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HISTORY AND DYNAMICS: MARRIAGE OR *MÉSALLIANCE*?

HISTORICAL DYNAMICS: WHY STATES RISE AND FALL. By Peter Turchin. Princeton and Oxford: Princeton University Press, 2003. Pp. 245.

In a review[1] of Peter Turchin's *Historical Dynamics: Why States Rise and Fall*, Joseph Tainter observes that theories of cycles in history are themselves subject to cycles in popularity, from the second-century-BC Greek historian Polybius, who predicted the demise of the Roman Empire 600 years in advance, to the early twentieth century's Oswald Spengler, who viewed world history through phases of development and predicted the "decline of the West." Cyclical theories having lain dormant for a suitable length of time, Turchin launches himself on an ambitious course of revivification, confident that mathematical formulations can help illuminate the long-term threads of history. However, Turchin is also confident that his approach leads the way, and what he perceives to be insights gained by mathematical modeling could as easily be seen as misconceptions aided and abetted by mathematical dust in the eyes.

The first part of this book focuses on territorial expansion and contraction in agrarian societies, and Turchin sets as his task to "translate various non-geopolitical mechanisms into models, determine whether these models are in principle capable of generating second-order dynamics, and if so, derive testable predictions from them." He believes that history as a field can mature only after it has embraced mathematical theory and discards "verbal theories [Collins, Kennedy, Braudel]," beyond which "the discussion of [the importance of time scales] typically does not get" (27). He cites Ibn Khaldun, a fourteenth-century Arab historian who sought to explain why desert nomads overthrew North African dynasties: although dynastic founders ruled wisely and taxed lightly, succeeding generations developed a taste for luxury resulting in higher taxes and declining welfare, opening themselves to a challenge by desert nomads who had developed strong solidarity and thus the capacity for collective action. Nomads with strong solidarity topple dynasties that lack it, and the cycle begins anew. In his "meta-ethnic frontier theory," Turchin proposes that when imperial frontiers overlie major ethnic boundaries, ethnic group solidarity strengthens. This favors their expansion at the expense of old empires. Turchin translates this mechanism into "a simple analytic model." Although he quickly acknowledges that "we need explicitly spatial data to test explicitly spatial models" (104), he has none. He thus conducts a simulation that, after adjusting five *ad hoc* parameters, he views as matching (non-spatial) actual outcomes. However, the number of parameters is large; large enough that it would be a greater surprise if the simulation did not

1. *Nature* 427 (2004), 488-489.

match. In addition, it is one thing to create possible scenarios; it is another to believe that such scenarios, dependent on arbitrary values of five parameters, have more general explanatory power. It is the latter belief to which Turchin clings: "I believe that the theory explains the *general pattern* of European political development—'the making of Europe'" (italics are Turchin's). Clinging can be a good strategy when the supporting structure is sound but this model's foundation is suspect, such as believing that ethnic groups are "quintessential human groups" (34) and that conflict among them is innate.

Turchin then turns to the rise of France as a nation, presenting it as an irresistible process as *ethnie* from the Île de France, according to him, benefited from a higher "collective solidarity" (called *asabiya* by Turchin after Ibn Khaldun) and imposed itself on the rest of France (175). Nordman and Revel,[2] studying the expansion of the power of the French monarchy from the death of Charlemagne in 843 to when Savoy and Nice were joined to France in 1860, document that far from being straightforward, successive acquisitions moved in fits, starts, and retrenchments. Only cartographic naiveté leads one to view the French expansion, especially in the east, as smooth and homogeneous. Spatial and chronological continuity are just artifacts: from the Treaty of the Pyrénées (1659) to the Peace of Utrecht (1713), negotiations brought or relinquished places, cities, and castellanies. Is there something "irresistible" here, or is this merely *post hoc* manifest destiny? Nordman and Revel described how the French kings organized regular long tours through the territory to assess their power and evaluate a kingdom that was under constant threat. From the Ancien Régime to the Revolution, the king's physical presence was gradually extended by institutions, equipment, and administrative networks to multiply sovereign authority and obstinately place France under control. This detailed view of how France became France lets us recognize how cursory Turchin's description is.

The second part of the book is devoted to "demographic-structural theory," based on Goldstone's work on population growth and the instability of states. The claim is that interaction between population size and a state's political instability produces cycles of expansion and contraction. Once again, Turchin builds his case on data of questionable reliability. For example, the number of archeological sites in Roman Gaul is a poor proxy for population size: as Tainter remarked in his review, the peak in sites from the first to the second century AD came from Romanization and settlement of veterans, and the peak in the fourth century was a response to changes in taxation. Although population reconstruction is one of the few tools available when there are no censuses, variability in these types of estimates should not be taken lightly. For example, the 1981 edition of Wrigley and Schofield's celebrated reconstruction made by Jim Oeppen for England between 1541 and 1871 contains a flaw making the result critically dependent on the initialization of the algorithm used.[3] The revised edition

2. Daniel Nordman and Jacques Revel, "La formation de l'espace français," in *L'espace français*, under the direction of André Burguière and Jacques Revel (Paris: Le Seuil, 1989), 33-174.

