Macrosociology and the Emerging Synthesis

François Nielsen
Department of Sociology
University of North Carolina – Chapel Hill

May 2005

Abstract

On the basis of genetic, linguistic and archaeological clues researchers are developing a new understanding of the role of demic expansions in human history named the *emerging synthesis.* Sociologists can contribute to this intellectual endeavor by providing a "plug-in" macrosociology based on Gerhard Lenski's ecological evolutionary theory of socio-cultural evolution. I propose to modify Lenski's typology of human societies by merging agrarian and herding societies into one category of *secondary products* societies (a concept due to Andrew Sherratt), and representing the mix of agrarian versus herding subsistence as a continuous proportion. The paper uses cross-cultural data to show how the modified typology is associated with five societal characteristics (depth of jurisdictional hierarchy, presence of social classes, female participation in subsistence production, patrilinear descent, and belief in an active high god supportive of human morality), and reconstructed technological terms of the Proto-Indo-European lexicon to illustrate how the proposed typology sheds light on the puzzle of pre-historic Indo-European expansions.

1 Introduction

The term *emerging synthesis* was adopted by Renfrew (1992a,b) to designate the growing consensus among geneticists, linguists, and archaeologists on the broad outlines of human evolution since the emergence of *Homo sapiens sapiens* in Africa some 200,000 years ago. The synthesis is sweeping in scope, covering the human diaspora out of Africa and the settlement of Australia, Asia, Europe and finally the Americas from about 100,000 BCE to 11,000 BCE; the massive population movements triggered by the uneven emergence of plant cultivation in different regions of the world after about 8,000 BCE; the European expansion that began in the 16th century and the consequences of the Industrial Revolution that are still unfolding today. The emerging synthesis is profoundly interdisciplinary, drawing from the fields of archaeology (Renfrew 1987; Mallory 1989), human genetics (Cavalli-Sforza et al. 1994), and linguistics (Ruhlen

1994). The most comprehensive statement of the emerging synthesis to date may be Diamond's *Guns, Germs and Steel* (1999).

I argue in this article that sociology can contribute to the emerging synthesis by providing the macro-sociological theory needed to relate the broad outline of human history to socio-cultural evolution (see also Maryanski and Turner 1992; Sanderson 1991). To develop this argument the next section first presents the main findings of the emerging synthesis. Section 3 outlines Gerhard lenski's ecological-evolutionary theory of socio-cultural evolution and argues that it can serve as a "plug-in" macro-sociology for the emerging synthesis. Section 4 shows the theory's affinity with the emerging synthesis and discusses one area in which the theory can be refined – by recognizing the role of the Secondary Products Revolution as a major engine of demic expansion and social change. Section 5 illustrates the theoretical discussion by showing how a modified typology of societies clarifies relationships between subsistence technology and other societal characteristics, using cross-cultural comparative data. Section 6 shows how the proposed theoretical perspective sheds light on the puzzle of Indo-European origins. The final section briefly relates demic expansions to other mechanisms of socio-cultural evolution – notably world-system processes – and discusses issues for further research.

2 The Emerging Synthesis

2.1 Demic Expansions

The emerging synthesis postulates that human history has been punctuated by *demic expansions* driven by innovations in subsistence technology (food production), transportation technology, or military technology. Technological innovations cause demic expansions by stimulating local population growth to saturation levels, or by facilitating migration, or by making possible the political subjugation of surrounding populations (Cavalli-Sforza et al. 1994, p. 111, Figure 2.7.5). Especially when the technological innovation responsible for the initial expansion permits a higher population density (by increasing efficiency of food production), a demic expansion may take the form of repeated cycles of colonization of adjacent territories followed by further population growth and territorial expansion, producing a *wave of advance* in which the expanding population progressively "spills-over" adjacent low-density areas along a slow-moving front. The wave of advance model was originally developed to model the expansion of farming into Europe from the Near-East over the period from 6,500 to 3,500 BCE. In this episode the population wave front moved at an estimated rate of 1 km per year (Ammerman and Cavalli-Sforza 1973, 1984). An important feature of the model is that it views expansion as taking place slowly, without implying military or political subjugation of the indigenous populations.[1]

[1]Population expansion can thus theoretically take place without violence, a feature of the wave of advance model that may contribute to its appeal.

2.2 Genetic and Linguistic Evidence

The nature of the genetic evidence for demic expansions is examplified by the work of Cavalli-Sforza and colleagues. Their project described in *History and Geography of Human Genes* collected blood samples from members of aboriginal populations all over the world, from which allele frequencies for various polymorphic genes were calculated. The frequencies were then used to compute genetic distances among populations (Cavalli-Sforza et al. 1994). From the matrix of distances a pedigree can be estimated, representing the hypothetical descent of the populations from a common ancestral stock. By relating the estimated pedigree to geographical locations the past history of movements of the populations can be inferred. Timing can be estimated from a genetic "clock" that assumes that time at which a branching occurred in the past is proportional to the genetic distance between populations.

An ancient demic expansion may be indicated by the existence of a geographical gradient (or cline) in gene frequencies. Such a gradient suggests that the particular technological innovation that generated the wave of advance spread by means of the physical expansion of the population associated with the technology (with interbreeding with indigenous populations), rather than through purely cultural diffusion of the technology by imitation and learning. A well documented example is the diffusion of Neolithic technology based on plant cultivation from the Near-East to Europe from 6,500 to 3,500 BCE, which left a continuous gradient in gene frequencies from Anatolia to Ireland. The genetic distinctiveness of a population such as the Basques (e.g., a high frequency of the Rh-negative allele compared to other European populations) results from its relative genetic isolation due to a mountainous habitat.[2]

Finally, there is sometimes a direct, substantive relationship between frequency of a specific gene and the evolutionary history of a population. A striking example is the distribution of the gene that permits digestion of milk sugar (lactose) in adults. High frequencies of the gene – found among northwestern European populations as well as the pastoral Fulani and Tutsi of Africa – have apparently co-evolved with the cultural practice of dairy farming and drinking raw milk over a span of a few thousands of years (Durham 1991; Sherratt 1981).

Linguistic evidence for demic expansions is based on known patterns of language evolution. When a population speaking a common language is spread over an extensive geographical area, local dialectal variations inevitably arise. After sufficient time has elapsed (thousands or tens of thousands of years) the local dialects have diverged into mutually incomprehensible tongues with no discernable resemblance. This was the situation found in the Central Valley of New Guinea. At the time of discovery by Europeans in the 1930s the various people there spoke over 700 highly differentiated languages, a pattern suggesting a long period of separate linguistic evolution (Diamond 1992).[3] Conversely,

[2]The emerging synthesis does not rule out in principle, however, the possibility of pure cultural diffusion.

[3]Sufficient similarity among the languages remains, however, that they can be classiified into a single, ancient family called Indo-Pacific (Ruhlen 1994, pp. 144–145).

resemblance among languages spoken in an area is a strong clue that the extant languages are descendants from a common ancestral tongue spoken in a relatively recent past. Resemblance among languages is symptomatic of a recent "steamroller", Diamond's (1992) term for a demic expansion that caused replacement of indigenous languages by the language of the intruders.[4]

The field of historical and comparative linguistics owes its existence to one such steamroller, the first one to be discovered. Scholars by the end of the 18th century had noted uncanny similarities in lexicon and syntax between Latin, Greek and Sanskrit. In 1786 Sir William Jones, Chief Justice of India, eventually spelled out the central hypothesis of historical linguistics, which is that the resemblances exist because these languages "have sprung from some common source, which, perhaps, no longer exists" (cited by Mallory 1989, p. 12). The hypothetical source language, spoken some 6,000 years ago, was named Proto-Indo-European (PIE). PIE is ancestral to many languages spoken from Ireland to the Indian subcontinent, and to the Tocharian languages that were spoken as far East as the Xinjiang province of China until the 10th century CE. Since then many linguistic steamrollers have been documented in different parts of the world (Diamond and Bellwood 2003).

A crucial finding of the emerging synthesis is that scenarios of demic expansions inferred from genetic and from linguistic data tend to converge. In a decisive moment of the human sciences Cavalli-Sforza et al. (1988) juxtaposed pedigrees of human populations obtained from differences in gene frequencies, on one hand, and pedigrees inferred from the grouping of languages into families and super-families, on the other (see also Cavalli-Sforza et al. 1994, p. 99, Figure 2.6.2). Despite some discrepancies (due to language replacement events) genetic and linguistic pedigrees coincide substantially, confirming the same scenario of prehistoric population movements.

Table 1: **Some Major Demic Expansions**

Time	People & Movement	Innovations / Remarks
19th–20th C	Europeans: Great Britain to Australia	discovery of Australia
16th–20th C	Europeans: Europe to Americas	transatlantic travel, discovery;"push factors" religion, poverty; disease germs
4th C BCE	Arawak (Taino) speakers: Orinoco River area to West Indies	hoe farming

Continued on next page

[4]Other linguistic processes, such as borrowings and the emergence of creole languages can also create resemblances among languages (Anttila 1989; Campbell 2004; Sherratt 1997, pp. 471–485). However comparative linguists can often tell when resemblance is caused by common descent rather than alternative processes. In a global perspective "descent with modification" from a common ancestor is by far the most important process producing similarities among languages (Ruhlen 1994, pp. 12–14).

Time	People & Movement	Innovations / Remarks
4th c BCE	Koguryo speakers: Korea to Japan	rice farming; interbreeding with Ainu-related locals
10th–6th c BCE	Greeks: Greece to Central and West Mediterranean	nautical improvements; colonization and trade
9th–6th c BCE	Phoenicians: Lebanon to West Mediterranean	nautical improvements; colonization and trade
300 BCE–2ky CE	Bantu-speakers: Nigeria-Cameroon to Central and South Africa	farming, iron smelting
4.4ky–2.8ky BCE	PIE-speakers: Pontic steppe to Europe, South Asia	horses, secondary products; Kurgan hypothesis
3.5ky–2ky BCE	Afro-Asiatic speakers: Near-East to North, East Africa	camelids, secondary products; Sherrat hypothesis
2.8ky BCE–1.5ky CE	Nomads (Magyars, Huns, Turks...): Eurasian steppe to Europe, South Asia	horses, military and social organization; plundering of farming communities
3ky BCE–1.2ky CE	Austronesian-speakers: South China to Polynesia, Madagascar	Pacific navigation, hoe farming; greatest distance covered of pre-historic expansions
8ky–4ky BCE	Neolithic farmers: Near East to Europe	hoe farming, boats; wave of advance
35–10kya	*H. s. sapiens*: Northeast Asia to America	language (?); 3 distinct expansions (?)
40–35kya	*H. s. sapiens*: West Asia to Europe	language (?)
60–40kya	*H. s. sapiens*: Africa to Australia	language (?), ability to cross sea tracts

SOURCES: Cavalli-Sforza et al. (1994, p. 112, Table 2.7.1); Diamond and Bellwood (2003)

2.3 Role of Technology

A fundamental assumption of the emerging synthesis is that demic expansions are driven by a technological advantage. Table 1 lists some major demic expansions together with the technological advance (or set of advances) that triggered them. Early human expansions such as the diaspora from Africa, displacing other hominids in some areas, may have been driven by biological advantages of modern humans. There is much speculation (but no consensus) that organizational advantage due to the ability to speak may have been the crucial asset of *Homo s. s.*. The uneven emergence of plant cultivation over the world has generated a number of expansions, including the spread of farming in Europe from the Near-East, the Bantu expansion into sub-Saharan Africa, and the Austronesian expansion from southern China eastward over the Pacific, and

westward all the way to Madagascar. These examples are among fifteen discussed by Diamond and Bellwood (2003). Other engines of expansion include advances in transportation technology such as domestication of the horse or the development of outrigger boats. I will discuss later the potentially major role in demic expansions played by the *Secondary Products Revolution* associated with animal traction applied to plow cultivation and wheeled vehicles, domestication of transport animals, and new uses of domesticated animals for milking and for wool (Sherratt 1981, 1997).

