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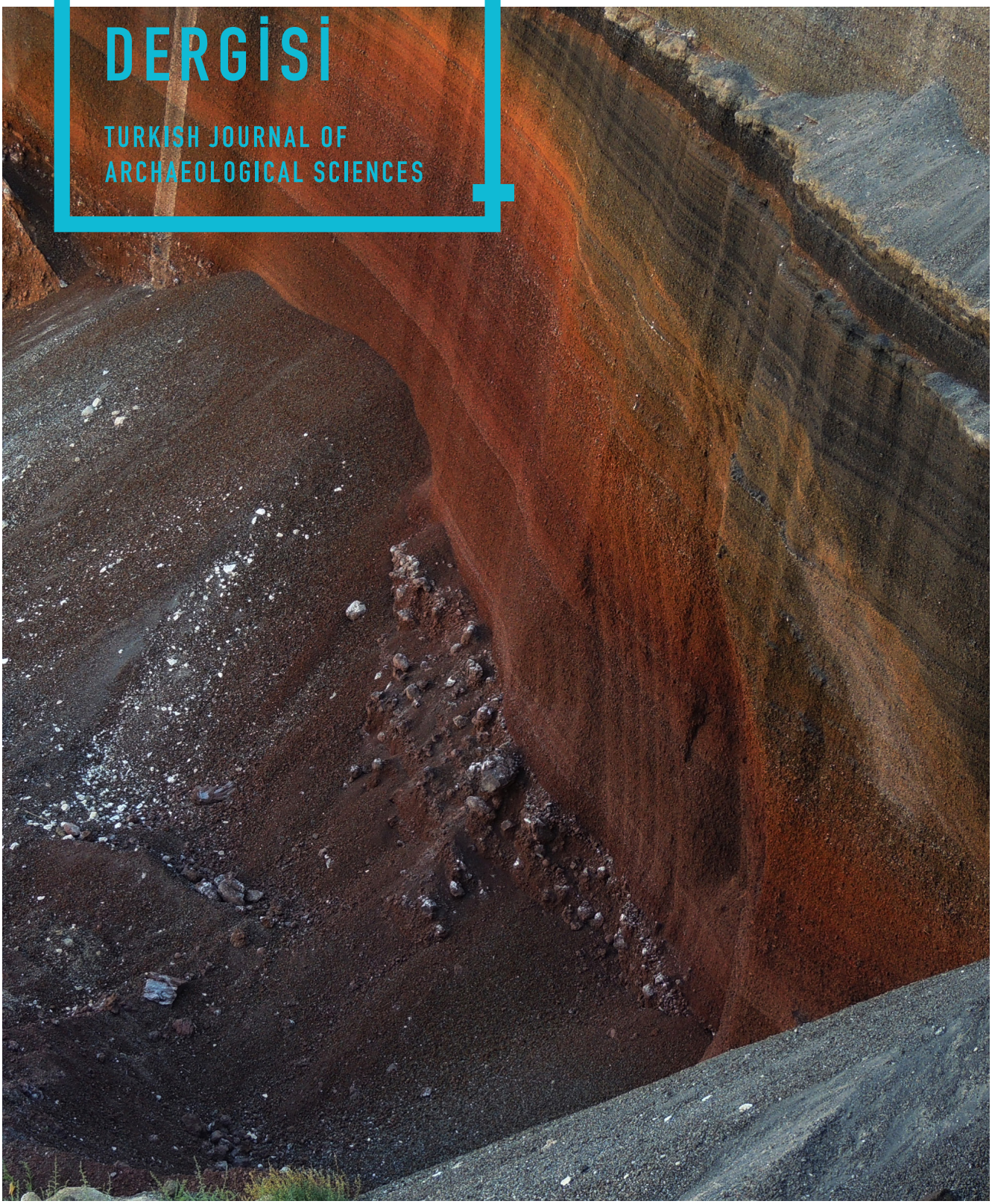

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İçindekiler / Contents

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Editörlerden

Dünyaya açılmamızı sağlayacak Arkeoloji Bilimleri Dergisi'nin ilk sayısı ile hepinize merhaba diyoruz.