3. Ronald D. Lee, "Inverse Projection and Back Projection: A Critical Appraisal, and Comparative Results for England, 1539 to 1871," *Population Studies* 39 (1985), 233-248; Noël Bonneuil, "Cohérence démographique et non-identifiabilité de la rétro-projection," in *Méthodes de la démographie historique*, INED, Congrès et Colloques 11 (1992), 99-108.

depends just as critically on untenable assumptions by Oeppen about the growth rate of the oldest age class at the beginning of the reconstruction period,[4] and the reconstructed population is very sensitive to small deviations from these assumptions. Similarly, most demographers now agree that the cycles based on the mechanism postulated by Easterlin in the 1960s have no factual existence. Briefly, Easterlin's hypothesis was that couples belonging to smaller birth cohorts would tend to be relatively advantaged and would have more children who, in their turn, finding themselves relatively disadvantaged by keener competition, would bear fewer children. This hypothesis enlivened much theoretical research—but Turchin takes it literally and seems not to distinguish between theoretical schemes based on plausible mechanisms and reality based on facts.

Turchin devotes the whole of chapter six to his seeming discovery that some social processes exhibit logistic growth (called autocatalytic in the book, an old term coined by physiologist Robertson in 1908): rapid growth at first, followed by a deceleration to a final stable asymptote. The examples cited, which though not spatial at all are intended to support the logistic growth of spatial processes, are Bulliet's data on the conversion of Iranian families to Islam in the medieval period, Stark's estimated proportions of Christians in Egypt, and Stark's estimated proportion of the world population converting to Mormonism. Turchin makes much of the goodness-of-fit of logistic curves to the data, but this is commonplace for growth processes with upper limitation. This is reminiscent of the 1920s, the golden age of the logistic curve, when Pearl enthusiastically applied the same function to any case of growth he could find, from the length of the tails of rats to census data for the United States.[5] Turchin claims several triumphs ("simple models can yield strikingly accurate results when applied to realistic historical data sets"), but the reader should recognize the triumphs as shallow: most constrained growth processes do resemble the logistic, but to say so adds little understanding to dynamics in history. For example, in the case of the conversion to Islam, which is used to support the *asabiya* of Arab conquerors, Courbage and Fargues[6] noted that both the current and past positions of Christian and Jewish minorities under Islam is widely misunderstood: Islam gained ground only gradually, not only through conversion during the thousand years after the Islamic conquest but also through marriage and differential population growth. Curve fitting is too often an exercise that misleads on two fronts: not only should it not be taken as probative, but it can also conceal important detail.

At the heart of Turchin's approach is his unequivocal acceptance of a fiercely debated issue: whether mathematics is up to the task of describing history. Students of dynamical systems learn early that differential equations (those equations relating a variable to its rate of change) often bring about "interesting behavior." For example, consider two variables x(t) and y(t) depending on time t: if the rate of change of x(t) is a function of y(t) and the rate of change of y(t)

4. Ronald D. Lee, "Inverse Projection and Demographic Fluctuations," in *Old and New Methods in Historical Demography* (Oxford: Oxford University Press, 1993), 7-28.

5. Sharon E. Kingsland, *Modeling Nature* [1985] (Chicago and London: University of Chicago Press, 1995).

6. Yusef Courbage and Philippe Fargues, *Christians and Jews under Islam* (London: I. B. Tauris & Co. Ltd., 1997).

a function of x(t), then x(t) and y(t) can, under certain common conditions, display perfectly cyclical behavior. To explain "territorial dynamics in one-dimensional space" (64), Turchin imagines that territory size and solidarity are linked through a basically similar system. Then his task is to see whether the claimed oscillations match up with observation, which is made possible by the large number of parameters with arbitrary values. Letting the velocity of x(t) depend on y(t) is commonly termed "endogenization," especially in economics or in biomathematics, whence comes Turchin. However, at best endogenization is often no more than a guess ("community ecology has a long tradition of conjectures"[7]), while at worst it is counterfactual: research consistently shows that mortality and fertility had little dependence on real wages in historical demographic regimes[8] but Turchin presumes that population depends directly on "state resources" (123). If allowed, endogenization could be the magic wand revolutionizing history: "In order to build a scientific theory of collective solidarity, we need to somehow endogenize this variable, that is to postulate mechanisms that cause it to wax or wane in response to other dynamic properties of societies and polities. So far, no respectable sociological theory has managed to do this, in my judgment, although there are many hints scattered through the scientific literature" (37). Elsewhere, I have examined the phenomenological justification of common ecological models in biology[9]: with regard to the survival of the species, the usual procedure consisting in postulating particular interactions, estimating parameters, and studying local asymptotic stability or permanence does not stem from the very necessity of the species to survive. I showed that it is possible to pose this latter question the other way round: if a biological system is to perpetuate itself (or on the contrary to disappear), at each time what is the whole set of directions among which its own must belong? Among the processes satisfying these conditions of maintenance (or on the contrary of extinction), only a part corresponds to "endogenous" ones; another part is made of discontinuous and unpredictable fluctuations. Yet, compared to biological systems, human behavior is far more complex and subtle. Believing that plausible interactions between area and social solidarity or between the strength of the state and population growth (122) adequately describes centuries of human history approaches hubris.