2.4 Controversies

The synthesis is very much "emerging". The degree of consensus varies according to the episode considered. There is much agreement, for example, on the the expansion of Proto-Bantu-speaking people from a homeland near the Nigeria-Cameroon border to central and southern Africa that lasted from about 300 BCE to the last century and was generated by adoption of the technologies of plant cultivation and iron metallurgy (Diamond 1999, pp. 376–401). On the other hand there is major controversy concerning the place of origin and timing of the PIE expansion, and the nature of technological advances that propelled PIE speakers over a vast expanse of the Eurasian landmass. Disagreement is considerable even though linguists have reconstructed the hypothetical proto-language itself in often exquisite details (Beekes 1995; Mallory 1989; Renfrew 1987; Watkins 2000). Thus the new paradigm is wide open for new scholarly contributions (Diamond and Bellwood 2003).

3 Lenski's Ecological-Evolutionary Theory

The time frame of the emerging synthesis, especially the 10,000 years or so since the emergence of plant cultivation, also encompasses the bulk of the evolution of human social organization and culture from the primordial hunting and gathering type to the most advanced industrial or post-industrial types. Sociologists impressed by the immense scholarship displayed by Diamond (1999) in his *Guns, Germs, and Steel* may well wonder whether their field has any role to play in this extraordinary intellectual endeavor, which has been largely in the hands of geneticists, linguists and archaeologists aided by physical anthropologists and paleobotanists. A main claim of this paper is that we (sociologists) *already have* a theory that can be readily "plugged-in" into the emerging synthesis to provide it with an explanatory mechanism linking the history of technology-driven demic expansions to trends of socio-cultural evolution. This is the ecological-evolutionary theory originally proposed by Gerhard Lenski (1966).

Revised versions of Lenski's theory, and of the ecological-evolutionary typology of human societies that constitutes its core, were published in nine successive editions of *Human Societies*, some written in collaboration with Jean Lenski and Patrick Nolan (Lenski 1970; Nolan and Lenski 2004).[5] Lenski (1994) provides

[5]Thus ideas attributed for simplicity to "Lenski" in this paper should be credited as ap-

a penetrating discussion of societal typologies, including his own (see also Barnett 2004; Lenski 2005; Nielsen 2004; Nolan 2004). The following subsections describe Lenski's ecological-evolutionary theory (hereafter EET).

3.1 Typology of Human Societies

The term "ecological-evolutionary" closely describes the principle of Lenski's typology, which is based on the combination of an evolutionary dimension of technological advance and an ecological dimension of environmental variation. The evolutionary dimension refers to the level of overall efficiency of the subsistence technology of a society. Each level on the efficiency scale is marked by the adoption of one crucial technological innovation. Thus Lenski postulates what is in effect a Gutman scale of technological innovations, such that each new innovation marking the passage to a more advanced level presupposes all the earlier innovations. In environments where plow cultivation is feasible, the sequence of societies at successive levels of the technological scale form what may be called the *main sequence* of socio-cultural evolution (although Lenski himself does not use that term). The main sequence consists of the following types:

1. *hunting-and-gathering* societies – the primordial type;
2. *simple horticultural* societies, characterized by farming using simple tools (hoe and digging stick) – appear about 8,000 BCE;
3. *advanced horticultural* societies, characterized by metallurgy of copper and bronze;
4. *simple agrarian* societies, characterized by the use of the plow – appear about 4,000 BCE;
5. *advanced agrarian* societies, characterized by iron metallurgy; and
6. *industrial* societies, characterized by the use of machines powered by inanimate forms of energy – appear about 1750 CE.

The ecological dimension is added to reflect the fact that the main sequence is limited to environments in which plow cultivation is feasible. Environments too arid for plow-based farming, or that present alternative subsistence opportunities because of proximity to large bodies of water, will support *specialized* societies based on different subsistence strategies:

7. *herding* societies subsist by herding livestock in arid environments where plant cultivation is not practical;
8. *fishing* societies subsist by fishing in environments with easy access to suitable bodies of water; and

propriate to his co-workers as well.

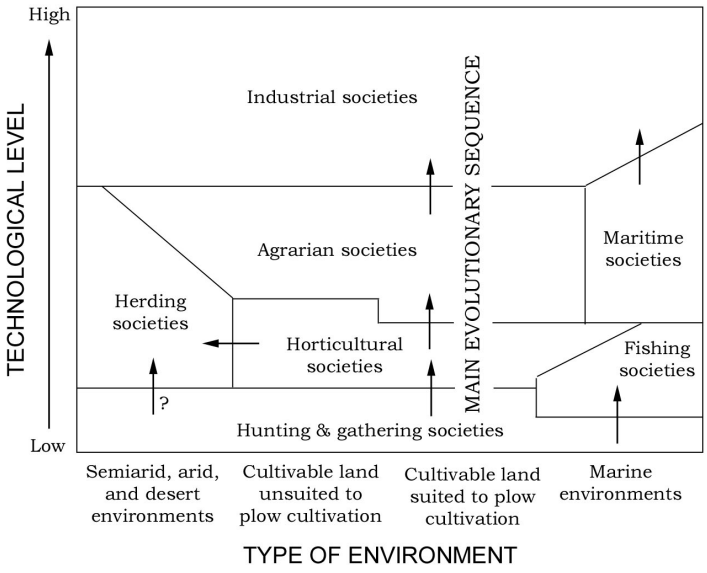

Figure 1: Typology of Human Societies

9. *maritime* societies use their proximity to large bodies of water to derive their subsistence from maritime trade.

Combining the two dimensions yields the ecological-evolutionary typology, represented in Figure 1. The figure shows the main sequence toward the center of the environmental axis, with the specialized societies symbolically situated to the left (arid environments) and right (marine environments) of the horizontal axis and spread vertically along comparable levels of technological development. In Figure 1 arrows show documented transitions between different types of societies.[6]

It is clear that Lenski considers the level of technology the primary dimension of the typology. For example in *Power and Privilege* he writes:

> The present typology is predicated on the assumption that there is an underlying continuum, in terms of which all societies can be ranked. This continuum is a measure of a society's overall technological efficiency, i.e., the value of a society's gross product in international markets divided by the human energy expended in its production. Unfortunately, this concept is not easily operationalized, and we are forced to rely on simpler and more obvious criteria for classificatory

[6]Modifications to Lenski's typology have been proposed by Blumberg (2004, pp.284–285) (dry vs. wet agrarian, rather than simple vs. advanced) and Sanderson (1999, p.90) (extensive or "long fallow" vs. intensive horticultural, rather than simple vs. advanced). Discussion of these contributions is beyond the scope of this paper.

> purposes. This is the reason for classifying societies in terms of their basic techniques of subsistence. Such data are readily available and seem highly correlated with overall technological efficiency. (Lenski 1966, p. 93)

In Lenski's thinking technological efficiency does not exhaust the effects of a particular mode of subsistence on social organization and culture. The mode of subsistence can affect society through causal paths other than efficiency of production. In the context of his work on social stratification Lenski recognizes that subsistence technology can also affect the distributive system directly by affecting "[b]asic demographic, political, and productive patterns of organization" (Lenski 1966, p. 89, Figure 2). I will expand on this point later.

3.2 Sociocultural Evolution

In Lenski's view sociocultural evolution takes place through two main mechanisms:

1. *intrasocietal selection* – the process in which a new cultural element is adopted, or an old one discarded, within a single society; examples are the disappearance of slide-rules, replaced by electronic calculators, or the spread of the corporation, based on the principle of limited liability, as the main form of business organization in 19th century Europe; and

2. *intersocietal selection* – the process in which an entire sociocultural system is destroyed following contact with another (usually more powerful) society, with or without the physical destruction of the members of the losing society; examples are the disappearance of many native American societies following expansion of Europeans into the Western frontier of North America, or the retreat of Khoisan-speaking hunter-gatherers from extensive regions of Africa before the advance of Bantu-speaking farmers.

Lenski's discussion suggests that intersocietal selection is the predominant engine of evolution: most societies that have existed have not themselves evolved, but have at some point been destroyed or absorbed by societies of a more advanced type (Nolan and Lenski 2004, pp. 56–58).[7] Moreover, evolution does not consist of the wholesale transformation of a former type into an advanced one during a short period of time, but rather of the progressive increase in the frequency of a given type among all human societies (and the percentage of the world population living in societies of that type). Lenski's mental image of the succession of societal types was originally similar to that of the succession of dominant species in the course of biological evolution, each with a cycle of expansion, dominance and extinction; this was later replaced by the picture shown in recent editions of *Human Societies* (Nolan and Lenski 2004, p. 68, Figure 4.2).

[7] Given the central role of intersocietal selection as a mechanism of social change in the EET the term "progressivism" used by (Sanderson and Alderson 2005) to describe it does not seem appropriate.

4 EET and the Emerging Synthesis

4.1 Affinities

EET and the emerging synthesis are compatible in a number of ways. First, the scenario of demic expansion that is central to the emerging synthesis and the process of intersocietal selection that underlies the EET are closely related notions. Both theories acknowledge that the encounter between two societies need not result in the physical elimination of members of the less powerful society. The EET, as a *sociological* theory, emphasizes that the encounter has consequences for sociocultural evolution when it results in the prevailing of one type of social organization and culture and the disappearance of another.

Second, both approaches agree that the principal agent of intersocietal selection or demic expansion is an element of technological superiority of the expanding society. The parallel is strong, as many of the technological innovations that are used by Lenski to distinguish societal types are also those that are identified as major engines of demic expansions in the emerging synthesis. Plant cultivation, which marks the emergence of horticultural societies in the EET, is recognized in the emerging synthesis as a powerful engine of demic expansion. Diamond and Bellwood (2003) discuss fifteen documented or suspected instances of demic expansions fuelled by farming that have had the effect of spreading the language of the farmers over vast geographical areas (see also Table 1). Other technological innovations that both differentiate societal types in the EET and are associated with demic expansions are metallurgy, the adoption of the plow, and the use of machines powered by inanimate forms of energy that marked the onset of the Industrial Revolution.