Arkeoloji bir süredir geçmişin yorumlanmasında teknoloji ve doğa bilimleri ile yoğun iş birliği içinde yeni bir anlayışa evrilmekte. Üniversiteler, ilgili kurum ve enstitülerde her yeni gün açılmakta olan "Arkeoloji Bilimleri" bölümleri ve programları, geleneksel anlayışı yavaş yavaş terk ederek değişen yeni bilim iklimine adapte olmaya çalışmaktalar. Arkeoloji disiplininin geçmişi, geçmişte yaşayan insanların yaşam biçimlerini bütüncül bir şekilde anlamaya, hızla gelişen ve yaygınlaşan teknolojilerle her geçen on yılda daha fazla yaklaşıyor. Arkeolojik araştırmalar, sorgulama ve değerlendirme biçimleri, bu yeni bilim üretme biçimine dönüşüyor. Derginin editörleri olarak bizler, bu süreçte, bu dönüşüme katkı sağlayacak bir mecra oluşturmanın önemli olduğu kanısındayız.

Amacımız arkeoloji içindeki arkeobotanik, arkeozooloji, alet ve bina teknolojileri, tarihlendirme, mikromorfoloji, biyoarkeoloji, jeokimyasal ve spektroskopik analizler, coğrafi bilgi sistemleri, iklim ve çevre modellemeleri gibi farklı uzmanlık alanlarının çeşitlenerek yaygınlaşmasına katkı sağlamak ve arkeolojide bilimsel yöntem ve analizlerin geliştirilmesi ve uygulanması üzerine çalışan bilim insanlarını bir araya getirmek. Elbette yeni ve özgün metodolojik ve kuramsal yaklaşımlar üzerine yapılan araştırmalara da yer vereceğiz. Destek, katkı ve ilginizi derginin seyri ve gelişimi adına çok önemli görüyoruz.

Güneş Duru & Mihriban Özbaşaran

ARKEOLOJİ BİLİMLERİ DERGİSİ
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Note from the editors

We would like to take this opportunity to introduce ourselves to the world, and say 'hello' to the archaeological media with the very first issue of our new archaeological journal: The Turkish Journal of Archaeological Sciences.

For the past couple of decades archaeology has been evolving in close cooperation with new technologies and the advances in the natural sciences towards new understandings and interpretations of the past. More and more newly established departments and programs in universities and other relevant institutions focus on "Archaeological Sciences" as they try to adapt to a changing climate, and gradually abandon older traditions. Rapidly developing technological, methodological and analytical advances move us closer to understanding the way of life in past communities in a holistic way. Archaeological research programs, and the many innovative new ways of testing, inquiring and evaluating these all converge into this new way of producing 'science'. As the founding editors of the TJAS, we think it is important to have a medium that will contribute to this transformation.

Our goal is to contribute to the diversification and dissemination of different areas of expertise such as archaeobotany, archaeozoology, tool and building technologies, dating methods, micromorphology, bioarchaeology, geochemical and spectroscopic analyses, geographical information systems, climate and environmental modeling. We aim to bring scholars working on the development and application of scientific methods and analyses together in these volumes. We also seek to include in these pages recent advances in methodological and theoretical approaches. Your support, contributions and engagement with the archaeological science presented here are crucial to the progress and development of the journal.

Güneş Duru & Mihriban Özbaşaran

Can Prehistoric Archaeology be a Scientific Discipline?

Trevor Watkins[a]

Abstract

Archaeologists have continually added new techniques of scientific analysis and interpretation, but the processualist archaeology of Binford and Flannery in the 1960s proposed that the central task was to set prehistoric archaeology within an ecosystems (i.e., ecological, and evolutionary) context. Evolutionary theory has expanded and developed significantly, especially over the last two decades, especially in the areas of gene-culture co-evolution and cultural niche construction theory. This paper proposes that, by using the new and still developing cultural evolutionary frameworks, we can explain our archaeological observations – for example, of the Epipalaeolithic-Neolithic transformation. In this way archaeologists can not only understand the processes at work within the period of our own particular interest, but at the same time we can contribute to the better understanding of where our period of interest fits within the greater scheme of human cultural evolution.

