

Renn, Jürgen. 2020. *The Evolution of Knowledge: Rethinking Science for the Anthropocene*.

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The mere existence of the history of science as a field of study tempts one to imagine that science can be cleaved off from other human endeavors and usefully studied in isolation; that the scientific revolution created a fundamentally different kind of process than what came before. This position is anathema to the rich and expansive viewpoint offered by Renn: not only is science commensurable with other methods of knowledge acquisition, but it is also deeply connected with other features of the society in which it is practiced. The overarching goal of *The Evolution of Knowledge*, then, is to show how we can grapple with such a wide-ranging notion of science to produce new insights about the human past and future. When it works, the reader gets a sense of distance and perspective, a mental zooming out revealing science as part of an evolving organism that is replete with beliefs, habits, and needs. However, too often the book is weighed down by its own ambitions: theory can become unfocussed, new terminology is defined so broadly as to risk becoming meaningless, and while examples illustrate some key points they fail to live up to the aims of the text. Nonetheless, attempts to link science with other human processes are worthy, and I was left with a great deal of sympathy for many details of Renn's position; I suspect he may be right, but work remains to be done.

Removing the barrier between science and the rest of humanity entails several steps that are the focus of parts two through five of *The Evolution of Knowledge* (part one effectively being an extended introduction). The second part deals

with what knowledge is, and it is here that Renn links theoretical knowledge produced through the scientific process with other kinds of knowledge; things like the intuitive and practical knowledge that have shaped human behavior for hundreds of thousands of years. The critical distinction between theoretical knowledge and other knowledge, Renn argues, is abstraction and reflection; for instance, while many societies knew how to solve various engineering problems posed by large construction projects, the solutions were often algorithmic in the sense that there was typically little understanding of the general principles that explain why these solutions worked. Only rarely did such knowledge evolve, and later Renn provides the examples of classical Greece and the Mohist school in China.

The different kinds of knowledge accumulated by a society constitute a "system of knowledge," a large aggregate composed of mental models, conceptual frameworks, social practices, and material artefacts. While mental models are well explained and feature throughout the book, the same cannot be said for all the other constituent parts. As such, while the role of mental models in knowledge evolution is quite clear, how this scales up to the evolution of entire knowledge systems remains a little woolly. Nonetheless, the chapter on scientific revolutions is excellent; arguing against Kuhnian paradigm shifts, Renn favors a gradualist (i.e. evolutionary) model in which problematic observations or competing explanations across disciplines prompt the steady development of new theories. As Renn shows, the outcome is

unpredictable. While new theories often start as small, isolated stubs, they can grow into larger frameworks, sometimes persisting as epistemic islands (as is the case for quantum mechanics); at other times, they turn on existing knowledge and fundamentally reshape it, as relativity did to the concepts of space and time.

The next concept to be introduced is the “knowledge economy,” a critical notion that Renn uses to integrate science with other social processes, and the focus of part three. Broadly speaking, the knowledge economy is the set of institutions, norms and niches that regulate how science functions. Things like funding bodies, government policies and priorities, the structure of research institutions, and so on. That much is hinted at in the introduction, but Renn goes into much more detail in a dedicated theory chapter. Despite this detail, I gained little understanding beyond the introductory summary of precisely what a knowledge economy is. The extended discussion is simply too vague to be helpful and the reader is left with the frustrating sense that knowledge economies can do and be virtually anything. They are driving forces behind, or obstacles to, innovation; sources of social stability or instability; repositories of knowledge, as well as notions of what counts as knowledge; critical factors in the dissemination of knowledge, but also its sequestration within epistemic communities. Such expansive terminology is perhaps necessary given the goals of the book, but without clear definitions the theory risks being too nebulous for others to build on. Renn offers an example, the construction of the dome of the cathedral of Florence, which helps give a sense of knowledge economy in action: we see the different contributions of architects, scientists, craftspeople, city councils, and patrons. But what is not clear is how important these contributions are (would things have turned out differently if the social structure was different?) or what alternative ways there are of understanding this process—that is, what Renn is arguing against. For instance, are there theories

of science that deny a role to wider social structures? The latter limitation, in particular, is present throughout the book; while Renn presents his theory as a means to understand human history it is not clear how it disagrees with (or exceeds) other competing theories. Without this comparison, the benefit of Renn’s expansive view is unstated and often unclear.

