105}$ cubic meters is about 551 bits, which for a 10^{-43} seconds Planck time is over $5x10^{45}$Hertz of processing power for one quantum event. Our best supercomputers are only just breaking the PetaHertz barrier (10^{15}Hertz).

Mind virtualism (the Big Mind option)

Mind virtualism is that a universal mind disassociated to dream the many lives we have (Kastrup, 2019). In Figure 4, the physical world again emerges from an observer reality, and the observer again doesn't exist in our physical space. The issues in this case are:

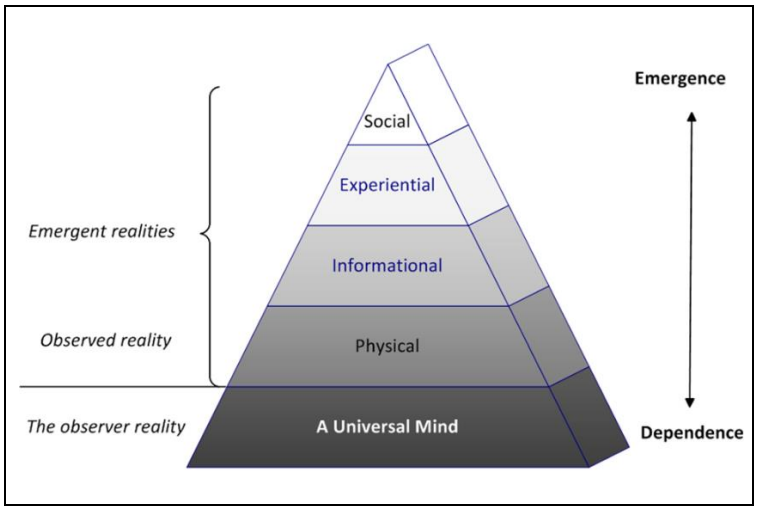

Figure 4. Physical reality emerges from a universal mind

a. *Performance.* If one person dreaming reality is solipsism, many dreamers is solipsism plus, where each dream affects others. But how do others know what I dreamt? Most discussants agree that minds can't be observed directly. Even I can't observe my I, only experience it, and others see body states not mental ones. If minds can't interact, neither can dreams, so this option is not possible in practice.

b. *Quantum theory.* If the universal mind can say "be" and it is, who needs the complexity of quantum waves? Dreamers don't need this degree of detail so this option again makes quantum theory a description of what is unreal.

c. *Regression.* Minds like ours need brains to provide dream information, so if the universal mind in Figure 4 has a brain below it, this option also leads to an infinite regression.

d. *Consciousness.* That my mind is part of an unspecified universal mind doesn't add to our understanding of consciousness or explain why a big mind would want to divide into parts that constantly fight each other, as we do.

e. *Testability*. If we are dreaming, anything is possible, so there is no way to test that.

Implications. If I am dreaming, why is my dream so boring? And why dream a drug-addict's nightmare life? That a great director is tailoring our dreams to trick us is an unlikely conspiracy, as why bother? Why would a perfect mind divide into our imperfect minds? In mind virtualism, a universal mind split apart to dream our world for no good reason, and it is also not possible.

Pure virtualism (*Quantum Realism*)

The above options attribute our world to another physicality, program, or mind but in practice none of these is able to create what we see. To derive physical reality from what it creates is circular, so they all allow infinite regression. To attribute consciousness to players or dreamers elsewhere doesn't help us understand it. Finally, none of these options accept that quantum theory is real, nor are they testable.

Pure virtualism is that a virtual reality can't be a result of its output, just as a game can't be a result of its pixels. The virtual reality is pure in the sense of not being adulterated by its output. Quantum realism satisfies this demand by attributing physical events to quantum waves that can't have a physical basis. In Figure 5, quantum reality causes physical events from which minds and information emerge and also provides the ability to observe. This avoids the previous issues:

