A Commentary on *The Knowledge Machine* by Michael Strevens
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Manuel Ortega-Rodríguez
Escuela de Física, Universidad de Costa Rica
11501-2060 San José, Costa Rica;
manuel.ortega@ucr.ac.cr

Abstract

We offer a few comments derived from a careful reading of Michael Strevens’ book *The Knowledge Machine* (TKM), with an emphasis on extensions for future work. We believe this book goes well beyond traditional accounts of scientific change, and offers thus many insights into new research.

TKM’s Argument: The Iron Rule

Disclaimer. This brief take is certainly no substitute for a careful reading of the book’s arguments, and it is cast in my own words and reflects my own understanding (that of a practicing theoretical physicist).

After thousands of years of flirting with technology and ideas, humankind invented a type of activity that was qualitatively different from anything that came before. This activity, which we now call “modern science,” may be thought of as an emergent property, in the sense of complex systems, and it is something that one could even dare to say that just came about, rather than being gradually and purposely crafted over the centuries. After that, as is the case with complex systems, there has been an invisible hand which steadily moves science towards its objectives.

This invention is a game whose rules guarantee that discussions are self-perpetuated in a sustainable and fertile fashion, in a way that is just not possible in pre-scientific, philosophical discussions.

In this game, you are trying to win an argument, with the rule that ideology not be brought into the discussion. Ideology (i.e. your beliefs) in this game is effectively treated as a taboo.

To be sure, you can have your beliefs—and as a scientist you pretty much have to, in order to engine your scientific private reasoning—but your beliefs are never to be offered as argumentation. The only possible argumentation
rests on explanatory power that is directly related to a form of agreed-upon testing.

A universal agreement (and this is part of the emergent character of science) is thus reached in which it is undisputed what kind of testing counts as corroboration or refutation and, equally important, in which the loser part always has the possibility of a “rematch” by challenging one or more auxiliary conditions, a situation again to be decided by testing.

These particular workings of the process are collectively called the Iron Rule (IR) and guarantee sustainability and movement towards science’s objectives. The IR is self-sustained in the sense that there is no controlling entity overseeing the process.

The result of all this is noise in the short time scale and science in the long time scale, i.e. an activity that looks grainy and idiosyncratic locally but that overall converges to something that we could call the truth, or at least some kind of truth (something useful).

The author also makes the case that the only reason science appeared in 17th century Europe and not, say, in Ancient Greece or China is because of the appearance of a complex, multi-layered social system in Europe that worked as a metaphor for the structure of science as an activity. (To be specific, in the form of a totemic relation between the pairs religion : nationality, on one hand, and private scientific reasoning : public argumentation, on the other.)

Comments, in no particular order

1. I believe there is a lot to be learned by casting TKM’s argument in a complex systems framework. Think of science as a tiny corner of the “phase space” (the space of possibilities) of human ideas and actions. By chance alone, science would have taken maybe a million years to appear spontaneously. But change the “external” conditions, and you have an emergent property, a phase transition into science. (In this case, the external conditions are the multi-layeredness of the social structure in 17th century Europe.)

   Opportunity for new research: Is the scenario described in TKM consistent with what we know about complex systems and phase transitions? Just as in a spontaneously crystallized undercooled liquid, once the new

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1 beyond the usual approach of network models and simulations
phase (science) appears, it is somewhat immune to reversing back to
the previous phase (philosophical thought).

2. One of the book’s main conclusions, the one that recommends that
science be let alone, not trying to fix it because it is just fine, could
easily be read by some as a conservative stance, supporting the status
quo of white men in science and going against the advancement of
women in science, for example.

*Opportunity for new research:* Far from it, I think the book’s ideas can
be taken as an invitation to rethink how to best catalyze the entrance
of women, and other groups, into science, not by forcing things but
rather by using analogies from other complex systems, acknowledging
that simplistic and naive solutions probably will not work.

3. In addition to seeing the argument of TKM under the light of complex
systems, one could also bring in what is known about **traditional
knowledge** in general. In this case, however, traditional knowledge
lies not in the contents *but in the method itself*. It emerges as the
system (humanity’s ideas) finds a loophole (a new structure) in order
to organize itself differently.