Third, both theories emphasize the role of the environment. Diamond (1999), for example, argues that the geographical orientation of the Eurasian landmass on an East-West axis, by facilitating the spread of innovation along the same latitude band, and the presence of suitable potential domesticates in the local fauna, go a long way in explaining the earlier technological development of Eurasia. For Lenski's EET features of the environment, especially rainfall level as it determines feasibility of plow cultivation versus herding, and access to bodies of water useable for fishing of for maritime trade, are also crucial in explaining mode of subsistence and hence the entire sociocultural profile of a society.[8]

The crucial contribution of EET is that it provides the sociological theory that is largely missing from the emerging synthesis. Diamond (1999, p. 268–269, Table 14.1), who does not seem to be aware of Lenski's work, appears to recognize a requirement for such a sociological theory when he adopts a version of the classification of pre-industrial societies into bands, tribes, chiefdoms and

[8] Affinities between EET and the emerging synthesis are due in part to common descent from the same intellectual roots, notably the work of archaeologist V. Gordon Childe (1936), who contributed both the emphasis on the role of subsistence technology as a determinant of social organization and the classic model of PIE expansion from the Pontic steppe (Sherratt 1997).

states proposed by Service (1962, 1975). From the point of view of a materialist approach to explaining social organization a disadvantage of Service's typology, and the related one of Fried (1967), is that they are based on aspects of the social structure that are dependent outcomes. Subsistence technology, by contrast, pertains to the material infrastructure of society and has a better claim as an explanatory factor. As Lenski (1994) has persuasively argued, the power of subsistence technology as a basis for societal classification is that it is the most important *independent variable* (i.e., causal factor) affecting other structural or superstructural features of society. The typologies of Service and Fried, being based on a dependent structural outcome, are descriptive rather than explicative. Thus Lenski's typology is inherently more compatible than Service's with the technological approach to socio-cultural evolution emphasized by Diamond (1999).

4.2 Typology and History

The EET and the emerging synthesis have obvious elective affinities, but marrying the two approaches is not without problems. An inherent feature of Lenski's EET is a tension concerning the relative causal importance of the ecological and technological dimension. Important theoretical articulations of the EET emphasize the technological dimension. Examples are explanations in terms of surplus. A typical argument is that more advanced subsistence technology begets increased productivity of labor and a greater surplus, which begets greater social complexity (division of labor) and deeper social hierarchies, resulting in higher levels of social inequality. There is a temptation to over-emphasize the technological dimension relative to the ecological one, to the point of reducing Lenski's scheme to one of technological determinism (Sanderson and Alderson 2005). Over-emphasis on the technological dimension entails a neglect of the specialized societies (fishing, maritime and herding societies). As these societies cannot be unambiguously inserted within the unidimensional technological ordering of the main sequence (hunting and gathering, horticultural, agrarian), they are simply ignored. It is important to note that Lenski had, at the outset, allowed the ecological dimension to play an independent role in the explanation of organizational and cultural features of a society (Lenski 1966, p. 89, Figure 2). I will argue later that to better adapt the EET to the emerging synthesis (notably in recognizing a broader impact of the Secondary Products Revolution) it is necessary to give the ecological dimension a proper emphasis.

A second issue has to do with the relationship between typological and historical approaches. As he is a sociologist, Lenski's strategy is appropriately typological and nomothetic. The ecological-evolutionary typology of societies distills the dimensions of technological advance and the nature of the environment and is meant to constitute the main independent variable in predicting patterns of variation in social organization and culture among societies. This orientation is expressly recognized by Lenski, who compares the technological basis of his typology with the genetic basis of the modern (cladistic) classification of species in biological systematics (Lenski 1994). The typological approach necessarily

entails a loss of historical specificity. Societies that are classified into the corresponding societal types on the abstract basis of their subsistence technology are necessarily stripped of much of their historical idiosyncrasy. By contrast, the focus of the emerging synthesis is inherently historical (in a broad sense). Researchers piecing together archaeological, genetic, linguistic and other clues left over by a demic expansion are attempting to reconstruct a specific historical event and its consequences (genetic, linguistics, and cultural) for daughter populations. One could argue that the pictures painted by Lenski's *Human Societies*, on one hand, and Diamond's *Guns, Germs and Steel*, on the other, are largely the same, the difference between the two being largely a matter of emphasis. Diamond's emphasis is historical, naming people and places; Lenski's is typological and theoretical.

4.3 The Secondary Products Revolution

Both contrasts – the roles of technological efficiency versus specific environment-related aspects of subsistence technology, and nomothetic versus historical approaches – come to the fore in relating the EET to an important episode in sociocultural evolution termed the Secondary Products Revolution (Sherratt 1981, 1997). Lenski's EET, following V. Gordon Childe, associates the emergence of agrarian societies such as Sumer and ancient Egypt with the use of the plow (Childe 1936). By allowing the use of animal power the plow ushered in a vast increase in productivity of human labor and made possible a larger surplus, which was used in turn to support a deeper system of exploitation (facilitated by religious ideology) as well as the diversification of specialized crafts, urban growth, and professional armies. Childe (1936), emphasizing the emergence of towns as a result of the agrarian transition, also used the term Urban Revolution. In Lenski's scheme the distinction between agrarian and herding societies reflects different strategies of adaptation to physical environments that differ markedly in their suitability for plow cultivation as contrasted with the raising of livestock. A sharp distinction is made between the two types.

A more complex scenario of the agrarian transition has emerged from recent archaeological research. The new perspective holds that the transition that took place *c.* 4,000 to 3,500 BCE in a broad area centered on the Near-East involved a number of major technological developments in addition to the plow. Sherratt (1981) has named this episode the *Secondary Products Revolution of the Old World* (hereafter SPR). He envisions it as the deployment of an entire package of technological innovations. For Sherrat the primary innovation was the technology of animal traction (using a pair of yoked oxen), which was applied to the plow but also to pulling wheeled vehicles. Other essential innovations were the ability to obtain food by milking (including development of milking techniques, preservation of milk into yogurt and cheese, and biological evolution in some human populations of the genetic ability of adults to digest lactose), the development of a breed of sheep whose wool was suitable for spinning, and the domestication of pack- and transport animals (camelids and equids depending on the region, notably horses).

An important aspect of the new understanding is that the technological package of the SPR ushered in *both* plow-based agriculture (i.e., from Lenski's point of view, the emergence of agrarian societies) *and* subsistence based on herding (i.e., the emergence of herding societies). Agriculture and herding are twin technologies, not independent adaptations to different environments. Historically diffusion of SPR technology to Europe after 3,500 BCE allowed more extensive raising of livestock and expansion of settlements away from narrow alluvial plains where they had been confined; to the East SPR technology allowed human exploitation of the steppe. The SPR made possible the simultaneous exploitation of agricultural and herding niches in the environment, thereby increasing the potential range of a society.[9] This view suggests that ideal-typical agrarian and herding societies be conceptualized as the two specialized ends of a continuous range of mixed agrarian-herding subsistence, rather than as two distinct societal types based on radically different subsistence strategies. Despite the independent development of plant cultivation in the New World, the SPR did not take place there. Thus the SPR represents a major step in the rise of Eurasia to technological prominence relative to other areas of the world (Diamond 1999).[10]

What are the implications for the EET? The SPR undermines the theoretical appeal of a *categorical* distinction between agrarian and herding societies, since both lifestyles are based on the same technological package related to harnessing animal energy for human subsistence, and both can contribute to a mix of subsistence strategies within a single society. The distinction may be reconceptualized by viewing both types of societies as members of the same category of *secondary products* societies; within this category societies can be characterized continuously according to the mix of subsistence they derive from herding and from plow-based agriculture. In the next section I examine the distribution of subsistence strategies among secondary products societies and show that some societal characteristics can be independently associated with each of the two variables: membership in the category of secondary products societies, on one hand, and proportion of subsistence derived from herding, on the other. Some features of social organization or culture are most sensitive to the technological jump represented by the secondary products package; others are specifically related to the mix of subsistence strategies, as measured by the proportion of subsistence derived from herding.

[9] As Sherratt (1981) notes the SPR thereby laid the foundations for polyethnic societies based on specialized exploitation of different ecological niches, as described by Barth (1969).

[10] Pre-Columbian America knew the concept of the wheel, as shown by finds of wheeled models (toys). The failure to apply the technology to transportation seems due to the absence of suitable animal domesticates (Sherratt 1981).

5 A Modified Typology of Societies and Empirical Illustrations

5.1 Modified Typology

Given the way it is constructed, categories of Lenski's ecological-evolutionary typology correspond to *ideal types* representing pure strategies of subsistence. In this form it is highly suitable for theorizing about features of social organization and culture associated with different subsistence technologies. For empirical investigation of associations between subsistence technology and other societal characteristics categorical distinctions among societal types may be less useful. One may wish to better utilize the information inherent in the fact that many societies use a *mix* of subsistence technologies. Theoretical explanations based on subsistence technology are of two types. One type of explanations used by Lenski and other researchers – notably explanations based on the notion of *surplus* – involves the general level of productive efficiency entailed by a given subsistence technology. For example, one would expect that greater productivity of human labor (perhaps due to the harnessing of animal power) entails a larger surplus, and thus both greater diversification of social roles and greater inequality. Another type of explanations emphasizes more specific features of the mode of subsistence net of (i.e., controlling for) the overall level of productivity associated with the technology. For example, militaristic and hierarchical tendencies in a herding society might be enhanced by the vulnerability of herds to raiding and subsequent emphasis on military power, independently of the effect of herding technology on size of the surplus.

In view of the previous discussion of the SPR as having paved the way for both the agrarian and herding lifestyles, it is particulary desirable to distinguish between general technological and subsistence-specific effects in comparing agrarian and herding societies. To separate these two types of explanation one can reformulate the typological distinction between agrarian and herding for purposes of empirical analysis with two variables: (1) a secondary products indicator that has value one for both agrarian and herding societies (and zero otherwise) and marks adoption of the technological package of the SPR, and (2) a variable with continuous values between zero and one that measures proportion of total subsistence that is derived from herding. In a regression context, when both variables are included among the independent variables, the secondary products indicator captures the effect on the dependent outcome of the greater overall level of technological efficiency entailed by the SPR package, while proportion herding captures any *specific* effect of herding subsistence as opposed to plow-based farming.

5.2 Data and Methods

Following Nolan and Lenski (2004) I use cross-cultural data from *Ethnographic Atlas* (hereafter *EA*) (Murdock 1967; Gray 1998) and *Standard Cross Cutural*

Sample (hereafter *SS*) (Murdock and White 1969; Divale 2000).[11] From the beginning of cross-cultural research a dominant methodological preoccupation has been Galton's Problem, the issue of the independence of observations in samples of societies.[12] As Gaulin and Boster (1997b, p. 373) aptly summarizes the issue "Societies, typically treated as separate cases in cross-cultural research, have histories of interaction. If interaction causes the joint diffusion of sets of traits, then the resultant statistical association between traits within such sets might be mistaken for a functional relationship.". The literature on Galton's Problem has traditionally been marked by a statistical emphasis, focusing on the threat to the validity of inference (Murdock 1967). Galton's Problem was a principal consideration in the design of the *SS* by first grouping contiguous societies with similar cultures in the *EA* into clusters, further aggregating similar clusters into more inclusive "distinctive world areas", and selecting one society from each area (typically the best documented one) to maximize the statistical independence of the cases (Murdock and White 1969). More recent approaches reject statistically-oriented solutions and emphasize the substantive role of historical interactions among societies, even claiming that non-independence of cases can be a methodological asset rather than a problem (Ember and Ember 1998, 2001; White et al. Forthcoming).