Keywords: Prehistory, Epipalaeolithic, Neolithic, cultural evolution, niche construction theory

Özet

Arkeologlar bilimsel analizlerine ve yorumlamalarına sürekli olarak yeni teknikler eklemektedir. Bu katkının en önemlilerinden biri 1960'larda Binford ve Flannery'nin Süreçsel Arkeoloji çizgisiyle önerdikleri prehistorik arkeolojiyi ekosistem (ekolojik ve evrimsel gibi) bağlamı içine dahil etmek olmuştu. Son 20 yılda evrimsel teori özellikle gen-kültürü, birlikte-evrim, kültürel niş inşa teorisi ile genişletilmiş ve geliştirilmiştir. Bu yazı, yeni ve halen gelişmekte olan evrimsel sistemleri kullanarak arkeolojik gözlemlerimizi açıklayabileceğimizi önermektedir, örneğin Epipaleolitik'ten Neolitik'e geçiş süreci gibi. Böylece arkeologlar olarak sadece üzerinde çalıştığımız dönemi anlamakla kalmayıp, aynı zamanda ilgilendiğimiz dönemin insanın kültürel evrimine ilişkin şemanın neresine oturduğunun anlaşılmasına da katkı sunabiliriz.

Anahtar Kelimeler: Prehistorya, Epipaleolitik, Neolitik, kültürel evrim, niş inşa kuramı

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Introduction

Archaeologists have continually improved the technical quality of their methodology, whether in terms of survey, excavation, or post-excavation analysis, and their methods have certainly become more rigorous in defining questions and recovering and analysing data. Many archaeologists have become expert in their fields of lithic technology, archaeobotany, archaeozoology, or the physical analysis of archaeological materials, answering questions by means of recognized scientific techniques. But we have not given enough attention to the higher level of integration required for the writing of prehistory. We can describe how archaeological material assemblages change from one period to the next, and the next. Across the Neolithic of southwest Asia, for example, we can identify trends, such as that settlement sites became larger, that domestic buildings became larger and architecturally more complex, that cultivated crops and herds of domesticated animals became steadily more important in the subsistence economies of most communities, and that quantities of Anatolian obsidian at settlements increased through the Pre-Pottery Neolithic period. But we have difficulty in going beyond descriptive history and explaining how and why those changes took place.

I will suggest that prehistoric archaeologists have the opportunity to join the growing international multi-disciplinary community of researchers who are developing cultural evolutionary theory. Together, using the new and still developing cultural evolutionary frameworks, we can investigate the evolutionary processes that will explain how our archaeological observations make sense. In that way we can not only understand the processes at work within the period of our own particular interest, but at the same time contribute to the better understanding of where our period fits within the greater scheme of human cultural evolution.

This is not a case of accepting and integrating a new analytical methodology that can be applied to our archaeological material. This is an enterprise in which we should collaborate, contribute, and gain real advances in return. Archaeology is not marginal to the development of better accounts of human social and cultural evolution. The archaeological material is the fundamental raw material that may document the progress of stages in the evolutionary process. And archaeological skills are essential in making primary sense of that material. Archaeologists and the physicists and other scientists who work with us can provide the essential chronological calibration of the processes of change and development. In short, it is my view that prehistoric archaeology must learn to understand these new developments in cultural evolutionary theory, and contribute to this exciting new enterprise: if we do not learn how to contribute, we will leave it to non-archaeologists to write our prehistory for us.

