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Plus ça change, plus c'est la même chose: de Solla Price's legacy and the changing face of scientometrics

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The invention and development of the Science Citation Index by Eugene Garfield in the 1960s was a major breakthrough in the study of science. This invention enabled statistical analyses of scientific literature on a very large scale. The great scientist Derek de Solla Price immediately recognized the value of Garfield's invention, particularly from the perspective of the contemporaneous history of science.

Scientists have always been fascinated by basic features such as simplicity, symmetry, harmony and order. The Science Citation Index motivated de Solla Price to work on a 'physical approach' to science, in which he tried to find laws to predict further developments, inspired by the principles of statistical mechanics.

Cognitive and social indicators

Specific parameters, 'indicators', are guides to finding and understanding such basic features. The most basic feature concerns the cognitive dimension: the development of the content and structure of science. Other indicators relate to the social dimension of science, in particular to aspects formulated in questions such as:

- How many researchers?
- How much money is spent on science? How 'good' are research groups?
- How does communication in science work, particularly the role of books, journals, conferences?

And beyond that there is another, often forgotten, question:

- What is the economic profit of scientific activities?

A landmark in the development of science indicators was the first publication in a biennial series of the Science & Engineering Indicators report (as it is now called) in 1973. Encouraged by the success of economists in developing quantitative measures of political significance for areas such as unemployment and GNP, the US National Science Board started this series of reports , which focus more on the demographic and economic state of science than on its cognitive state.

What is the difference between data and indicators?

An indicator is a measure that explicitly addresses some assumption. To begin with, we need to discover which features of science can be given a numerical expression. Indicators cannot exist without a specific goal; they must address specific questions. They have to be created to gauge important 'forces'; for example, how scientific progress is related to specific cognitive and socio-economic aspects. If indicators are not problem-driven, they are useless. They have to describe the recent past in such a way that they can guide us in, and inform us about, the near future.

> What has also changed is the mode of publishing. Electronic publishing and electronic archives mark a whole new era.

A second and more fundamental role of indicators is their potential to test aspects of theories and models of scientific development and its interaction with society. In this sense, indicators are not only tools for science policymakers and research managers, but also instruments in the study of science.

But we also have to realize that science indicators do not answer typical epistemological questions such as:

- How do scientists decide what will be called a scientific fact?
- How do scientists decide whether a particular observation supports or contradicts a theory?
- How do scientists come to accept certain methods or scientific instruments as valid means of attaining knowledge?
- How does knowledge selectively accumulate? *(1)*

De Solla Price strikingly described the mission of the indicator-maker: to find the simplest pattern in the data at hand, and then look for the more complex patterns that modify the first *(2)*. What should be constructed from the data is not a number but a pattern: a cluster of points on a map, a peak on a graph, a correlation of significant elements in a matrix, a qualitative similarity between two histograms.

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If these patterns are found, the next step is to suggest models that produce such patterns and to test these models with further data. A numerical indicator or an indicative pattern alone has little significance. The data must be given perspective: the change of an indicator with time, or different rates of change of two different indicators. It is crucial that geometrical or topological objects or relations are used to replace numerical quantities.

Now, 25 years after the passing of de Solla Price, *plus ça change, plus c'est la même* chose rings true. What has changed is the very significant progress in application-oriented indicator work based on the enormous increase of available data and, above all, the almost unbelievable – compared to the 1970s – increase of computing power and electronic facilities. What has also changed is the mode of publishing. Electronic publishing and electronic archives mark a whole new era.

What has remained the same, however, are some of the most fundamental questions. For instance, to what extent can science maps derived from citation or concept-similarity data be said to exist in a strict spatial sense? In other words, do measures of similarity imply the existence of metric space? This question brings us to an even more fundamental problem formulated by de Solla Price: that the ontological status of maps of science will remain speculative until more has been learned about the structure of the brain itself.

The ideas and work of de Solla Price have always been one of my major sources of inspiration and I take pride in being a winner of an international award that bears his name.

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