The concern with independence of cases in cross-cultural data sets is closely associated with a functional interpretation of sociocultural evolution that views associations among traits as resulting from the mutual adjustment and functional integration of traits over time within cultures (Murdock and White 1969). In this functional view only associations resulting from the independent evolution of the same combination of traits in isolated societies are considered valid (non-spurious). The functional perspective is enlightened by analogy with the biological theory of evolution. A trait or association of traits that results from independent adaptation and mutual adjustment of traits within a single society is analogous to a trait or an association of traits in biological species that results from *convergent evolution*. Convergent evolution is the process by which similar characters evolve independently in two species (such as fins and a hydrodynamic shape in both fishes and aquatic mammals such as dolphins), without being present in a common ancestor of these species. The insistence of the functional approach on independent evolution is equivalent to a requirement that an association between traits, to be truly causal, must be the result of convergent evolution, rather than diffusion or common descent. Diffusion or common descent can create an association between traits and thus the appearance of a functional relationship where none exists. Associations among traits produced by cultural diffusion or by cultural descent from a common origin are viewed as

[11] Codebooks and data sets are distributed by the electronic journal *World Cultures* at http://eclectic.ss.uci.edu/∼drwhite/worldcul/world.htm.

[12] The problem was so named because it was formulated for the first time in 1888 by polymath genius Francis Galton in comments on a presentation by Edward B. Tylor of results of what seems to be the first cross-cultural research project (Tylor 1889). The issue raised by Galton has paralyzed cross-cultural research for decades until a mid-20th century renaissance associated with the work of Murdock (Ember and Ember 2001; Murdock 1967; White et al. Forthcoming).

spurious in the functional perspective (Mace and Pagel 1997). This is the motive underlying concern for independence of cases in the design of cross-cultural samples such as the *SS* (Murdock and White 1969).

The issue of non-independence of cases plays a very different role as a potential threat to inference in the perspective of the emerging synthesis, which emphasizes demic expansions as an agent of cultural change, than in a functional perspective. A requirement of independence of cases is inconsistent with an evolutionary prespective that attributes a major role to inter-societal selection in socio-cultural evolution. By analogy, strict application of the functional criterion of independence of cases (no common descent allowed) to biological evolution would have absurd implications: one would have to reject the notion that the fins of bony fishes are an adaptation to a swimming lifestyle, because any sample of bony fishes is composed of descendants from a common ancestor and is thus "contaminated" by Galton's Problem.[13] On the contrary, the central methodological problem of evolutionary taxonomy is distinguishing between resemblances that are truly due to descent from a common ancestor and *spurious* ones that are due to convergent evolution (Ridley 1996).

In the aftermath of a demic expansion a certain combination of traits present in the ancestral culture can be "replicated" among daughter societies spawned by the expansion, creating or amplifying the original association between the traits. This replication effect takes place even though the particular combination of traits may be contingent (non-functional) in the ancestral culture. For example, speaking a Bantu language and the practices of hoe-farming and metallurgy may be associated among peoples of Africa because of the historical Bantu expansion, even though no one would seriously maintain that Bantu-speaking is *functionally* associated with either hoe-farming or metallurgy (Gaulin and Boster 1997a,b; Mace and Pagel 1997). An association between technology and language, however, can be an important clue to an ancient demic expansion that produced daughter societies using the technology and speaking a language derived from the same ancestral tongue.

As a practical strategy in this paper I adopt the simple method, suggested by Gaulin and Boster (1997a), of comparing results of the same analyses using *Ethnographic Atlas* and *Standard Sample*. A significant association in the *SS* suggests that the relationship is functional, since cases in that data set are selected to maximize independence (Murdock and White 1969). Significance in the *EA*, a larger set less carefully selected for independence, but not in the *SS*, indicates that the association may be at least in part non-functional, perhaps the result of common cultural descent resulting from an earlier demic expansion, or other forms of inter-societal interaction such as diffusion. The point is that such historical (rather than functional) relationships among traits are not considered spurious but of central interest, as they may reveal ancient episodes of inter-

[13] An exact analogue in cultural evolution is alphabetic writing. It is believed that true alphabetic writing evolved independently only once in human history, in Canaan about 1700 BCE among speakers of West Semitic languages (Diamond 1999, pp. 195–238). All later alphabets are derived from that single cultural innovation. Strict application of the independence criterion would reduce the sample to only one case.

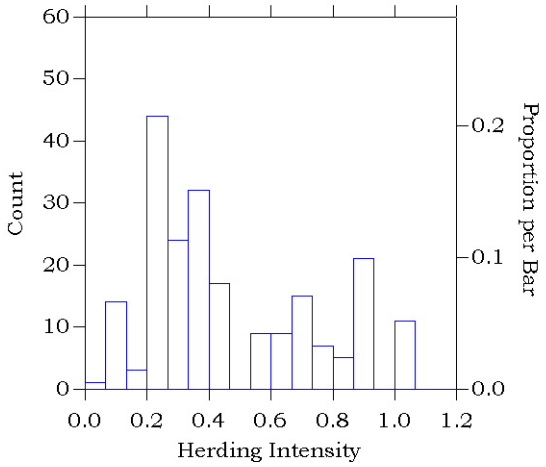

Figure 2: Distribution of Herding Intensity in Secondary Products Societies (*EA* Data)

societal selection. I will present analyses using the *SS* in the main text; tables with the *EA* results are presented in appendix.

Figure 2 shows that there is substantial variation in proportion herding among secondary products societies. In the rest of this section I will compare regression and logistic regression models of various societal characteristics using Lenski's original typology, on one hand, and the modified typology in which the agrarian and herding categories are replaced by the secondary products indicator and a continuous variable representing herding as a proportion of total subsistence, on the other. The modified typology will be useful to the extent that it distinguishes better between effects of the general level of technological advance (represented by the coefficient of the secondary products indicator) and of herding subsistence specifically (represented by proportion herding).

5.3 Political Hierarchy and Class Stratification

The left panel of Table 2 shows mean levels of jurisdictional hierarchy beyond the local community by type of society according to Lenski's classic ecological-evolutionary typology.[14] Jurisdictional hierarchy is measured as the number of jurisdictional levels beyond the local community, from 0 levels (corresponding to politically autonomous societies) to a maximum of 4 levels (corresponding

[14]One cannot distinguish between simple and advanced agrarian, or identify maritime societies, with *Ethnographic Atlas* data, so these categories are omitted. I have reordered the categories to place fishing societies in between hunting and gathering and simple horticultural ones, as fishing subsistence may be viewed in many way as a specialized form of foraging.

Table 2: **Jurisdictional Hierarchy Beyond the Local Community by Type of Society** (*SS* Data, $N = 158$)

Mean by Type of Society			OLS Regression[a]		
Category	Mean	N	Variable	Coef[b]	StdCoef
HuntGath	1.111	27	Constant	1.111^{***}	—
Fishing	1.273	11	Fishing	0.162	.032
SimpHort	1.686	35	SimpHort	0.575^{*}	.184
AdvHort	2.475	40	AdvHort	1.364^{***}	.458
Agrarian	3.690	29	SecProd	3.387^{***}	1.182
Herding	2.125	16	PropHerd	-2.663^{***}	−0.587
Total	2.171	158	$R^2 = .469$ vs. .447[c]		

[a] On modified typology with Agrarian and Herding categories replaced with Secondary Products category and Proportion Herding. HuntGath is omitted category. Jurisdictional hierarchy beyond local community is *ss* V237 coded 1 (0 levels beyond community) to 5 (4 levels)

[b] $^{*}p < .05$ $^{**}p < .01$ $^{***}p < .001$ (two-tailed tests)

[c] R^2 for OLS regression using original typology

to large states). Because the dependent variable is an interval scale I use comparison of means and OLS regression as methods of analysis. The sequence of means indicates a monotonous increase in hierarchy from hunting and gathering (1.111) to agrarian types (3.690). Hierarchy dips for herding societies (2.125), compared to agrarian. The OLS regression in the right panel of the table interprets the contrast between agrarian and herding societies in a somewhat different way. Here the secondary products indicator is associated with a large increase in hierarchy (3.387), and proportion herding with a significant *decrease* in hierarchy (-2.663). Both coefficients are highly significant. The implication is that the secondary products level entails a substantially deeper jurisdictional hierarchy, but herding activities, perhaps because of the associated mobility of communities, tend to inhibit this hierarchical trend. This pattern is confirmed in the *EA* data (Table 8).

More advanced levels of subsistence technology are classically associated with the emergence of class distinctions. Table 3 (left panel) shows the percentage of societies of each type in which social classes are present (Murdock 1967, p. 57). There is a monotonic trend of increasing stratification following the sequence hunting and gathering, simple horticultural, advanced horticultural, and agrarian types. Fishing societies are much more likely to have class distinctions (72.7%), compared to foraging and simple horticultural societies, presumably because of the greater abundance and stability of resources entailed by fishing subsistence. The percentage is highest for agrarian (93.5%) and herding (81.2%) societies. The right panel of Table 3 shows the logistic regression of presence of class stratification (coded 1) as opposed to its absence (coded 0) on

Table 3: **Presence of Social Classes by Type of Society** (*SS* Data, $N = 160$)

Distribution by Type of Society			Logistic Regression[a]		
Category	Percent	N	Variable	Coef[b]	OddsRat
HuntGath	7.4	27	Constant	-2.526^{***}	—
Fishing	72.7	11	Fishing	3.507^{***}	33.333
SimpHort	48.6	35	SimpHort	2.469^{**}	11.806
AdvHort	75.0	40	AdvHort	3.624^{***}	37.500
Agrarian	93.5	31	SecProd	5.830^{***}	340.313
Herding	81.2	16	PropHerd	0.132	0.132
Total	61.9	160	McFadden's $\rho^2 = .292$ vs. .291[c]		

[a] On modified typology with Agrarian and Herding categories replaced with Secondary Products category and Proportion Herding. HuntGath is omitted category. Presence of social classes is coded 0 if *SS* V270 is 1 (absence of class stratification among freemen); 1 otherwise

[b] $^{*}p < .05 \quad ^{**}p < .01 \quad ^{***}p < .001$ (two-tailed tests)

[c] McFadden's ρ^2 for logistic regression using original typology

the modified typology, in which the secondary products indicator and proportion herding replace the agrarian and herding indicators of the classic typology. The logistic regression coefficients largely confirm the ordering of percentages in the left panel of the table. The secondary products indicator has a large and highly significant positive coefficient, suggesting that the formation of social classes is associated with the technological package of the SPR, while the non-significant coefficent for proportion herding indicates that class formation is not substantially affected by specialization of a society in herding as opposed to plow cultivation. McFadden's ρ^2, a pseudo-R^2 measure of model fit that is considered conservative, is .292, indicating a high degree of fit similar to that of the original EET (.291). A similar pattern is found in the *EA* data (Table 9).

