

Title: How does Technological Innovation Happen? A conversation with W. Brian Arthur on The Nature of Technology.

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Abstract: More than any thing else technology creates our world. It creates our wealth, our economy, our very way of being," says W. Brian Arthur. Yet, until now major questions related to the evolution of technology have gone unanswered. Where do new technologies come from -- how exactly does invention work? What constitutes innovation, and how is it achieved? Why are certain regions -- Cambridge, England, in the 1920s and Silicon Valley today -- hotbeds of innovation, while others languish? Does technology, like biological life, evolve? How do new industries, and the economy itself, emerge from technologies? In this talk, leading thinkers Lee Smolin, Frances Westley, and Thomas Homer-Dixon discuss economist W. Brian Arthur's work on a boldly original way of thinking about technology that gives answers to these questions.

Ogburn's Claim (1922)



William Fielding Ogburn

Social Change, 1922

“It would seem that the larger the equipment of material culture, the greater the number of inventions. The more there is to invent with, the greater will be the number of

inventions. When the existing material culture is small, embracing a stone technique and a knowledge of skins and some woodwork, the number of inventions is more limited than when the culture consists of a knowledge of a variety of metals and chemicals and the use of steam, electricity, and various mechanical principles such as the screw, the wheel, the lever, the piston, belts, pulleys, etc. The street car could not have been invented from the material culture existing at the last glacial period. The discovery of the power of steam and the mechanical technology existing at the time made possible a large number of inventions.”

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Evolution of Technology (Steps)

1. Novel **element forms as combination** from existing elements. Accepted if provides a *needed functionality*, and is technically and economically viable
2. Novel element **replaces techs and components** with similar functionality across the collective
3. **Adds to the substrate** of elements to construct from

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Evolution of Technology (Steps cont'd)

4. Novel element **generates new needs**
 - for supporting methods and arrangements
 - for methods to overcome limitations
 - for techs to broaden functionalities
5. New element **destroys replaced technologies' niches** for *their* dependent technologies
6. The economy adjusts to these steps

Biological vs. Technological Evolution

- Biological:
 - Darwinian variation and selection,
 - accumulation of incremental changes
 - But ... occasional combinations
- Technological:
 - Combinatorial, abrupt,
 - self-augmenting
 - With much Darwinian evolution once a technology exists