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SOCIAL EVOLUTION FORUM

The Role of Ritual in the Evolution of Social Complexity: Five Predictions and a Drum Roll

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In his "Reflections on the French Revolution," the great Anglo-Irish statesman and philosopher Edmund Burke declared: "In history a great volume is unrolled for our instruction, drawing the materials of future wisdom from the past errors and infirmities of mankind." But since the 18th century when Burke penned these lines, the "great volume" to which he referred has grown so vast through the accumulated discoveries and writings of historians, classicists, archaeologists and others that "unrolling" it has become practically unthinkable. Until now…

The process of inferring general patterns in human history has usually meant cunningly plucking out facts to fit your argument—for instance 'cherry picking' historical events to lend credence to your judgments about the 'errors' of the past and your favored 'prescriptions' for the future. However flawed this methodology, alternative options were limited. Anybody seeking to use our accumulated experience of the past to predict likely patterns of history-making in the future has been limited by how much knowledge they could personally command, given the difficulties of accessing information, the limitations of brains (especially memory and processing power), and the shortness of scholars' lifespans. To overcome these very human frailties, what has long been needed is a computerized database of global history in which patterns of correlations across space and time between variables of interest could be reliably tracked using statistical tools. Seshat: Global History Databank, a vast collection of information gleaned from the work of scholars who study the human past, will provide a new way of addressing this challenge (Seshat: Global History Databank 2015a).

Seshat builds upon and radically expands a number of more established initiatives, including the Human Relation Area Files (HRAF; Human Relation Area Files 2015) and the Standard Cross-Cultural Sample (SCCS; Murdock and White 1969). The crucial added value of Seshat is its longitudinal depth. Pre-existing

databases are too historically shallow to understand long-term persistence and trend reversals, but Seshat will provide dynamic data revealing how different aspects of societies change with time. Our work also builds upon earlier efforts to construct and analyze more modest datasets using ethnographic material derived from both HRAF and the SCCS (Atkinson and Whitehouse 2011) and independently assembled archaeological materials (Whitehouse et al. 2013).

We started working together on this massive undertaking about five years ago. By the end of 2015, with the help of many colleagues who have joined forces with us along the way and the generous support of several funding bodies, we will have coded information pertaining to over 500 political systems (or 'polities') in 30 'natural geographic areas' (NGAs; Seshat: Global History Databank 2015b; 2015c). We call them 'NGAs' because they each cover a geo-ecological zone that has retained its distinctive character over the millennia, even while the scale and structure of human social systems have changed, often quite dramatically. Our NGAs were selected to cover as broad a range as possible of social, cultural, political, and economic variation in world history selected from Africa, Europe, the Pacific, the Americas, and all the major regions of Asia. For each world region, we selected NGAs capable of furnishing examples of polities at all levels of sociocultural complexity (categorized as 'low,' 'medium,' or 'high'). Some NGAs yielded polities with richly documented histories, and, taken together, these polities span very long time periods. Other NGAs had much shallower histories and offered thus a smaller number of polities. Overall, however, this sampling approach provided us with a rich slice of variability in human history (see Table 1). For each of the many hundreds of polities included in Seshat, we have been coding for a great range of variables pertaining to social complexity, warfare, ritual, governance, law, stratification, social mobility, religion, quality of life, economy, technology, agriculture, and demography. At the time of writing, we have about 78,000 data points already coded, and, by the end of the year, we expect this to have risen to around 100,000. Coding our initial sample of 30 NGAs is only the starting point, however; by 2025, we expect to hit our target of 100 NGAs, allowing us to test a great variety of hypotheses about the history of humankind and laying the groundwork for others to follow suit when the database 'goes public.'