5.4 Male Centrality

Sherratt (1981) discusses two aspects of social organization that were profoundly affected by the advent of secondary products technology. One aspect is the increased importance of inheritance rules entailed by the growing values of real property and herds. Another aspect is the relative position of the sexes. In both agrarian and herding variants of secondary products societies men occupy a more central role in primary subsistence (food) production. In agrarian societies men take over plow-based farming, perhaps because of the new physical demands of plow cultivation and the involvement of large animals for traction. Women's activities become more focused on the domestic sphere and on manufacturing activities using some of the new animal products, such as spinning and weaving

Table 4: **Female Participation in Food Production by Type of Society** (*SS* Data, $N = 111$)

Mean by Type of Society			OLS Regression[a]		
Category	Mean	N	Variable	Coef[b]	StdCoef
HuntGath	2.996	23	Constant	2.996^{***}	—
Fishing	2.217	9	Fishing	-0.779	$-.225$
SimpHort	3.102	22	SimpHort	0.107	.045
AdvHort	3.177	23	AdvHort	0.182	.078
Agrarian	2.273	24	SecProd	-0.713^{*}	$-.348$
Herding	2.250	10	PropHerd	-0.035	$-.011$
Total	2.774	111	$R^2 = .190$ vs. .190[c]		

[a] On modified typology with Agrarian and Herding categories replaced with Secondary Products category and Proportion Herding. HuntGath is omitted category. Female participation in food production is calculated from *SS* V203 to V207 and V260 to V264 (see text for details)

[b] $^{*}p < .05 \quad ^{**}p < .01 \quad ^{***}p < .001$ (two-tailed tests)

[c] R^2 for OLS regression using original typology

textiles made of wool. In herding societies the central role of males in subsistence may be further magnified by the importance of livestock, which can be raided and must be defended, leading to frequent warfare (Nolan and Lenski 2004).[15]

Table 4 shows a score of participation of women in primary subsistence (food production) calculated as the average score of female participation (relative to male participation) in five subsistence activities (gathering, hunting, fishing including the pursuit of sea mammals, animal husbandry, agriculture), with each participation score weighted by the proportion of total subsistence of a society contributed by the activity. Female participation in an activity is assigned a score of 1 if there is complete male monopoly of the activity to 6 if there is complete female monopoly. A low score corresponds to greater proportional participation by men in subsistence production, a high score to greater participation by women. Table 4 (left panel) shows that the lowest degree of female participation in subsistence corresponds to fishing societies. Female participation is high in hunting and gathering societies (where in warm climates gathering typically produces a larger share of total caloric intake than hunting), and in simple and advanced horticultural societies where women do much of the planting, cultivating, and harvesting of crops. Male role clearly becomes more prominent in agrarian and herding societies. The regression results in the right panel of Table 4 partially confirm these patterns. The coefficient of the secondary products indicator is negative and significant, indicating decreased female participation in subsistence. The non significant coefficient of proportion

[15] On the relations between sex stratification and subsistence technology see Blumberg (1978, 2004); Chafetz (1984, 2004); Collins et al. (1993).

Table 5: **Patrilineal Descent by Type of Society** (*SS* Data, $N = 160$)

Distribution by Type of Society			Logistic Regression[a]		
Category	Percent	N	Variable	Coef[b]	OddsRat
HuntGath	14.8	27	Constant	-1.749^{***}	—
Fishing	9.1	11	Fishing	$-.553$	.575
SimpHort	25.7	35	SimpHort	.688	1.990
AdvHort	45.0	40	AdvHort	1.549^{*}	4.705
Agrarian	51.6	31	SecProd	1.829^{*}	6.227
Herding	50.0	16	PropHerd	.074	.929
Total	35.0	160	McFadden's $\rho^2 = .086$ vs. .086[c]		

[a] On modified typology with Agrarian and Herding categories replaced with Secondary Products category and Proportion Herding. HuntGath is omitted category. Patrilineal descent is coded 1 if *SS* V247=1; 0 otherwise

[b] $^{*}p < .05 \quad ^{**}p < .01 \quad ^{***}p < .001$ (two-tailed tests)

[c] McFadden's ρ^2 for logistic regression using original typology

herding indicates that, within secondary products societies, greater dependence on herding is not associated with reduced female participation in subsistence. The coefficient for fishing society is negative (in the expected direction) but non significant, perhaps because of the small number of fishing societies in the *SS*. Results for the *EA* (Table 10) are similar, except that the coefficient for the fishing society indicator is highly significant in this larger data set.

Another clue to the position of the sexes is the predominant (patrilineal versus matrilineal) mode of descent. According to an influenctial hypothesis called the *main sequence theory of kinship*[16] features of the kinship system are related in a causal chain such that subsistence technology affects patterns of marital residence, which in turn affect the form of descent, which finally entails adjustments in kinship terminology (Levinson and Malone 1980). In horticultural societies based on hoe farming women play a central role in planting, cultivating and harvesting. Correspondly there is a greater prevalence of matrilineal inheritance in horticultural societies than in any other type of society (Keesing 1975; Nolan and Lenski 2004). Table 5 shows the percentage of societies with patrilineal descent by type of society. Patrilineal descent is taken to be an indicator of the centrality of males in society (or patriarchy). The classic argument is that greater association of males with the means of production (fields and herds) in secondary products societies strengthens the motivation to establish descent through the male line. Patrilineal descent is relatively less frequent in hunting and gathering and simple horticultural societies, consistent with the less central role of males in subsistence in these societies. Percentages are higher in both

[16] The term "main sequence" is used in this context in a sense different from that in Figure 1.

agrarian (51.6%) and herding societies (50.0%). Curiously, the percentage for advanced horticultural societies (45.0%) is only slightly lower than for agrarian and herding, contrary to the expectation that horticutural societies, even the advanced type, would be substantially more oriented toward matrilineal filiation because of the greater role of women in production. The low percentage (9.1%) for fishing societies is surprising given the reduced role of women in food production in these societies, but the figure is supported by only 11 cases.

The logistic regression of patrilineality on the modified typology is shown in the right panel of Table 5. The coefficient of secondary products is significant, indicating an overall tendency to patrilineality for secondary products societies. However proportion herding is not associated with a greater propensity to patrilineality, as indicated by the non-significant coefficient. In other words the herding lifestyle, despite the central role of men in handling livestock and the importance of military activities, does not seem to be associated with greater male centrality (at least as indicated by a preference for patrilineal descent) beyond the association entailed by secondary products subsistence. Parallel analyses with the EA (Table 11), however, show a higher percentage of patrilineality for herding societies (79.7%) and a highly significant effect of proportion herding in the logistic regression. The larger set of 74 herding societies in the *EA*, compared to the 16 in the *SS*, may be a reason for the discrepancy.[17]

A related pattern (not shown in this paper) links the use of land to rules of inheritance of real property. The expectation is that more intensive and more permanent cultivation of land, by making real property more valuable, should be associated with more explicit rules of inheritance. There is a relationship between type of society and the rules of inheritance of real property, so that over 90% of both advanced horticultural and agrarian societies have inheritance rules while the percentage for herding is lower, around 70% (Nolan and Lenski 2004). The complex interrelationships between subsistence technology, marital residence, property transfers at marriage and inheritance rules are discussed in detail by Goody (1969, 1976).

5.5 Religious Beliefs

Today's "historic" religions – faiths such as Buddhism, Chistianity and Islam – are characterized by a universalistic scope and often monotheistic beliefs and have all emerged during the advanced agrarian era (Nolan and Lenski 2004, pp. 169–172). It is tempting to relate the success of these religions in an agrarian environment to the political convenience of their universalistic doctrine in the context of large and ethnically heterogeneous agrarian empires. Universalism would have been utilized by rulers as a means of unifying a population with diverse languages and customs. Another conspicuous characteristic of religions in the Judaeo-Christian and Moslem tradition is the pervading pastoral

[17] Another reason may be that the association between herding intensity and patrilineality is largely due to common descent or joint cultural diffusion, rather than convergence (functional adjustment), and is thus less likely to appear in the *SS* where independence of cases is optimized.

Table 6: **Score of Belief in a High God Who is Active and Supports Human Morality by Type of Society** (*SS* Data, $N = 143$)

Mean by Type of Society			OLS Regression[a]		
Category	Mean	N	Variable	Coef[b]	StdCoef
HuntGath	1.640	25	Constant	1.640^{***}	—
Fishing	1.600	10	Fishing	$-.040$	$-.008$
SimpHort	1.815	27	SimpHort	.175	.057
AdvHort	2.270	37	AdvHort	$.630^{*}$	.228
Agrarian	2.700	30	SecProd	.607	.232
Herding	3.357	14	PropHerd	1.355^{*}	.315
Total	2.224	143	$R^2 = .216$ vs. .200[c]		

[a] On modified typology with Agrarian and Herding categories replaced with Secondary Products category and Proportion Herding. HuntGath is omitted category. Belief score is *SS* V238 coded 1 (high god absent or not reported in substantial descriptions of religious beliefs), 2 (high god present but inactive or not concerned with human affairs), 3 (high god present and active in human affairs but not offering positive support to human morality), and 4 (high god present, active, and specifically supportive of human morality); "high god" defined after Swanson (1960) (see text)

[b] $^{*}p < .05$ $^{**}p < .01$ $^{***}p < .001$ (two-tailed tests)

[c] R^2 for OLS regression using original typology

symbolism – images of the shepherd and his flock, and of sacrificial lambs – suggesting a more than casual affinity with the herding lifestyle. Is there a contradiction between these agrarian roots and herding imagery? The notion of secondary products societies, enacting the package of innovations that fostered both agrarian and herding subsistence strategies, offers a resolution of the apparent contradiction. One can speculate that universal religions are ideological products of the SPR and would therefore show affinities with both agrarian and herding derived types.

Ethnographic Atlas codes religious beliefs according to the presence of a high god, defined, following Swanson (1960), as "a spiritual being who is believed to have created all reality and/or to be its ultimate governor, even though his sole act was to create other spirits who, in turn, created or control the natural world" (Murdock 1967, p. 52). Table 6 (left panel) shows the mean score of belief in a high god by type of society. Belief in a high god is coded 1 to 4 according to increasing degree of high god activity in human affairs and support for human morality (see note in Table 6). Agrarian and herding types have the largest mean scores (2.70 and 3.36), confirming the expected association. The regression coefficients associated with the modified typology are shown in the right panel

of Table 6. The fit of the model, as measured by the R^2, is slightly better for the modified typology than for the classic one (.216 versus .200), suggesting that incorporating information on proportion of subsistence derived from herding (given that a society belongs to the secondary products category) improves prediction relative to categorizing societies into agrarian and herding types. However the coefficient for the secondary products indicator is non significant in Table 6. *EA* data (Table 12) better supports the hypothesis, with highly significant coefficients for both secondary products and proportion herding. The regression with *EA* data more clearly decomposes the affinity of agrarian and herding societies for monotheism into two effects: a significant positive effect of the secondary products indicator and an independent, additional positive effect of herding subsistence.

