

The End of Theory?

Does the Data Deluge Make the Scientific Method Obsolete?

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1. Why Do We Need Theory?

- *One of the purposes* of science is to predict.
- *Example:* predict how a complex material (or a chemical substance) behaves in different situations.
- *Available information:* a lot of records describing how different materials behave in different situations.
- *In the past, it was not possible* to find a similar record and simply recall what happened then.
- *The only possibility* was:
 - to extract, from the data, a simple dependence, and then
 - use this dependence for predictions.
- *Example:* we can use Ohm's law $V = I \cdot R$ to predict the voltage V based on I and R .

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2. Interesting Consequence of Computer Progress

- *Fact*: nowadays, computer searches are very fast.
- *Impression*: there seems to be no need for any theoretical laws anymore:
 - if we want to predict (e.g., the voltage),
 - we can simply search through all the records and find what happened in a similar situation.
- *Seeming conclusion*: maybe we do not need theory at all.
- *This argument was developed*: in a recent (June 2008) article in a popular *Wired* magazine.
- *Question*: will the computer progress indeed lead to the end of the theory as we know it?

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3. Arguments For

- *Question (reminder):* will the computer progress indeed lead to the end of the theory as we know it?
- *This phenomenon is real:*
 - we do not need to discover that $V = I \cdot R$ anymore,
 - we can simply look up the records.
- *This already happened in numerical mathematics:*
 - some methods are not used because computer are fast,
 - we can find solutions by exhaustive search.
- *This happens in medicine:* we do not know why, e.g., pepto-bismol works.

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4. Arguments Against

- *Idea (reminder)*: look for a record of similar situation.
- *Not possible*: when there are too many parameters:
 - we can predict where the hurricane goes,
 - but not where a tornado may go.
- *Not possible*: with new materials, we cannot just look up the data, we need *extrapolation*.
- *Problem*: extrapolation is often misleading:
 - correlation between exp growing number of publications and exp decaying radioactive sample;
 - Aztecs believed that human sacrifices make the Sun come out.
- *Comment*: “scientific method” as taught in US high schools is not how science works.

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