Part four deals with the spread of knowledge and knowledge evolution as a cross-cultural, global process, rather than a feature of Western societies. While many examples of knowledge spread are provided, the theory runs into the same problems described above. The dynamics of information transfer are described in such open-ended terms that it is not clear if anything is off the table, or which are the general principles the reader should be attending to in particular. While Renn is no doubt right to acknowledge the complexity of the process, it would help readers if additional structure could be provided. The final part of the book departs from traditional history of science and instead veers towards contemporary meta-science in that it asks how and why we should consider changing our own knowledge economies to protect and secure a future for humanity. The problems with the current knowledge economy are vividly described, especially, the hole in the ozone layer that would have been orders of magnitude worse had chance historical factors not led to the use of CFCs instead of their much more harmful bromine counterparts. However, the treatment of possible solutions feels a little shallow. The sustainable knowledge economy of Tokugawa Japan is discussed in detail before it is mentioned that it also involved state mandated infanticide and nonetheless resulted in devastating famines. Renn’s suggested way forward is effectively a more successful system for public outreach: the products of our knowledge economy need to be communicated to society with sufficient efficacy that there is little scope for bad actors or vested interests to distort public debate. A revised internet is seen as central to

this, but Renn's description of it sounds very much like the Panglossian visions of the founders of the current internet. While one can't blame Renn for wanting to end on a positive note, I'd prefer a clear, stark warning over a vague promise.

Throughout, the biggest strength of *The Evolution of Knowledge* is the analogy it draws between biological evolution and knowledge change (although, as a cultural evolutionist, I guess I would say so). Most critically, the population-level thinking central to biological evolution, in which only populations and not individuals can be said to evolve, is integral to Renn's notion of gradual change in science. Such a position is well argued, with even the work of critical figures such as Einstein being shown to emerge slowly and through repeated interactions with other individuals; the golden age of general relativity not arising until after his death, for instance. We also see examples of convergence, divergence, and complex path dependence. It is widely understood in biology that the endless contingencies of biological systems means that, even while selection relentlessly favors those who survive and reproduce, the eventual outcome is sufficiently unpredictable that rewinding the clock to let evolution play out again would continually produce different end states. Renn suggests the same complexity is true of knowledge. For instance, both ancient Greece and the Mohist school of ancient China converged on abstract theories of mechanics in response to peculiar phenomena, like the force-enhancing action of a lever. However, while such theories were successful and persisted in Greece, in part due to cultural norms that valued public disputation of paradoxes, they were abandoned in China, suppressed by a centralized political system. Lastly, Renn identifies a positive feedback loop within science, whereby new degrees of reflection and abstraction bring into view new puzzling phenomena that prompt further reflection, that has also been argued for human, biological evolution, in which the evolution of

increasingly sophisticated cognition permits ever more cognitively demanding behaviors that redouble selection on cognition (Dennett 2003; Morgan 2016).

As a whole, the book persuades that the evolutionary model of science is a good one. Nonetheless, Renn is not the first to suggest this. Indeed, in the introduction he refers to the field of cultural evolution wherein tools developed for studying biological change have been applied to culture, knowledge, and science for over 40 years (Boyd and Richerson 1985; Cavalli-Sforza and Feldman 1981). Drawing on population genetics, economics, anthropology, and psychology, cultural evolution is a heavily quantitative field replete with arcane mathematical theory. As such, it is understandable that Renn takes a different approach. Nonetheless, given that Renn is clearly aware of the field and accepts the analogy with biological evolution, I would have liked to know why: Does the mathematical approach of cultural evolution have limitations that Renn's more qualitative approach can fill? This reflects the broader issue with the book, mentioned above, which is that while Renn is happy to describe his own view he stops short of arguing why the reader should favor his theory over others.

The largest drawback of the work, however, is its readability, which suffers due to excessive length and the segregation of theory and example. New terms, such as "knowledge economy" and "system of knowledge" are given dedicated theory chapters where their varied possible forms are discussed at great length. Given that this is done largely in the absence of clarifying examples the mental load upon the reader is extreme and after reading them I typically felt my understanding was little better than following the sentence length definitions provided in the introduction. While the subsequent examples do help clarify what these terms look like in practice, their separation from the theory means that they largely stand on their own as opposed to illuminating the wider

framework. This structure is appropriate for the more developed examples, whose length demands some separation; however, many of the examples are much shorter and could easily be studded throughout the theory chapters to clarify key points as they arise.

As a theory of science, *The Evolution of Knowledge* is unique in its ambition to draw in virtually the entirety of human practice from the present day back into deep human history, as well as looking towards the human future. This

breadth is laudable and, ultimately, quite convincing. Nonetheless, the format of the book struggles to bear the weight of everything the theory touches upon, and this challenge is passed on to the reader as well. As Renn himself would argue, beyond being accurate or useful, for knowledge to survive it must be transmitted to and adopted by other individuals. While Renn's theory is comprehensive, rich, and rewarding, the unwieldiness and intransmissibility of its key concepts may turn out to be its biggest drawback.

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