6 Secondary Products and Indo-European Expansions

The notion of the SPR is intimately related to the classic historical and linguistic problem of Indo-European origins and the nature of Indo-European expansions. There are currently two contending theories. One theory holds that the PIE languages diffused over Europe in the wake of the Neolithic Revolution that also brought plant cultivation to these areas, beginning in 6,500 BCE. In that view, the PIE homeland is situated in Anatolia (Eastern Turkey) and early farmers brought the language with them in their westward wave of advance (Renfrew 1987).[18] When archaeologist Colin Renfrew published this theory, it immediately acquired an enthusiastic following. Underlying the appeal of the theory is an implicit syllogism. As the PIE daughter languages are spread over such an immense area, the PIE expansion must have been truly massive. Such a massive expansion needs a "big" cause. The Neolithic Revolution that led to the diffusion of plant cultivation is such a powerful cause, producing demic expansions documented in other areas of the world (Diamond and Bellwood 2003). Thus PIE expansions must have been driven by the Neolithic Revolution. This logic is of course less than compelling (Mallory 1989; Diamond 1992; Beekes 1995).

The main alternative theory is the classical *Kurgan* model (named after the Russian word for the burial barrows characteristic of the steppe cultures) according to which Indo-European expansions took place in the 4th or 3d millenium BCE – some three or four millenia later than Renfrew postulates – from a homeland situated North of the Black Sea in modern Ukraine or further East in the Caspian area. The engine of this later expansion would have been the technological innovations of the SPR, including the use of wheeled vehicles, with a central role played by the domestication and riding of horses (Childe 1936; Gimbutas 1997; Mallory 1989; Diamond 1992, pp. 249–275). One important body of evidence supporting the Kurgan model is provided by *linguistic paleontology*, a term referring to the reconstruction of prehistoric Indo-European

[18] Renfrew also discusses the Indo-European expansion East into the Indian sub-continent.

society and culture on the basis of the reconstructed PIE lexicon.[19] The basic principle of linguistic paleontology is that if PIE had a term in the reconstructed lexicon for a specific object, then PIE speakers must have been familiar with it. Table 7 lists reconstructed PIE roots or words pertaining to subsistence technology. To motivate the reconstructed terms, reflexes in daughter languages are also shown, with an emphasis on words that have found their way into English (directly through the Germanic heritage of English or through Latin or other filiations). Table 7 uses a conservative approach, including only terms attested in both Western and Eastern branches of the Indo-European languages (for example in Germanic and Sanskrit), so they cannot be terms borrowed more recently from substrate languages encountered during expansion (Huld 1997).

Table 7: **PIE Subsistence Terms**

Reconstructed Subsistence Terms & Reflexes
Domesticated Plants
'field' *Aeǵros > L ager; E ACRE
'to sow' *seE- > E SOW, SEED;
'seed' *seE-mn̥- > L sēmen > E SEMEN
'domestic plant, herb' *se-sE-i̯o-s
'grain, perhaps spelt or barley' *i̯eu̯-o-s
'barley' *g^{h}r̥s-d > OHG gersta
'ripened (grain)' *gr̥A-nom > L grānum > E GRAIN; E CORN
'barley' *b^{h}ar-s- > L far, OE bere > E BARLEY
'vetch' *k̂i/e-k̂r-o-s > L cicer
'grind' *mel- > L molĕre > E MILL, MILLER; OE melu > E MEAL ('ground grain')
'quern, hand mill' *g^{w}(e)rAn- > OE cweorn > E QUERN
Domesticated Animals
'dog' k̂uon- > L canis, OE hund > E HOUND
'livestock' *pek̂u- > L pecū, OE feoh > E FEE
'sheep, ewe' *Hou̯i- > L ovis, OE eowe > E EWE
'ram' *moiso-
'lamb' *u̯r̥-en-, *Hag$^{w(h)}$-nos > L agnus, OE eanian 'to lamb'
'kid' qapro- > L caper, OE haefer
'sow, swine' *suH- > L sus, OE sū; E SOW, SWINE
'piglet, farrow' *pork̂-o-s > L porcus > E PORK; OE fearh > E FARROW
'cow' *g^{w}ou-s > L bōs > E BOVINE; OE cū > E COW
'bull' (intact male) *Hug^{w}-sen > OE oxa > E OX
'steer' (castrated male) *steuH-ro-s > OE stēor > E STEER
'calf' (immature female) *u̯ak̂- > L vacca

Continued on next page

[19] The term *linguistic prehistory* is also used (Campbell 2004).

Reconstructed Subsistence Terms & Reflexes

'horse' *Eek̂uo-s > L equus, G hippos, OE eoh
'mare, colt' *pl̥-/*pōl-n-i̯eA > L pullus; OE fola > E FOAL; ON fyllja > E FILLY

Traction & Transport Technology
'plow' *HarΩ-trom > L arātrum; 'to plow' *HarΩ- > OE erian
'yoke' *i̯ug^{w}o-m > L iugum; E YOKE; root *i̯eug- > S yogah 'union, joining' > E YOGA
'mount' *steig^{h} > PG *stigan 'climb' > E STIRRUP
'wheel' *k^{w}ek^{w}lo-s > OE hwēol > E WHEEL; G kuklos > E CYCLE
'wheel' or 'wheel and axle assembly' *rot-A- > L rota > E ROTATE, ROUND; OI ratha 'chariot'
'hub' *nob^{h}-eA > OE nafu > E NAVE ('hub of a wheel'), NAVEL
'axle' *Hăk̂s- > L axis; OE eax; derivative *Hăk̂s-le-A > E AXLE
'transport' *u̯eg^{h}(H)- > L veho; derivative *u̯eg^{h}H-tlo-m 'vehicle' > L vehiculum > E VEHICLE; ON vagn > E WAGON; E WAIN ('wagon')

Wool & Milk Products
'wool' *Hu̯lH-neA > L lāna; OE wulla > E WOOL
'weave' *u̯eb^{h} > OE wefan > E WEAVE; E WEB, WEBSTER
'milk' *g(o)lAq-t > L lac-tis > E LACTATE
'to milk' *Amelg- > OE melcan > E MILK
'cream' *rough^{h}-mo- > E REAM
'whey' *k^{w}sir- ON skyr 'curds' < *sk^{w}ir-u̯o-m
'butter' *selpE-es- > OE sealf > E SALVE
'curds' *d^{h}e-d^{h}E-
'cheese' *tuHri-s > G turos

Abbreviations: E English, OE Old English, OI Old Irish, L Latin, G Greek, ON Old Norse, S Sanscrit

The reconstructed PIE technological terms in Table 7 include many items that are characteristic of the SPR but did not yet exist at the time of the Neolithic expansion that brought PIE languages to Europe according to Renfrew (1987). This is the case for items related to the traction complex that forms a principal innovation of the SPR, such as 'yoke', 'wheel', 'vehicle', 'axle' and 'plow', and for secondary products from domesticated animals such as 'milk' and 'wool' and perhaps derived activities such as 'weaving'. The reconstructed lexicon reveals a mixed agrarian-herding economy with an emphasis on stock-breeding. As Huld (1997, p. 375) writes "The evidence derived from linguistic paleontology indicates that IE society was based on a mixed economy of agriculture and stock-breeding. Many writers have mistakenly embraced the fallacy of the false dichotomy, believing that the Indo-Europeans must have been either

strict agriculturalists or 'pure' pastoral nomads. ... IE terms indicate a familiarity with basic agricultural techniques, but the number of terms for domesticated cereals is far smaller than those for domesticated livestock." The mixed subsistence economy reflected in Table 7 could potentially be adapted to the nature of the environment to facilitate PIE expansions both East into the Eurasian steppe and West into the woodlands of Europe, emphasizing the stock-breeding aspects in one environment and the agricultural aspects in another.

Linguists have found additional, subtle clues about the origins of terms in the reconstructed lexicon. For example two terms for 'wheel', *k^{w}ek^{w}lo-s and *rot-A- are each derived from pre-existing PIE roots *k^{w}el- 'turning' and *Hret- 'to walk', respectively (Beekes 1995, p. 37).[20] This pattern indicates that these terms were formed indigenously, not borrowed. Thus it has been suggested that Indo-Europeans may have invented (and named) the wheel independently, since terms for borrowed innovations are often loanwords.

The many SPR-typical terms revealed by linguistic paleontology suggest that Indo-European expansions into Europe took place some time after 4,000 BCE (earliest date for the SPR) and before 2,500 BCE. The expansions were propelled by the combination within PIE culture of the new secondary products technologies borrowed from the Near-East and the riding of horses, which may have been a local steppe development. This combination allowed PIE-speaking populations to expand both East toward the Asian steppe and West toward Europe. Their mixed pastoral and agrarian technology permitted subsistence in a much wider range of environments than had been possible with early Neolithic horticultural technology. In Europe, the more effective soil preparation (using the plow) and herding techniques allowed settlements located on higher grounds, away from the fertile river valley bottoms where they had previously been confined. These changing settlement patterns have been abundantly documented archaeologically (Gimbutas 1997; Sherratt 1981, 1997). The capacity of the new technological complex to greatly expand the useable environment may explain the "steamroller" power of PIE expansions in replacing pre-existing languages, in comparison with later expansions by steppe pastoralists that have had less profound linguistic impacts.

7 Discussion

7.1 Overview

The emerging synthesis offers a new understanding of human history as resulting from interactions of technological innovations, population growth, demic expansions and language replacement. EET, as it emphasizes environmental and technological factors determining social organization and culture, complements the emerging synthesis to provide an account of socio-cultural evolution and of

[20] The derivation of *k^{w}ek^{w}lo-s by redoubling of the root suggests a "slangish" way of naming a novel technological item (Watkins 2000). The word also represents an archaic mode of PIE word formation (Craig Melchert, personal communication).

the commonalitites and differences among human societies, which is the subject matter of macrosociology. The typology of human societies that constitutes the core of the EET permits useful generalizations concerning associations of subsistence technology with features of social organization and culture that can be investigated with comparative data such as that in *Ethnographic Atlas*. Even sociologists who prefer to define their field more narrowly as focusing on industrial (or post-industrial) societies, leaving preindustrial societies to the ministrations of anthropologists and historians, will want to consider that the secondary products societies of Western Europe set the stage for the Industrial Revolution that produced the modern industrial societies they study. Thus socio-cultural correlates of the SPR contributed a huge part of the common cultural heritage of contemporary (post-)industrial societies.