As well as enabling us to avoid the charge of cherry-picking examples to fit our arguments, Seshat will allow us to test predictions formulated before we compiled the database, paving the way for a scientific approach to learning from history. Here, we set out five predictions concerning the relationship between ritual and various wider features of society. For each of these predictions, we provide a rationale or motivation based on the theory of 'Divergent Modes of Religiosity' (hereafter DMR theory). When the first phase of data assembly is completed early

Table 1. The World Sample of 30 NGAs (Turchin et al. 2015)

World Region	Low Complexity	Medium Complexity	High Complexity
Africa	Ghanaian Coast	Niger Inland Delta	Upper Egypt
Europe	Iceland	Paris Basin	Latium
Central Eurasia	Lena River Valley	Orkhon Valley	Sogdiana
Southwest Asia	Yemeni Coastal Plain	Konya Plain	Susiana
South Asia	Garo Hills	Deccan	Kachi Plain
Southeast Asia	Kapuasi Basin	Central Java	Cambodian Basin
East Asia	Southern China Hills	Kansai	Middle Yellow River Valley
North America	Finger Lakes	Cahokia	Valley of Oaxaca
South America	Lowland Andes	North Colombia	Cuzco
Oceania-Australia	Oro PNG	Chuuk Islands	Big Island Hawaii

in 2016, we will begin the process of testing these predictions statistically using our world sample of 30 NGAs.

Five Predictions

DMR theory posits two clusters of features pertaining to collective ritual and social morphology in the world's religious traditions (Whitehouse 1995, 2000, 2004, 2012). One cluster—the imagistic mode of religiosity—is characterized by low-frequency (i.e., rarely performed), high-arousal (typically painful or frightening) rituals and small but intensely cohesive communities. The other cluster—the doctrinal mode of religiosity—is characterized by high-frequency (i.e., routinized) low-arousal (often tedious and repetitive) rituals and large-scale, hierarchical, but more diffusely cohesive communities. The imagistic mode is thought to be adaptive for groups that need to stick together in the face of strong temptations to defect— for example, when engaging enemies on the battlefield or large prey on the hunting ground. The doctrinal mode is thought to be adaptive for groups seeking to pool small amounts of resource from individuals in a much larger population so as to create a large, centralized resource in the form of charitable donations, legacies, tax or tribute—for example, when competing coalitions are organized via categorical ties of caste, race, ethnicity, or belief. These contrasting patterns of ritual and group formation have been studied in a few select religious groups both past and present (e.g., Whitehouse & Laidlaw 2004; Whitehouse and Martin 2004; Whitehouse and McCauley 2005), as well as in military groups that may or may not subscribe to beliefs in supernatural agents or forces (e.g., Whitehouse and

McQuinn 2012; Whitehouse 2013). In addition to analysis of case study material from social-cultural anthropology, history, and archaeology, evidence that imagistic and doctrinal modes constitute universal features of group formation comes from the analysis of approximately 100 variables pertaining to 645 rituals from 74 cultures (Atkinson and Whitehouse 2011). This early database, allowing synchronic comparison, generated a number of predictions that will be testable using a longitudinal dataset such as Seshat.

For each polity coded in Seshat, we record details for five kinds of rituals: the largest scale, the most widespread, the most frequent, the most euphoric, and the most dysphoric. For each of these five rituals, we assemble information on the frequency, duration, scale, and inclusiveness of performances along with evidence of the quality and intensity of the emotions evoked through participation. This information is gathered through direct input from domain experts and through extensive literature reviews conducted by research assistants. As such, the data reflect the most recent scholarly understanding of ritualistic behavior for each of the polities. Because Seshat also contains extensive information on social complexity, warfare, agricultural intensity, and other variables of relevance to DMR theory, we will be able to test a wide variety of hypotheses concerning the evolution of doctrinal and imagistic modes over time. Here, we lay out five initial predictions to be tested using Seshat. We also provide an alternative to each of our predictions together with competing rationales (Table 2).

Prediction 1: Dysphoric Rituals Produce More Tribal Warfare, Intra-Elite Conflicts, Military Revolts, and Separatist Rebellions.