One could hope that a question as substantial as territorial expansion would encourage one to study historical situations in detail prior to finalizing a theory, whether mathematical or not. But this appears not to be the case: Turchin arrives with a hammer in hand (that populations cycle just as in the theoretical Lotka-Volterra predator-prey models), and to him everything is a nail. No modern biologist believes that these simple models accurately describe real populations; on the contrary, *in situ* observations emphasize how poorly they fit.[10] Nor do historical human population data support cycles. Population historian Patrice

7. P. J. Morin and P. S. Lawler, "Food Web Architecture and Population Dynamics: Theory and Empirical Evidence," *Annual Review of Ecological Systematics* 26 (1995), 505-529.

8. Ronald D. Lee, "The Demographic Response to Economic Crisis in Historical and Contemporary Populations," *Population Bulletin of the United Nations* 29 (1990), 1-15.

9. Noël Bonneuil, "Making Ecosystem Models Viable," *Bulletin of Mathematical Biology* 65 (2003), 1081-1094.

10. E. R. Pianka, *Evolutionary Ecology* (New York: Harper and Row Publishers, 1978).

Bourdelais[11] specifically rejects the idea that observed oscillations have anything to do with mechanistic cycles: he shows that these fluctuations result from a combination of climate, epidemics, technology, and resources.

Overall, Turchin's premise is that historians have much to learn from those who can handle a system of differential equations. Even if the application of the theory of cycles raises doubt, it does not mean that all mathematical models are equally useless. The theory of dynamical systems can bring much more to history than the application of equations yielding cycles. For this discussion, I would like to present a few examples of historical demographic oscillations that have nothing to do with cycles. At the beginning of the twentieth century, Henri Poincaré, recognizing that most differential equation systems are intractable, devised state space analysis. A state space analysis of fertility in Western countries since 1930 reveals that, instead of a cycle, fertility moves from one norm of behavior to another (for example, in France, three children per woman during the baby boom to two children since the 1970s).[12] The duration of the temporary stagnation at a given norm or regime is not determined in advance, as in a cycle; history is no longer viewed as the unfolding of predictable scenarios. On the contrary, state space analysis rehabilitates broken threads, sudden switches from one regime to another, temporary stagnations, discontinuity, unexpected futures.

In seventeenth-century Normandy,[13] life expectancy at birth did not exceed twenty-seven years on average, but fluctuated between ten and forty-five. Fertility also fluctuated widely and irregularly. State space analysis of fertility again shows no cycle, but rather a low and a high level of fertility, between which fertility oscillated, with respect to specific combinations of age structure, access to land, and incidence of epidemics: for example, by the mid-seventeenth century there had been no mortality crises for four decades, so that the population of married women was relatively old and the associated fertility low. Unmarried women were still numerous enough so that marriages could quickly recover from the fearsome plague of 1638–1639. This was no longer the case after the following plagues of 1651 and 1670, when the dead had to be replaced by younger couples. Fertility was subsequently pushed to a high level, where it was maintained by successive mortality crises, such as the great famine of 1693–1694. There is no cycle there, although fertility fluctuated with large amplitude.

The difficulty inherent in history and in the history of populations is to think about human time. In former demographic regimes when temporal irregularities reflected the capacity (or incapacity) of small communities to perpetuate themselves under conditions of harsh mortality, up to modern times with baby booms and busts, it appears that broad historical demographic movements are better characterized by discontinuous jumps from one regime to another than by cycles. The causes of population patterns across time are surely determined more by

11. Patrice Bourdelais, "Le paysage français," in *L'espace français*, under the direction of André Burguière and Jacques Revel, Paris: Le Seuil (1989) 175-290.

12. Noël Bonneuil, "Contextual and Structural Factors in Fertility Behavior," *Population* (English Version) 2 (1990), 69-92. Noël Bonneuil, "Capital Accumulation, Inertia of Consumption and Norms of Reproduction," *Journal of Population Economics* 7 (1994), 49-62.

13. Noël Bonneuil, "Turbulent Dynamics in a 17th century population," *Mathematical Population Studies* 2:4 (1990), 289-311.

uncertainty and human agency than by strict and immutable endogeneity in model equations.[14]

Thus, Turchin's unintentional contribution to scholarship is to raise the critical question of how appropriate differential calculus is to history. Will we prefer a caricature of a model to a solid "verbal" discussion? What evidentiary value does one particular output of a simulation bring? When simulations fit observed data reasonably well, it is wise to wonder about the extent to which the number and significance of the parameters made it possible. However, as I showed through a few examples, the mathematical theory of dynamic systems should not be reduced to this attempt. It has great potential for contributing to history, provided we acknowledge the complexity of social matters and human time.

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14. Noël Bonneuil, "History, Differential Inclusions, and Narrative," *History and Theory,* Theme Issue 40, *Agency after Postmodernism* (2001), 101-115.