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"Historical Dynamics: Why States Rise and Fall"
Peter Turchin, Princeton University Press, 2003.

Reviewed by Kevin T. Kilty

At the conclusion of my talk about experimental and historical sciences at the June 2002 meeting of the Society for Amateur Scientists, Sheldon Greaves asked me if I had ever thought about how the study of history itself might become an experimental science. I had not thought about this, and my first inclination was to suggest that perhaps economics already combined elements of history and experimentation. Peter Turchin's "Historical Dynamics" (Princeton University Press, 2003) presents a better answer, but one that is still not satisfactory. Yet I recommend the book on the basis of its most engaging passages on history and causation.

"Historical Dynamics" is an extremely ambitious book and fascinating to read in parts. According to Turchin, the problem he intends to attack in this book is that a science, such as history or sociology, cannot become a mature science until it incorporates mathematical models. He intends to show the way toward applying mathematics to history.

History and sociology both rely on verbal arguments, not mathematics, as models. Verbal arguments can be misleading at times. They give a person the confidence of explanation without a reliable view of model dynamics. This is similar to the problem I identified regarding geology in my 2002 talk. One can propose a verbal model as geologists often do, but one cannot know the value of the model until one specifies its consequences and tests these against experimental data.

Consider predator-prey relationships as an example of the verbal model problem. The feedback system that results in population cycles of predator (lynx) and prey (snowshoe hare) is explained verbally as growth of prey in the presence of few predators, then over-exploitation by a rapidly expanding predator population. This explanation sounds perfectly complete and convincing. Yet, the phase lag between the two populations (and differing time constants of response) that is needed for cyclic behavior might be overlooked where it not for analysis of the associated differential equations.

Turchin's organization of his book is one of iteratively stating a problem in the study of human action (for example the growth of ethnic identity), providing a background of facts pertaining to the issue, presenting verbal theories, reducing the verbiage to a mathematical model, describing some results of the mathematical model, and occasionally applying an empirical test. The discussion of growth of empires, or even just polities, constitute the most interesting parts of the book. It made the book so interesting that I continued to read even though I became bored with the "mathematical" discussions.

The mathematical models Turchin presents consist of the usual culprits--the exponential growth equation, logistic equation, and second order reaction-diffusion equations (sets of two or more first order coupled differential equations) we have seen in the past. Many people have applied these for the past seven decades to explain such varied phenomena as feedback control circuits, electronic devices, predator-prey relationships, autocatalytic chemical reactions, and chaotic behavior of climate. We have seen them too often in the context of complexity science, which has

little accomplishment compared to its fan-fare and book sales. Historical dynamics looks slightly like an excuse to present these same analyses yet one more time.

The book contains several other flaws that seem worth mentioning. First, there is the usual problem with historical science by way of not enough data to compare theories to predictions. Second, the conclusions seem tendentious rather than objective at times. For example, in the chapter on ethnokinetics Turchin examines actual data on the growth of religion against a series of models and finds that growth according to a logistic model (autocatayltic model) fits well; in fact, according to Turchin, it "does much better relative to alternatives." Yet the data he illustrates for growth of Christianity in Egypt suggests a threshold model and not logistic-style growth.

Turchin's empirical tests contain too much "adhoc-icity." For example, in his analysis of the political history of Europe from 0 to 1900 C.E. he looks at the frontier as an independent variable and empire as the dependent variable. These he organizes as a two-way table. However, his measure of being on a frontier is a sum of points given by being on the boundary between antagonistic religions (each weighted 0 to 3), differing languages, lifestyles, and intense warfare (0 to 2). It is at once an ad hoc scale, and also skewed, since religious differences and strife are practically one and the same. Moreover, his measure of being an empire is simply that of comprising an area greater than 100,000 kilometers squared. It is equally ad hoc. Such are not the ordinary fare of two-way analysis which depends on objective, clear measures. What we need is a sense that his analysis does not depend on his ad hoc divisions. Yet he offers nothing in the way of a table of contrasts or "dose-response" curves.

The biggest flaw that I see is one typical of the historian-sociologist applying mathematics to their science. The process is more like finding models that satisfy the need to have an explanation rather than providing the basis of an experimental test. Certainly the models sometimes fit well, but what do the parameters in the models mean? In the physical sciences, we do not just apply mathematical models. We test whether or not the models make sense. Partially this is a process of deciding whether or not the parameters in a model are realistic. In fact, thinking about the connection between model parameters and physical meaning is where prediction usually begins. And prediction is a prerequisite to hypothesis testing. Turchin touts one of his models as containing only five parameters! To a physicist five parameters seems just on the verge of being complex enough to lose its explanatory power. One can fit almost anything with five parameters.

People outside of hard sciences often think that a science matures because it uses mathematics. But this misses the point of both science and mathematics. Science matures through definitive experimentation and the testing of hypotheses. Mathematics is necessary for this goal, but it is not sufficient.