For each polity coded in Seshat, we are collecting information on the most dysphoric (e.g., painful or frightening) ritual and details of the group(s) performing it. We predict that any tribes, elites, military organizations, or movements in the polity that have highly dysphoric rituals will be more prone to engaging in inter-group conflict than groups lacking such rituals. The logic of this prediction is that groups bound together by dysphoric rituals are more willing to fight and die to defend themselves against perceived external threats. Depending on the groups in question and the nature of the threats they face, we would expect intergroup conflict to take fairly typical forms such as civil war, sectarianism, rebellion, and revolution. The evidence supporting this prediction comes from real-world studies of the effects of shared dysphoria on group cohesion and willingness to fight and die for the group. Dysphoric experiences trigger enduring episodic memories that shape the personal self (Whitehouse 1992; Conway 1995). When such experiences are ritualized, they prompt elevated levels of reflection and meaning-making, increasing their transformative effect on the essential-self concept (Wilson and Ross 2003; Richert et al. 2005). Sharing such self-defining memories with others

Table 2. Five Predictions of DMR Theory

Prediction	Explanation	Alternative
1. Dysphoric rituals correlate with small-scale armed groups, intra-elite conflicts, military revolts, and separatist rebellions	Dysphoric rituals lead to local fusion and willingness to fight and die for the relational group—thus increasing the incidence of small-scale intergroup conflict, revolt, or revolution.	Dysphoric rituals have no effect or a negative effect on the incidence of intergroup conflict, revolt, or revolution.
2. Intensification of agriculture leads to routinization and orthopraxy	Agricultural intensification increases the frequency and scale of cooperative activity and, therefore, leads to ritual routinization and standardization	Routinization and orthopraxy are triggered by factors unrelated to agriculture (e.g., warfare, trade, status inequality, polarization of economic classes, etc.).
3. Routinized rituals enabled the emergence of larger polities	Routinized rituals are necessary for the first appearance of large-scale, anonymous, hierarchical, centralized communities. Thus, they appear before such large-scale polities.	Large-scale, anonymous, hierarchical, centralized communities arose first (e.g., due to warfare) and routinized rituals emerged subsequently to help maintain social cohesion.
4. Widespread orthopraxy makes polities more stable and long-lived	Widespread orthopraxy leads to shared identity and deference to a common authority so the more widespread and routinized the polity's rituals are, the more stable and enduring its political system.	Widespread orthopraxy has no effect on or reduces the stability and longevity of the polity (e.g., because orthopraxy implies rigidity and risk of predation by more agile competitors).
5. Routinization & orthopraxy lead to the expansion of political dominion and trade	Because ritual routinization and standardization produce stable group identities that spread efficiently, they precede the expansion of political systems and trading networks.	Routinization and standardization obstruct assimilation, syncretism and cultural pluralism, inhibiting both political and commercial expansion.

renders the boundary between self and group more porous, producing 'identity fusion'—a form of extreme group cohesion associated with willingness to sacrifice self for the group (Swann et al. 2010; Swann et al. 2012). The effects of fusion on willingness to fight and die for the group has been studied empirically with revolutionaries in Libya (Whitehouse et al. 2014), war veterans who served in Vietnam, Afghanistan, and Iraq (Whitehouse et al., submitted), and participants in painful hazing rituals (ibid.). Together, these studies show that the effects of shared experience on fusion with the group is mediated by reflection on transformative dysphoric experiences and gives rise to extreme self-sacrifice in defense of the group's interests (Whitehouse and Lanman 2014).

Prediction 2: Routinized Rituals Enabled the Emergence of Larger Polities.

For each polity coded in Seshat, we will code details of the most frequently performed collective ritual supporting the prevailing power structure. It is a truism of social science research that rituals bolster the status quo, but it is only possible for rituals to serve this function if they enshrine a set of features common to the entire subject population. In order for a set of beliefs and practices to become standardized across large populations, however, they need to be enacted with sufficient regularity that everyone remembers their content and meaning in more or less the same way (Whitehouse 2000). When the frequency of complex cultural practices drops below a certain threshold, the tradition becomes prone to unauthorized innovation, giving rise to localized or regional offshoots and factions, undermining the unity of the tradition as a whole (Whitehouse 2004). Thus, in order to establish a large polity in the first place and to maintain it over time, the beliefs and practices of the population need to be homogenized through the process of routinization, typically in tandem with processes of centralized monitoring and control. Whereas local communities (e.g. tribes and villages) may be bonded through lower frequency rituals, ranging from annual festivals to rites of passage to once-in-a-generation events such as chiefly installation rites, state and world religions rely heavily on repetitive (e.g., daily or weekly) rituals to maintain their collective identities. We therefore predict the rise of ritual routinization prior to the appearance of large-scale political systems.