*Opportunity for new research:* Can the workings of the IR be under-
stood in terms of what we know in general about traditional knowledge
systems around the world (and through time)?

4. The IR may explain, in very simple terms, why the ideas related to
landscape and multiverse physics are so problematic within the physics
community. At times, critics of these ideas seem to know intuitively
that something is being violated, that there is something truly unsci-
entific there, but failing when trying to articulate it convincingly.

*Opportunity for new research:* Can the IR explain in simple terms
why multiverse physics is outside science, for example by arguing that
there is too little in explanatory power and too much in metaphysical
argumentation? This could also be used to *guide* future work in the
field.

5. Is the IR still applicable to the science of complex systems\(^2\) as in the
study of the collective behavior of molecules or animals? As complexity

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\(^2\)Note that in this item complex systems is a possible field of study within science. This
differs from traditional physics, for example in precluding predictions, one may ask whether the IR applies to it.

*Opportunity for new research:* Are there any limitations on the IR when dealing with complexity? Does the IR lose effectiveness in the context of a more nuanced explanatory power, such as the one found in complexity thinking?

6. A more nuanced stance for the IR can be sought in which the “all explanation, no ideology” stance would be replaced with something more subtle, along the lines of Lewis’ idea of “first and second things.” According to this author, if one puts second things first and first things second, then you lose both, a typical simple example being running and health; once running becomes more important than health (as in an obsession with running), you can easily become unhealthy and stop running.

*Opportunity for new research:* Can a more nuanced stance be taken, in which ideology is not eliminated but merely made sure it is always second? That would give some leeway to metaphysical commitments (such as beauty) in the same sense that a pinball player can tilt slightly the machine as long as she doesn’t go too far. (Multiverse physics presumably went too far.) But what does it mean exactly to be second in this context? How do you measure it?

7. TKR’s argument of the multi-layeredness of society (nationality, religion), a feature unique to Western societies in the 17th century, as a working metaphor for the construction of the structure of science as an activity, could be critically contrasted with Joseph Henrich’s ideas on the particularities of European kinship relations for the same purpose.

*Opportunity for new research:* Does Henrich’s ideas merit a revision of TKR’s argument? A possibility is that both causes worked in tandem, reinforcing each other.

8. An intriguing idea is whether the arguments expounded in TKR can be used to cast predictions or not, predictions about how science works is different from what is discussed in item 1, where *science itself* is considered a complex system, akin to a living organism.

*Henrich’s ideas are important for those who (like Steven Shapin) think that trust was a key element in the development of modern science.*
in our present society. It is not even clear that the IR can be put to use in such a way.

*Opportunity for new research:* One could try, for example, to formulate some sort of algorithm that would determine which candidates for scientific activity will prosper or stagnate. This algorithm would say something like “multiverse physics” is not scientific for such and such reasons.

9. Could it be possible that the maxim of leaving science alone worked well in the past, but as the social world is changing we need to update that view? Analogies can be found in the realms of economics and law, where the rapid emergence of the internet has resulted in a situation of destructive catch-up. (Think of how pre-internet legal systems were not really equipped to handle the subtleties of privacy issues in internet platforms.)

*Opportunity for new research:* Does science need some minor help to keep on being effective? If so, what kind of help? Can analogies from other complex systems be helpful?

10. TFK argues that a new form of activity, modern science, appeared in the 17th century with no precedent and with features that make it qualitatively different from its predecessors. Should we expect then the appearance of a new form of science, let us call it Science Plus, or Super-Science, which is to science what science is to pre-science?

*Opportunity for new research:* What would this extrapolated Science Plus look like? Could it be “artificially” induced⁴ or would we need some sort of (possibly uncontrollable) societal change for that? Is modern physics already this Science Plus? That is, do we have already an Iron Rule 2.0 in Peter Galison’s “intercalated periodization” explanation of progress in physics (with theoretical and experimental physics as separate, symbiotic disciplines)?

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⁴as with a seed crystal in the case of undercooled liquids
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Peter Galison, “Trading Zone; Coordinating Action and Belief,” in *The Science Studies Reader*, M. Biagoli, ed. (New York: Routledge, 1999). See the discussion around diagram 10.3 on p. 143.