I have proposed in this paper that a slight modification of EET that places both agrarian and herding societies into a single category of secondary products societies based on the same technological package of innovations related to applications of animal traction and other new uses of animal products elucidates some of the commonalities and differences between these two types of societies. The modified typology, by measuring herding intensity (proportion of susbsistence from herding) along a continuous scale, permits a natural approach to societies based on a mixed agrarian-herding economy. I have illustrated the way in which the modified typology sometimes accounts more effectively for the presence of a particular socio-cultural characteristic (e.g., jurisdictional hierarchy and belief in a high god) compared to Lenski's classic typology.

I have also briefly illustrated how the modified typology, as it emphasizes the importance of the Secondary Products Revolution for both agrarian and herding subsistence strategies, can contribute to illuminate the nature and timing of Indo-European expansions – a notoriously contentious problem of prehistory. This example is particularly striking as the reconstruction of the PIE lexicon provides us with an actual inventory of the technology of a long extinct society. The proposed approach may also contribute in the future to the resolution of another cultural puzzle, that of the origins of the Judaeo-Christian and Moslem tradition of monotheism. Secondary products societies tend to have more monotheistic beliefs; and among them the monotheistic tendency increases as a function of herding intensity. On the basis of these comparative patterns and the pastoral imagery that pervades Judaeo-Christian tradition, the latter has traditionally been related to the herding lifestyle of early Israelites. Recent archaeological research suggests a greater role of settled agrarian subsistence, and correspondingly lesser role of herding, than previously thought, casting doubts on this reconstruction (Lenski 2005, Chapter 8). The recognition that herding and agrarian subsistences are not radically different strategies but participate in the same package of technologies, and that herding intensity may be viewed as a continuously varying trait, may potentially contribute to resolving the origins of monotheism.

7.2 Issues

The integration of EET and the emerging synthesis is best viewed as a project, rather than a completed task. A number of issues remain to be resolved. I address briefly two of these issues.

First, the emerging synthesis has focused on demic expansions as a mechanism of change in part because of the distinctive combination of genetic, archaeological, and linguistic traces that demic expansions leave behind. Demic expansions in prehistory are likely to be conspicuous because (in the best empirical circumstances) they leave a combination of traces including a genetic cline, language replacement, and such archaeological clues as new pottery style, burial practices and skeletal type. This emphasis on physical population movements has contributed to rehabilitate *migration* as a principal mechanism of cultural change in the field of archaeology. Demic expansion, corresponding to *inter-societal selection* in the terminology of EET, is perhaps the principal mechanism of socio-cultural evolution. There is no doubt that other mechanisms play an important role in socio-cultural evolution, but they typically do not produce the same conspicuous combination of convergent genetic, linguistic, and archaeological clues as demic expansions.

Alternative mechanisms of change include at least adaptation by indigenous cultural development (equivalent to EET's *intra-societal selection*) (Harris 2004; Sanderson 1990, 1991, 1999); cultural diffusion of technology and ideas by imitation, without the physical expansion of a population; the spread of material products through trade networks; and the influences of societies on each other through world-system effects. Social scientists working within the world-system perspective have begun adapting characterizations of inter-societal relational networks originally developed for the modern world to the study of pre-capitalist socio-cultural evolution. They analyze, for example, the sorting of societies into core and peripheries within trade networks centered on early agrarian empires (Chase-Dunn and Hall 1991, 1997; Schneider 1991; Sanderson 1991). Development of systemic asymmetries such as those uncovered by the world-system approach may well constitute a separate mechanism of socio-cultural change that has no counterpart in biological or linguistic evolution (Ruhlen 1994, pp. 12–14). Although world-system theorists have tended to emphasize external effects of trade network position in preference to other macrosociological processes, they have begun incorporating invasions (particularly with respect to the role of Central Asian nomads) within their explanatory framework (Gills and Frank 1991; Hall 1991). Such a trend might herald theoretical convergences between the world-system approach and the emerging synthesis, as is also suggested by the work of Sherratt (1997).

Second, the EET and the typology of societies that constitutes its core (including the modification proposed in this paper) is only a theoretical skeleton. The typology provides a very useful framework for exploring patterns of associations between subsistence technology and socio-cultural characteristics of societies. The theories that provide predictions or explanations of these associations are to some extent independent of the framework, and theorists may

legitimately disagree about which mechanism is responsible for an association. For example, part of the explanation proposed by Nolan and Lenski (2004) for the decline in social inequality in industrial societies postulates a deliberate strategy on the part of the elite of "sharing the pie" in exchange for social peace. Researchers who object to the functionalist flavor of this explanation may prefer to emphasize other mechanisms, such as the role of the increasing value of human capital in reducing inequality. Further theoretical and empirical debate about the association of industrialization with declining social inequality may continue to rage entirely *within* the ecological-evolutionary framework, without endangering the integrity of the overall structure. As another example, Goody (1976) gives a rich theoretical account of the interrelationships of subsistence technology, marriage customs, and descent and inheritance rules well documented with comparative ethnographic data. There is much work of that kind to be done to flesh out the EET skeleton and advance our understanding of socio-cultural evolution.

References

Ammerman, Albert J. and Luigi Luca Cavalli-Sforza. 1973. "A Population Model for the Diffusion of Early Farming in Europe." In *The Explanation of Cultural Change*, edited by Colin Renfrew, pp. 343–357. London: Duckworth.

—. 1984. *Neolithic Transition and the Genetics of Populations in Europe*. Princeton, N.J.: Princeton University Press.

Anttila, Raimo. 1989. *Historical and Comparative Linguistics*. Amsterdam, Netherlands: John Benjamins, 2 ed.

Barnett, Bernice McNair. 2004. "The Life, Career, and Social Thought of Gerhard Lenski." *Sociological Theory* 22:163–193. In *Essays in Honor of Gerhard Lenski*, special issue edited by Bernice McNair Barnett.

Barth, Fredrik, ed. 1969. *Ethnic Groups and Boundaries: The Social Organization of Culture Difference*. Boston, MA: Little, Brown.

Beekes, Robert S.P. 1995. *Comparative Indo-European Linguistics: An Introduction*. Amsterdam, Netherlands: John Benjamins.

Blumberg, Rae lesser. 1978. *Stratification: Socioeconomic and Sexual Inequality*. Dubuque, IA: William C. Brown.

Blumberg, Rae Lesser. 2004. "Extending Lenski's Schema to Hold Up Both Halves of the Sky." *Sociological Theory* 22:278–291. In *Essays in Honor of Gerhard Lenski*, special issue edited by Bernice McNair Barnett.

Campbell, Lyle. 2004. *Historical Linguistics: An Introduction*. Cambridge, MA: MIT Press, 2 ed.

Cavalli-Sforza, Luigi Luca, Alberto Piazza, and Paolo Menozzi. 1994. *History and Geography of Human Genes*. Princeton, NJ: Princeton University Press.

Cavalli-Sforza, Luigi Luca, Alberto Piazza, Paolo Menozzi, and Joanna Mountain. 1988. "Reconstruction of Human Evolution: Bringing Together Genetic, Archaeological and Linguistic Data." *Proceedings of the National Academy of Sciences* 85:6002–6006.

Chafetz, Janet Salzman. 1984. *Sex and Advantage: A Comparative Macrostructural Theory of Sex Stratification*. Totowa, NJ: Rowman and Allenheld.

—. 2004. "Gender Power and Privilege: Taking Lenski One Step Further." *Sociological Theory* 22:269–277. In *Essays in Honor of Gerhard Lenski*, special issue edited by Bernice McNair Barnett.

Chase-Dunn, Christopher and Thomas D. Hall, eds. 1991. *Core/Periphery Relations in Precapitalist Worlds*. Boulder, CO: Westview Press.

Chase-Dunn, Christopher and Thomas D. Hall. 1997. *Rise and Demise: Comparing World-Systems*. Boulder, CO: Westview Press.

Childe, V. Gordon. 1936. *Man Makes Himself*. London, England: Watts.

Collins, Randall, Janet Salzman Chafetz, Rae Lesser Blumberg, S. Coltrane, and Jonathan Turner. 1993. "Toward and Integrated Theory of Gender Stratification." *Sociological Perspectives* 36:185–216.

Diamond, Jared. 1992. *The Third Chimpanzee: The Evolution and Future of the Human Animal*. New York: HarperCollins Publishers.

—. 1999. *Guns, Germs, and Steel: The Fates of Human Societies*. New York: Norton.

Diamond, Jared and Peter Bellwood. 2003. "Farmers and Their Languages: The First Expansions." *Science* 300:597–603.

Divale, William. 2000. "Pre-Coded Variables for the Standard Cross-Cultural Sample, Volume I & II." *World Cultures* 12:1–332.

Durham, William H. 1991. *Coevolution: Genes, Culture and Human Diversity*. Stanford, CA: Stanford University Press.

Ember, Carol R. and Melvin Ember. 1998. "Cross-Cultural Research." In *Handbook of Methods in Cultural Anthropology*, edited by H. R. Bernard, pp. 647–687. Walnut Creek, CA: AltaMira Press.

—. 2001. *Cross-Cultural Research Methods*. Lanham, MD: AltaMira Press.

Fried, Morton. 1967. *The Evolution of Political Society*. New York: Random House.

Gaulin, Steven J. C. and James S. Boster. 1997a. "Dowry as Female Competition." In *Human Nature: A Critical Reader*, edited by Laura Betzig, pp. 362–371. New York: Oxford University Press.

—. 1997b. "When Are Husbands Worth Fighting For?" In *Human Nature: A Critical Reader*, edited by Laura Betzig, pp. 372–374. New York: Oxford University Press.

Gills, Barry K. and Andre Gunder Frank. 1991. "5000 Years of World System History." In *Core/Periphery Relations in Precapitalist Worlds*, edited by Christopher Chase-Dunn and Thomas D. Hall, pp. 67–112. Boulder, CO: Westview Press.

Gimbutas, Marija. 1997. *The Kurgan Culture and the Indo-Europeanization of Europe: Selected Articles from 1953 to 1993*. Washington, DC: Institute for the Study of Man. Edited by Miriam Robbins Dexter and Karlene Jones-Bley.

Goody, Jack. 1969. "Inheritance, Property and Marriage in Africa and Eurasia." *Sociology* 3:55–76.

—. 1976. *Production and Reproduction: A Comparative Study of the Domestic Domain*. Cambridge, England: Cambridge University Press.

Gray, J. Patrick. 1998. "Ethnographic Atlas Codebook." *World Cultures* 10:86–136.

Hall, Thomas D. 1991. "The Role of Nomads in Core/Periphery Relations." In *Core/Periphery Relations in Precapitalist Worlds*, edited by Christopher Chase-Dunn and Thomas D. Hall, pp. 212–239. Boulder, CO: Westview Press.

Harris, Marvin. 2004. *Culture, People, Nature: An Introduction to General Anthropology*. New York: HarperCollins College Publishers.

Huld, Martin E. 1997. "The Vocabulary of Indo-European Culture." In *The Kurgan Culture and the Indo-Europeanization of Europe: Selected articles from 1952 to 1993*, edited by Marija Gimbutas, pp. 373–393. Washington, DC: Institute for the Study of Man. Edited by Miriam Robbins Dexter and Karlene Jones-Bley.