Prediction 3: Intensification of Agriculture Leads to Routinization and Orthopraxy.

One of the main drivers of routinization is thought to be the intensification of farming. In our survey of 74 cultural traditions and their rituals (Atkinson and Whitehouse 2011; see above), we established a strong negative correlation between ritual frequency and agricultural intensity. A possible explanation for this pattern is that as subsistence strategies become increasingly reliant on regularized

forms of cooperation punctuated by collective ritual, polity-wide beliefs and practices become more standardized, stably uniting a wider and larger population. There is some evidence that these processes began in Western Asia with the Neolithic transition from foraging to farming. Over a period of nearly two thousand years, we have attempted to unpick the intricately entwined relationships between agricultural intensification, ritual frequency, and the standardization of communal identities (Whitehouse and Hodder 2010). We then constructed a database of Anatolian and Levantine sites from the end of the Paleolithic through the beginning of the Bronze Age, showing a gradual shift from imagistic to doctrinal modes of group formation as the cultivation of crops and the domestication of animals emerged and slowly intensified (Whitehouse et al. 2013; see above). Eventually, Seshat will be able to link to databases of this kind so that we can compare the complex relationships between agriculture, ritual, and social morphology across multiple regions and time periods, potentially on a global scale.

Prediction 4: Widespread Orthopraxy Makes Polities More Stable and Long-lived.

To the extent that routinization leads to the standardization of beliefs and practices and the emergence of centralized hierarchies responsible for maintaining adherence to the authorized canon, we would expect the resulting orthopraxy to inspire deference to the status quo and so contribute to the stability and endurance of the social order. Functionalist arguments of this kind, once enjoying almost hegemonic status in the social sciences (Parsons 1961), became a target for criticism in recent decades mainly on the grounds that not all societies are functionally integrated and stable—and even if some are, it is hard to explain how that functional integration came about (Barnard 2000). Some of these issues will be possible to address empirically for the first time using Seshat. Are certain features of rituals correlated with political stability over time, as we would predict? Are there conditions (e.g., pressures external to the polity) under which those same ritual features become dysfunctional (e.g., in inter-group competition)? DMR theory presents a series of sub-hypotheses regarding patterns of change in the relationship between routinized ritual, the 'tedium effect,' splintering, and reformation (Whitehouse 2004)—all of which lend themselves to empirical testing using the kind of longitudinal information that Seshat will provide (Turchin et al. 2012; Turchin et al. 2015; Francois et al. submitted).

Prediction 5: Routinization and Orthopraxy Lead to the Expansion of Political Dominion and Trade.

In addition to the possibility that the establishment of an orthopraxy might help to legitimate the power structure, we predict that it will facilitate the expansion of its

dominions. As empires grow and expand into new territories, they must run the risk of losing sovereignty over distant outposts. Establishing a routinized ritual system can help to ensure the loyalty of subjects distant from the centers of control. But we hypothesize that it can also facilitate expansionary trading networks, allowing prospective partners to extend bonds of trust and cooperation based merely on exteriorized evidence of common belief and practice. In some cases, this trading advantage might consist mainly of a preference for ingroup over outgroup where a range of commercial partners is present. But it can run deeper still, where, for example, the religious system promotes particular ethical standards and associated sanctions or provides other assurances of the reputational standing of prospective associates in business.

And a Drum Roll

Making predictions is a scary business. The initial analysis of our first database of 645 rituals from 74 cultures (Atkinson and Whitehouse 2011) was accompanied by much anxious anticipation. Prior to it, there had been no shortage of scholars claiming to have shot down DMR theory on the grounds that they had found a low-frequency low-arousal ritual, or a high-frequency high-arousal one. Explaining that DMR theory was claiming to pick out statistical tendencies across space and time, not to explain every individual case, was often met with great affront as if one were claiming that the theory could not after all be empirically refuted. To be fair, it was more like claiming that the theory could not be tested on the evidence currently available. With the new rituals database, this changed for the first time. We were finally able to see whether rituals statistically clustered as predicted around imagistic and doctrinal 'attractor positions.' To our immense relief, they did. But this was only the beginning.