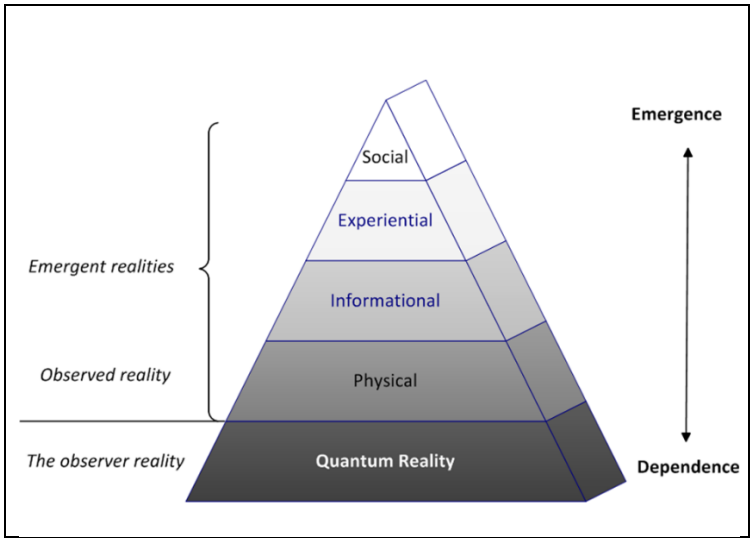

Figure 5. Physical reality emerges from quantum reality

a. *Performance.* A universe of quantum processing has the power to create a virtual reality just as big.

b. *Quantum theory.* If quantum waves exist, the equations of physics stay the same, but they now describe actual events.

c. *Regression.* Quantum activity is context free because a qubit includes all the options, so it doesn't depend on physical states and thus implies no regression.

d. Consciousness. If quantum reality causes consciousness, its properties limit the claims about consciousness, which adds value to its study.

e. *Testability*. Reverse engineering physical reality explains space and time (Chapter 2), light (Chapter 3), matter (Chapter 4), and field effects (Chapter 5). It predicts that extreme light collided to create matter (4.5.9), which current theory denies.

Implications

Pure virtualism is that a virtual reality can't be caused by its creation, or any result of it, so if our physical world is virtual, nothing physical or physically-based can cause it, including:

- Another physical world, as in the Matrix movie.
- A big program running on a big computer.
- A great mind that dissociates to dream our little lives.

A virtual reality can never, by definition, completely explain itself. For example, space in the game Civilization is hexagonal not because the game needs it but because the program sets it so. We need quantum theory to explain physical events because quantum reality generates them. Pure virtualism implies that something non-physical created a virtual world that evolved.

QUANTUM REALISM

Quantum realism is a pure virtualism because quantum waves act in physically impossible ways. They are all around us but how can we observe what creates observation itself? Instead, we see objects made of a matter substance that collide in space.

A substance has to extend in space, so it should be dividable, thus it made sense to smash matter apart to find its basic bits. Using particle accelerators, physicists discovered that electrons and quarks can't be divided further, so they were fundamental particles that existed at a point with no sub-structure. But what has no length, breadth, or depth can't be a substance, and what has no substance can't be a particle. Particles need substance as letters need shape, so a dimensionless electron can't be a particle. The physical world can't build up from particles that have no size, and arguing that virtual particles from invisible fields allow this is no help, because empty space can't host fields that create particles from nothing either.

However, if the reality around us is quantum waves, not substantive particles, there can be:

i. *No particles*. Just waves that interact like particles, then revert to waves again.

ii. *No empty space.* Light waves require a medium, so the "empty" space around us is really the network that transmits light.

iii. *No big bang*. A matter universe that began at a point would instantly form a black hole that no explosion could overcome, so the universe was never contained in a speck. Instead, a small rip in the fabric of reality gave one photon in one unit of space, and the rest followed in a stepwise creation.

iv. *No time travel.* When quantum waves interact in a physical event, they reboot at a new point, so there is no undo because what came before is gone. And the restart point is undefined until that event occurs, so the present can't define the future. Hence one can't travel backwards or forwards in time.

v. *No control centre.* Like the Internet, our universe has no control centre. Control is distributed not centralized because that is the best way to run a network.

vi. *No fate.* All physical events involve choice, so there is no fate but as is chosen. The future isn't written in stone because choices define the timeline at every stage.

vii. *No errors.* To choose an option that fails is an error but evolution tries every available option, so it doesn't err in that sense.

This isn't an inert machine winding down to an empty fate, but a dynamic flux evolving by its choices. There is no watcher on high, but if everything observes, nothing is hidden. There is no register of deeds in a heavenly book, but if the physical world is the record, nothing is lost. There is no single hand guiding everything, but if everything has choice, there are many hands.