Keesing, Roger M. 1975. *Kin Groups and Social Structure*. New York: Holt, Reinhart and Winston.

Lenski, Gerhard. 1966. *Power and Privilege*. Chapel Hill, NC: University of North Carolina Press.

—. 1970. *Human Societies: A Macrolevel Introduction to Sociology*. New York: McGraw-Hill, 1 ed.

—. 1994. "Societal Taxonomies: Mapping the Social Universe." *Annual Review of Sociology* 20:1–26.

—. 2005. *Ecological Evolutionary Theory: Principles and Applications*. Boulder, CO: Paradigm Publishers.

Levinson, David and Martin J. Malone. 1980. *Toward Explaining Human Culture: A Critical Review of the Findings of Worldwide Cross-Cultural Research*. New Haven, CT: Human Relations Area Files Press.

Mace, Ruth and Mark Pagel. 1997. "Tips, Branches, and Nodes: Seeking Adaptation Through Comparative Studies." In *Human Nature: A Critical Reader*, edited by Laura Betzig, pp. 297–310. New York: Oxford University Press.

Mallory, J.P. 1989. *In Search of the Indo-Europeans*. London, England: Thames and Hudson Ltd.

Maryanski, Alexandra and Jonathan H. Turner. 1992. *The Social Cage: Human Nature and the Evolution of Society*. Stanford, CA: Stanford University Press.

Murdock, George P. 1967. *Ethnographic Atlas*. Pittsburgh, PA: University of Pittsburgh Press.

Murdock, George P. and Douglas White. 1969. "The Standard Cross-Cultural Sample." *Ethnology* 8:329–369.

Nielsen, François. 2004. "The Ecological-Evolutionary Typology of Human Societies and the Evolution of Social Inequality." *Sociological Theory* 22:292–314. In *Essays in Honor of Gerhard Lenski*, special issue edited by Bernice McNair Barnett.

Nolan, Patrick. 2004. "Ecological-Evolutionary Theory: A Reanalysis and Reassessment of Lenski's Theory for the 21st Century." *Sociological Theory* 22:328–337. In *Essays in Honor of Gerhard Lenski*, special issue edited by Bernice McNair Barnett.

Nolan, Patrick and Gerhard Lenski. 2004. *Human Societies: An Introduction to Macrosociology*. Boulder, CO: Paradigm Publishers, 9 ed.

Renfrew, Colin. 1987. *Archaeology and Language: The Puzzle of Indo-European Origins*. London, England: J. Cape.

—. 1992a. "Archaeology, Genetics, and Linguistic Diversity." *Man* 27:445–478.

—. 1992b. "World Languages and Human Dispersals: A Minimalist View." In *Transition to Modernity: Essays on Power, Wealth, and Beliefs*, edited by John A. Hall and Ian C. Garvey, pp. 11–68. Cambridge, England: Cambridge University Press.

Ridley, Mark. 1996. *Evolution*. Cambridge, MA: Blackwell Science, 2 ed.

Ruhlen, Merritt. 1994. *The Origin of Language: Tracing the Evolution of the Mother Tongue*. New York: John Wiley & Sons.

Sanderson, Stephen K. 1990. *Social Evolutionism: A Critical History*. Oxford, England: Basil Blackwell.

—. 1991. "The Evolution of Societies in World-Systems." In *Core/Periphery Relations in Precapitalist Worlds*, edited by Christopher Chase-Dunn and Thomas D. Hall, pp. 167–192. Boulder, CO: Westview Press.

—. 1999. *Social Transformations: A General Theory of Historical Development*. New York: Rowman and Littlefield.

Sanderson, Stephen K. and Arthur S. Alderson. 2005. *World Societies: The Evolution of Human Social Life*. New York: Pearson.

Schneider, Jane. 1991. "Was There a Precapitalist World-System?" In *Core/Periphery Relations in Precapitalist Worlds*, edited by Christopher Chase-Dunn and Thomas D. Hall, pp. 45–66. Boulder, CO: Westview Press.

Service, Elman. 1962. *Primitive Social Organization*. New York: Random House.

—. 1975. *Origins of the State and Civilization*. New York: Norton.

Sherratt, Andrew. 1981. "Plough and Pastoralism: Aspects of the Secondary Products Revolution." In *Pattern of the Past: Studies in Honour of David Clarke*, edited by Ian Hodder, Glynn Isaac, and Norman Hammond, pp. 261–305. Cambridge, England: Cambridge University Press.

—. 1997. *Economy and Society in Prehistoric Europe: Changing Perspectives*. Princeton, NJ: Princeton University Press.

Swanson, Guy E. 1960. *The Birth of the Gods: The Origin of Primitive Beliefs*. Ann Arbor, MI: University of Michigan Press.

Tylor, Edward B. 1889. "On a Method of Investigating the Development of Institutions applied to the Laws of Marriage and Descent." *Journal of the Royal Anthropological Institute of Great Britain and Ireland* 18:245–272.

Watkins, Calvert, ed. 2000. *The American Heritage Dictionary of Indo-European Roots*. Boston, MA: Houghton Mifflin Company, 2 ed.

White, Douglas R., Andrey Korotayev, and Daria Khaltourina. Forthcoming. *Using SPSS: Analysis and Comparison in the Social Sciences*. Sage.

Table 8: **Jurisdictional Hierarchy Beyond the Local Community by Type of Society** (*EA* Data, $N = 839$)

Mean by Type of Society			OLS Regression[a]		
Category	Mean	N	Variable	Coef[b]	StdCoef
HuntGath	1.120	167	Constant	1.120^{***}	—
Fishing	1.357	56	Fishing	0.237	.053
SimpHort	1.494	162	SimpHort	0.374^{***}	.132
AdvHort	2.238	260	AdvHort	1.119^{***}	.462
Agrarian	3.256	125	SecProd	2.401^{***}	.905
Herding	2.551	69	PropHerd	-1.129^{***}	−0.234
Total	1.990	839	$R^2 = .403$ vs. .407[c]		

[a] On modified typology with Agrarian and Herding categories replaced with Secondary Products category and Proportion Herding. HuntGath is omitted category. Jurisdictional hierarchy beyond local community is *EA* V33 coded 1 (0 levels beyond community) to 5 (4 levels)

[b] $^{*}p < .05 \quad ^{**}p < .01 \quad ^{***}p < .001$ (two-tailed tests)

[c] R^2 for OLS regression using original typology

Table 9: **Presence of Social Classes by Type of Society** (*EA* Data, $N = 801$)

Distribution by Type of Society			Logistic Regression[a]		
Category	Percent	N	Variable	Coef[b]	OddsRat
HuntGath	21.8	165	Constant	-1.276^{***}	—
Fishing	51.9	54	Fishing	1.350^{***}	3.859
SimpHort	41.8	158	SimpHort	$.944^{***}$	2.571
AdvHort	62.3	236	AdvHort	1.778^{***}	5.919
Agrarian	85.7	126	SecProd	2.904^{***}	18.250
Herding	79.0	62	PropHerd	−.013	0.988
Total	54.2	801	McFadden's $\rho^2 = .147$ vs. .146[c]		

[a] On modified typology with Agrarian and Herding categories replaced with Secondary Products category and Proportion Herding. HuntGath is omitted category. Presence of social classes is coded 0 if *EA* V66 is 1 (absence of class stratification among freemen); 1 otherwise

[b] $^{*}p < .05 \quad ^{**}p < .01 \quad ^{***}p < .001$ (two-tailed tests)

[c] McFadden's ρ^2 for logistic regression using original typology

Table 10: **Female Participation in Food Production by Type of Society** (*EA* Data, $N = 378$)

Mean by Type of Society			OLS Regression[a]		
Category	Mean	N	Variable	Coef[b]	StdCoef
HuntGath	3.070	106	Constant	3.070^{***}	—
Fishing	2.058	33	Fishing	-1.011^{***}	$-.325$
SimpHort	3.055	68	SimpHort	$-.015$	$-.006$
AdvHort	3.197	86	AdvHort	0.127	.061
Agrarian	2.497	65	SecProd	-0.458^{**}	$-.218$
Herding	2.341	20	PropHerd	-0.361	$-.090$
Total	2.871	378	$R^2 = .181$ vs. .179[c]		

[a] On modified typology with Agrarian and Herding categories replaced with Secondary Products category and Proportion Herding. HuntGath is omitted category. Female participation in food production is calculated from *EA* V1 to V5 and V50 to V54 (see text for details)

[b] $^{*}p < .05 \quad ^{**}p < .01 \quad ^{***}p < .001$ (two-tailed tests)

[c] R^2 for OLS regression using original typology

Table 11: **Patrilineal Descent by Type of Society** (*EA* Data, $N = 863$)

Distribution by Type of Society			Logistic Regression[a]		
Category	Percent	N	Variable	Coef[b]	OddsRat
HuntGath	25.4	173	Constant	-1.076^{***}	—
Fishing	16.7	60	Fishing	-0.534	.586
SimpHort	29.4	160	SimpHort	0.198	1.219
AdvHort	65.6	262	AdvHort	1.723^{***}	5.603
Agrarian	54.5	134	SecProd	0.804^{***}	2.234
Herding	79.7	74	PropHerd	1.891^{***}	6.629
Total	46.9	863	McFadden's $\rho^2 = .125$ vs. .128[c]		

[a] On modified typology with Agrarian and Herding categories replaced with Secondary Products category and Proportion Herding. HuntGath is omitted category. Patrilineal descent is coded 1 if *EA* V43=1; 0 otherwise

[b] $^{*}p < .05 \quad ^{**}p < .01 \quad ^{***}p < .001$ (two-tailed tests)

[c] McFadden's ρ^2 for logistic regression using original typology

Table 12: **Score of Belief in a High God Who is Active and Supports Human Morality by Type of Society** (*EA* Data, $N = 607$)

Mean by Type of Society			OLS Regression[a]		
Category	Mean	N	Variable	Coef[b]	StdCoef
HuntGath	1.505	101	Constant	1.505^{***}	—
Fishing	1.657	35	Fishing	.152	.030
SimpHort	1.627	102	SimpHort	.123	.039
AdvHort	2.208	192	AdvHort	$.703^{***}$	.277
Agrarian	2.904	115	SecProd	$.910^{***}$	.350
Herding	3.468	62	PropHerd	1.520^{***}	.320
Total	2.227	607	$R^2 = .311$ vs. .293[c]		

[a] On modified typology with Agrarian and Herding categories replaced with Secondary Products category and Proportion Herding. HuntGath is omitted category. Belief score is *EA* V34 coded 1 (high god absent or not reported in substantial descriptions of religious beliefs), 2 (high god present but inactive or not concerned with human affairs), 3 (high god present and active in human affairs but not offering positive support to human morality), and 4 (high god present, active, and specifically supportive of human morality); "high god" defined after Swanson (1960) (see text)

[b] $^{*}p < .05$ $^{**}p < .01$ $^{***}p < .001$ (two-tailed tests)

[c] R^2 for OLS regression using original typology