Not every prediction of DMR theory was capable of being tested by the Atkinson and Whitehouse database. In some cases, this was simply because we were unable to find compelling proxies for variables of interest. For example, levels of social cohesion were surprisingly difficult to measure using ethnographic sources. In other cases, the problem was simply that the rituals database was synchronic—we couldn't test hypotheses about causation based on the assumption that causes usually precede effects. With Seshat, this will change.

Seshat will allow us to test hypotheses longitudinally for the first time—not only in one culture area or geographical region but across the entire globe, reaching as far back into the mists of times as historians and archaeologists have been able to go. The five predictions plucked out here for consideration will not be everyone's cup of tea, but they will nevertheless allow us to demonstrate proof of concept. In the years to come, we will be able to test many more hypotheses with ever more precision, providing a whole new way of thinking about the human past.

We will at last bring history under the purview of experimental science. Surely this is an act that deserves a drum roll?

Acknowledgements

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Commentaries

Peter N. Peregrine. *Comment on "The Role of Ritual in the Evolution of Social Complexity"*
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"The Role of Ritual in the Evolution of Social Complexity" is one of several recent publications that introduce the Seshat databank and its potential contributions to social science (e.g. Turchin, Whitehouse, et al. 2012; Turchin, Brennan, et al. 2015). Here Whitehouse and colleagues provide a number of interesting hypotheses concerning the relationship between ritual and social complexity that will be testable once Seshat is more complete. I have two critiques and one comment to make about this interesting paper.

First, Whitehouse and colleagues argue that one of the most important elements of Seshat is its "longitudinal depth," implying that the Human Relations Area Files (HRAF) lacks such depth. This is not wholly true. A number of the cultures (e.g. Iroquois) in the HRAF World Cultures archive do have longitudinal depth; that is, there are ethnographic materials from several focal periods. This longitudinal depth is not great—several centuries at most—but it does allow for some diachronic analysis. In addition, the HRAF Archaeology archive is designed

around longitudinal sequences that explicitly provide data for diachronic analyses. HRAF Archaeology, however, does not extend into the historic period. Whitehouse and colleagues would be more accurate in saying that HRAF does not provide data that extends from the historic period into the past.

Second, I am puzzled by the prediction that dysphoric rituals produce more conflict. The discussion of the "imagistic" mode of religiosity suggests that these intense experiences are adaptive to conditions of high conflict, creating tightly bound groups in situations where defection might be a more "logical" option. To the extent that dysphoric rituals are a central element of "imagistic" religiosity, it would imply that dysphoric rituals are adaptive to situations of high conflict, not causal to them. Indeed, the explanation that Whitehouse and colleagues give for this hypothesis suggests to me that they are confusing a social adaptation to high levels of conflict for a causal force behind that conflict.

Finally, a comment, or perhaps a story. Whitehouse and colleagues rightly identify a common problem in social science, which is a misunderstanding of probability. Our predictions are probabilistic ones—in such and such a situation it is likely that such and such is the result—and not absolute ones. Some (perhaps most) social scientists do not understand this, and thus do not understand that exceptions to the prediction are expected, even desired, as they provide interesting cases to examine in order to improve explanations and predictions. But we are not alone in having this problem. As the late Steven J. Gould (1999:83) explains:

> Broad generalizations always include exceptions and nuanced regions of "however" at their borders—without invalidating, or even injuring, the cogency of the major point. (In my business of natural history, we often refer to this phenomenon as the "mouse from Michigan" rule, to honor the expert on taxonomic details who always pipes up from the back of the room to challenge a speaker's claim about a general evolutionary principle: "Yes, but there's a mouse from Michigan that . . .")

Even evolutionary biologists must face those critics who do not understand probabilistic explanation. We will never explain every case we find, for human behavior is too complex and too contextually-dependent for that, so we should not let the "mouse from Michigan" trouble us too much. Though maybe someday, and maybe with the help of Seshat, we will build a better mouse trap.

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Brian Malley. *The New* Golden Bough*?*

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The development of Seshat is tremendously good news for social scientists interested in broad patterns in human history. It has long been evident to any unbiased observer that there are historical trends, large-scale patterns in the ways societies (or complexes of societies) evolve.