Archaeology and Evolution

The idea of "evolution" was problematic from the start; Darwin delayed the publication of his major book (Darwin 1859), knowing that the idea of a theory of evolution that had implications for humans was likely to provoke strong feelings and fierce arguments. Darwin had close relations with the pioneers of scientific geology; indeed, his theory depended on the idea of a chronology of geological immensity. He mentored his neighbour the young John Lubbock in the scientific methodology of natural history, and later encouraged him to write the first account of prehistoric times in which readers were introduced to the Palaeolithic hunters whose relative chronology could be gauged with reference to the large fauna that they hunted at different stages of the Pleistocene period (Lubbock 1865). There were similar developments in France, where early excavators of Pleistocene cave-deposits sought to establish the context of early humans in geological time. Édouard Lartet, for example was as much a geologist and paleontologist, as a pioneer of Palaeolithic archaeology. Evolution went on to get a bad name, because of its association with the ideas that went under the name of "social Darwinism", promoted notably by Thomas Galton, a cousin of Darwin. Social Darwinism sought to apply biological concepts such as natural selection and survival of the fittest to sociology, economics, and politics. And that soon led to eugenics, racism and anti-semitism in the twentieth century. It is not surprising, therefore, that archaeologists, together with most humanities scholars and social scientists, wanted no part in the application of evolutionary theory.

Evolutionary theory appeared again in prehistoric archaeology in 1960s America with the processualist movement led by Lewis Binford. They wanted an anthropological archaeology that made ecological studies of (cultural) adaptation to environmental change. At the base of their thinking was Leslie White's theory that culture can be defined as the exo-somatic (that is, outside the body, and thus non-biological) means of environmental adaptation for humans (White 1959). Both Binford and Kent Flannery proposed that an exemplary subject for processualist research was the origins of agriculture, and each of them put forward dynamic ecological models to account for it (Binford 1968; Flannery 1969). Flannery's broad-spectrum revolution theory made a link between resource diversification among Epipalaeolithic groups and demographic density, which broke the ecological equilibrium, requiring those hunter-gatherer groups to find ways to adapt to the new situation by means of intensifying the availability of their food resources (by broadening the spectra of plants and animals). They thus initiated the process whereby population continued to grow, and further intensification of plant-foods and meat resources was required until cultivation of crops and herding of animals led to the emergence of farming economies. Flannery's broad-spectrum revolution theory excited many archaeologists; it encouraged much research and some criticism but has continued to be used or discussed (for a detailed review, see Zeder 2012). For us the important point to note is that the

simple evolutionary model that underpins the theories of Binford and Flannery is outdated; we now know that change/adaptation is not necessarily the consequence of external environmental pressure as in the original formulation of the theory of evolution. There were major advances in knowledge, of course, especially with the emergence of the fields of genetics; learning about genes and DNA in the middle of the twentieth century made for such an improvement on Darwin's evolutionary theory that the upgraded theory was called "the modern synthesis", or "the standard evolutionary theory". But advances in evolutionary theory have continued and expanded, which is a subject to which I return later.

I have been concerned with the Epipalaeolithic and Neolithic of southwest Asia, and I will use that period as the case-study here. We can describe that transformation—the emergence of permanently co-resident communities, the focus on storable harvests leading to the emergence of cultivation of crops and the herding of domesticated animals, the increasingly networked super-communities of cultural sharing and exchange, and the very distinctive displays of symbolic forms and rituals—but we need a means of understanding the processes of socio-cultural development if we are to do more than describe. If we are to understand the Epipalaeolithic-Neolithic transformation, we need to know how it relates to, and how it develops from, the earlier Palaeolithic. Over recent years Palaeolithic archaeologists have naturally been concerned with human evolution; if they were particularly interested in the Lower to Middle Palaeolithic, they will surely have been engaged in debates about early hominin evolution, and if they were more focused on the Middle to Upper Palaeolithic periods, they will have been very aware of the debates about "the human revolution" and the emergence in *Homo sapiens* of "the modern mind". The unfortunate social division within archaeology between those who study human evolution and the Palaeolithic and those who work in later prehistory has generally isolated those working in the Neolithic and later periods from the recent developments in cultural evolutionary theory. The case that I wish to make here is that the archaeology of the Epipalaeolithic and Neolithic needs to be re-worked in terms of the available cultural evolutionary frameworks so that it can become part of the long-term process of human cultural evolution. The same can be said for the succeeding periods, at least into protohistoric and early historic times. Indeed, there are initiatives to develop ways of writing "deep histories" that treat the whole of human history in the same social and cultural evolutionary terms (e.g., Turchin 2008; Shryock and Smail 2011; Richerson and Christiansen 2013; Smail 2015).