Table 1 compares various reality theories based on key questions. In the classical options, reality is physical, dual, or mental, and in the virtual options, it is physical, informational, mental, or quantum. Physical realism doesn't allow an observer at all but the other options let us observe at least. Only quantum realism and idealism as pantheism let everything observe, so even rocks are conscious, albeit on a molecular scale. Physical realism is testable, though it often fails to deliver, but maybe the predictions of quantum theory always work because quantum reality is real.

Finally, the physical realism of science and the dualism of religion both naively assume that the world is real because we see it so, but if the world is instead virtual, does that make it fake? In a dream, simulation, or game, my acts have no long-term consequences because:

- If I die in a game, I can restart from a save.
- If my plane crashes a simulation, I can retry the scenario.
- If I die in a dream, I still wake up in my bed.

Even if I conquer the earth in a game, I still have to pay my rent. Even if I fly to Tokyo in a simulator, I am still in Auckland. Even if I dream my knee is fine, I still wake up and it hurts. These virtual realities are fake because their effects don't extend to the reality outside them, just as Monopoly money doesn't work outside the game.

Yet our universe built up the ability to observe from scratch, starting at the photon scale. We take our reality for granted, but it took fourteen billion years to develop not just stars, galaxies, and planets but also sentient beings to observe them. Dreams don't create dreamers, nor do games create gamers, but this universe created the ability to observe that we call consciousness (6.3.13). We live in an observer-observed reality where choices affect an observer that is real, even if the observed isn't. It follows that it isn't fake because it has consequences for what is outside it. A virtual universe that struggles to increase consciousness, as beings in it create themselves, is as real as it gets! Chapter 7 explores what this means for us personally in more detail.

Table 1. Reality theories compared by key questions

Question	***Classical options***			***Virtual options***			
	Physical realism	*Dualism*	*Idealism*	*Matrix option*	*A big Program*	*A big Mind*	*Quantum Realism*
Is reality physical?	Yes	Yes	No	No	No	No	**No**
Is reality dual?	No	Yes	No	No	No	No	**No**
Is reality mental?	No	No	Yes	No	No	Yes	**No**
Is reality information?	No	No	Yes	Yes	Yes	No	**No**
Is there an observer?	No	Yes	Yes	Yes	Yes	Yes	**Yes**
Do rocks observe?	No	No	Yes	No	No	No	**Yes**
Is the theory testable?	Yes	No	No	No	No	No	**Yes**
Is our reality fake?	No	No	Yes	Yes	Yes	Yes	**No**

REFERENCES

Aspect, A., Grangier, P., & Roger, G. (1982). Experimental Realization of Einstein-Podolsky-Rosen-Bohm Gedankenexperiment: A New Violation of Bell's Inequalities. *Physical Review Letters, 49*(2), 91–94.

Baggot, J. (2013). *Farewell to Reality: How fairytale physics betrays the search for scientific truth*. Constable.

Bone, J. (2005). The social map and the problem of order: A re-evaluation of "Homo Sociologicus." *Theory & Science, 6*(1).

Bostrom, N. (2002). Are you Living in a Computer Simulation? *Philosophical Quarterly, 53*(211), 243–255.

Campbell, T. W. (2003). *My Big TOE* (Vol. 3). Lightning Strike Books.

Davies, P. (2006). *The Goldilocks Enigma*. Penguin Books.

Everett, H. (1957). "Relative state" formulation of quantum mechanics. *Rev. of Mod. Phys., 29*, 454–462.

Kastrup, B. (2019). *The Idea of the World,—-A multi-disciplinary -argument for the mental -nature of reality*. John Hunt Publishing.

Kwiat, P. G., Weinfurter, H., Herzog, T., Zeilinger, A., & Kasevich, M. A. (1995). Interaction-free Measurement. *Phys. Rev. Lett., 74*, 4763.

Laughlin, R. B. (2005). *A Different Universe: Reinventing physics from the bottom down*. Basic Books.

McCabe, G. (2005). Universe creation on a computer. *Stud.Hist.Philos.Mod.Phys.36:591-625*.

Raspanti, M. (2000). *The Virtual Universe*. Authorhouse.

Shannon, C. E., & Weaver, W. (1949). *The Mathematical Theory of Communication*. University of Illinois Press.

Smolin, L. (2001). *Three Roads to Quantum Gravity*. Basic Books.

Whitworth, B., & Ahmad, A. (2013). *The Social Design of Technical Systems: Building technologies for communities*. The Interaction Design Foundation.

Wolfram, S. (2002). *A New Kind of Science*. Wolfram Media.