In some domains, such as that of military technology, the pattern seems fairly straightforward: all other things being equal, peoples favor more efficient technologies, and when they do not there are usually fairly evident reasons. For example, there is no great mystery to how firearms became the predominant weapon of the frontline soldier. Firearms may not have won every battle, but they had greater efficacy than rival technologies overall.

Other questions, such as whether alphabetic literacy promotes democracy, are more difficult to decide. As Whitehouse, Francois, and Turchin note,

The process of inferring general patterns in human history has usually meant cunningly plucking out facts to fit your argument—for instance 'cherry picking' historical events to lend credence to your judgments about the 'errors' of the past and your favored 'prescriptions' for the future.

Proponents of a theory make general claims, and illustrate them with one or two extended case studies. Their critics deny the generalization, and hold up one or two counterexamples. At the end of the day, there is no clear conclusion, and the success of a theory comes right back down to its *prima facie* plausibility. The form of empirical inquiry has been followed, but its spirit has been exorcised.

Seshat promises to change this by allowing the rigorous testing of historical hypotheses against a database that is large both synchronically and diachronically. What's not to love?

I am excited about Seshat, and optimistic that it will teach us a great deal. I do wonder, however, about the following.

Correlation vs. causation: Seshat will be able to generate correlational data, but these are of limited value in assessing causal claims. To be sure, if there is no correlation where a causal claim has been made or if the putative effect precedes the putative cause, then Seshat will be able effectively to disconfirm a causal hypothesis. But in many cases it seems that cultures evolve as complexes: for instance, we might imagine that agriculture and the state tend to coevolve because a state can organize large-scale irrigation projects, and large-scale irrigation projects increase tax revenue and strengthen the state. There is a causal influence here, but it is non-linear. If the variables change together, it is doubtful that Seshat can discriminate causal from coincidental relationships, or tell us anything about the particular causal linkages.

Which variables? The database is obviously designed to include all the variables relevant to Whitehouse' Modes theory, and so it might reasonably be expected to provide an excellent test of those hypotheses. But if the database merely substitutes cherry-picked variables and gerrymandered categories for cherry-picked examples, I don't think we will come out much ahead. Does the database contain the variables relevant to the Ritual Frequency Hypothesis, a rival to Whitehouse' Modes theory? Or is the Modes theory to be tested only against the null hypothesis, that there is *no pattern at all*? Will the database include the variables required to actually compare *specific* predictions, or merely to confirm the existence of *some* kind of pattern?

Psychology has recently faced something of a crisis of conscience over the discovery that some of its most famous findings are either not replicable or were tested by statistical measures insufficiently powerful to establish their claims. Here I must confess that I am the type that prefers classical mathematics to statistics, and that I have a hard time following statistical arguments. Given how easy it is to "lie" (intentionally or unintentionally) using statistical methods, I cannot help but feel doubt that statistical arguments are going to resolve anything.

In short, I wonder whether Seshat will not really be a giant, digital *Golden Bough*. Frazer, in writing the original, gathered all the examples he could, and tied them together into a coherent narrative about social evolution. He clearly intended to carry his argument precisely by the weight of examples he cited—a kind of intuitive statistics, without numbers. Ultimately, his work was rejected because he took his examples out of their contexts. But isn't this exactly what a database is designed to do? To permit the cross-cultural comparison of variables stripped of

all their particular contexts? If this was such a problem for Frazer's undertaking, has it now ceased to be a problem? I understand that Seshat includes hundreds of variables from different societies, and that these can—*potentially*—be invoked to provide some degree of context. But for this much depends on the right variables being coded, and coded in relevant ways.

It is obvious today that even the documentary value of the *Golden Bough* is limited by Frazer's theoretical agenda: because he was invested in a particular narrative, he gathered information in a particular way, sifting the relevant from the irrelevant on the basis of his theory. So, too, even if Seshat includes hundreds of variables, these are still but a selection from all that might be coded. It is not obvious to me how this selection should be made: it seems to me that cultural anthropologists have emphasized the importance of ethnography precisely because it is impossible to predict in advance which cultural phenomena might be related, or how. There are, I am sure, many variables that all social scientists would agree are important—but are any that all would agree are *not?*

I must emphasize that I do not know anything more about the design of Seshat than what is contained in the preceding article, and that none of the foregoing are intended as claims about it: they are merely questions, and ones I hope (and trust) will prove to be ill-founded. I am certain that all of my questions occurred long ago to Sestet's designers. This project is indubitably worthwhile—indeed, it is the most exciting thing I have seen in a long time. I hope it lives up to its promise.

Harvey Whitehouse, Pieter François, and Peter Turchin. *Can there be a science of history? Response to commentaries on "The Role of Ritual in the Evolution of Social Complexity: Five Predictions and a Drum Roll"*

Our recent article invited readers of the SEF to imagine a drum roll in the background as we announced the imminent arrival of a vast global databank that will bring history under the purview of experimental science for the first time. We are extremely grateful to Peter Peregrine and Brian Malley for their willingness to comment on the article—and for raising such big and interesting questions, to boot. But first, let us emphasize that our purpose here is to explain our approach—this is a work in progress, not a set of results. Our main rationale is that we want our key predictions to have appeared in print before putting them to the test through the first phase of analysis in 2016.

Both commentators express reservations about the capacity of *Seshat: Global History Databank* to demonstrate causal links between the variables of interest. Malley concedes that the database could be used to disconfirm certain causal claims (e.g., where a hypothesized effect precedes its putative cause), but because socio-cultural systems are so complex, he suspects that the causal role of one or a few variables is likely to be "non-linear." To some extent, this concern may illustrate Peregrine's point about the dangers of misunderstanding probability in social science. If we have enough examples of a particular variable (e.g., routinized ritual) historically preceding another (e.g., enlarged political systems), then we can say that, all else being equal, routinization causes political expansion. The fact that that this causal chain may depend on the presence of numerous mediating variables does not detract from the main claim—indeed, it only opens up the prospect of more finely-grained analysis of the causal chain.

A related issue may lurk behind the concern that Seshat will be just another, grander version of *The Golden Bough* (Frazer, 1890 [1926], Macmillan Press). But as Malley himself points out, Frazer never attempted to place his hypotheses about the evolution of religion or, more generally, social complexity, head-to-head with alternative hypotheses. That is exactly what we attempted to do, however, in Table 2: Five Predictions of DMR Theory. Deciding which rival theories to test is obviously a key challenge here. The 'Ritual Frequency Hypothesis' (from McCauley and Lawson's *Bringing Ritual to Mind*, CUP, 2002) that Malley mentions in passing is an attractive candidate for some but not all of the predictions of interest to us, but it also requires historically accurate information about the intervention of culturally postulated supernatural agents in rituals —information that is generally lacking in the historical record and entirely absent in the archaeology.

In fact, we would argue that our general approach is the very antithesis of the classical approaches used by humanists, so brilliantly illustrated by The Golden Bough. Unlike Frazer, instead of focusing on a single hypothesis, we bring in multiple explanations right from the start of the enterprise. Yes, we cannot cover all possible hypotheses—that's a practical and logical impossibility—and, yes, we have started with variables of relevance to theories of particular interest to us as Seshat's creators. This is one of the great privileges of pioneers in any domain: you get to make decisions about what to prioritize. But we also build a solid foundation and neutral platform for others to add to the database by collecting data on additional variables to test additional theories. As the stock of variables increases, the job of each next researcher wishing to test an additional theory becomes easier.

A second difference between the approach taken by Frazer and ours is that we do not "cherry-pick" facts. Instead, we employ a systematic procedure by collecting all data available for all societies that occupied a set of 30 points on the globe between the Agrarian Revolution and the Industrial Revolution. We are limited

only by what historians and archaeologist know about these societies. (And one of the "products" of the Seshat Databank will be to highlight important gaps in our knowledge that can be filled with additional research.) By turning Seshat into a public resource available to everyone to test theories they consider to be the most compelling or timely, we believe to have put in a place the infrastructure necessary to analyze history using the scientific method. Science, like other domains of culture, evolves—and we believe a science of history may evolve faster and more spectacularly than most.