Long-Term Cultural Evolution

Over and above the morphological changes in the body and the brain in hominin evolution over the last two or three million years, there are three significant, inter-locking trends in human social and cultural evolution. We will then focus on the Epipalaeolithic-Neolithic

transformation, where the same three interlocking trends can be identified in operation, but at a rapidly accelerating rate. Those three inter-related, slow, but accelerating trends are documented: (a) in cultural innovation and change; (b) in the expansion of the range of cultural products, skills, and capacities; (c) and in the growth of population, of population density and the scale of human social groups.

More than twenty-five years ago Robin Dunbar showed that there is a relationship between the size of the brain of primate species, in particular the crinkly outer cortex of the brain, and the size of their social groups. The hominin brain has increased greatly over the two or three million years that the genus *Homo* has been in existence. Fitting increasing hominin brain size, and particularly the ratio of the outer cortex, into that relationship of brains of primates to social groups, Dunbar suggested that the hominin brain has co-evolved with the growth in the size of social groups (Dunbar 1997, 1998). As the social group grows in size arithmetically, the complexity of the web of personal relations that need to be known and monitored expands exponentially. Dunbar showed in a graph how the predicted size of hominin social groups increased through time. This is the basis of his "social brain hypothesis". In the process, Dunbar argues, *Homo* has also evolved the unique human faculty of language to replace the one-to-one grooming that is typical of many primate species. What Dunbar has been talking about is complex gene-culture co-evolution which in addition involves other factors such as extended human infancy, the plasticity of the human brain, the expansion of its cognitive capacities, the capacity for mind-reading. I want to draw attention to another feature of that graph: there is a clearly accelerating upward curve in that graph.

In a different study, Dietrich Stout has argued that cognitive skills, language and the ability to accumulate a sophisticated cultural package of stone tool-making skills have co-evolved (Stout 2011); the positive feedback loops between brain evolution and technical and cultural skills produce an accelerating curve in the range and complexity of chipped stone tools through the long term of the Pleistocene (Stout 2011, 1056, Fig. 2). This research adds practical and conceptual cultural knowledge to the equation of co-evolution of cognition, the scale of social group, language and culture.

Dunbar's social brain hypothesis infers that the expensive investment in the evolution of a much larger and powerful brain enabled early hominins to live in larger numbers of socially interconnected individuals. Another indicator of the increasing scale of hominin social groups is the range over which an individual band obtained some of the raw materials for chipped stone tools. In Middle Stone Age Africa from around 120,000 years ago, bands obtained some raw materials over distances of 300 km and more (McBrearty and Brooks, 2000). The individual forager band may have been small, but what mattered was the larger social group of which each band was a component. Ben Marwick (2003) has discussed the implications for the scale and

nature of social networks by examining the range over which raw materials travelled. At first, as much as 1 million years ago, early hominin groups obtained their raw material from within their own territory. After about 1.2 mya, human groups might obtain some raw materials by means of exchange with other bands within their tribe. Marwick argues that fully modern language emerged among *Homo sapiens* in Africa around 120,000 years ago, because the sophistication of fully modern, syntactical language would have been essential for negotiations among participants in long distance networks of exchange and delayed reciprocity that carried raw materials over hundreds of kilometres, across multiple territories. He shows how the range from which raw materials were obtained grew across the African Palaeolithic, implying that groups began to exchange with more distant and unrelated groups.

Accelerating Scale and Tempo Within the Epipalaeolithic-Neolithic Transformation

For the most part, studies of cultural evolution have concluded either with the emergence of *Homo sapiens*, or around the beginning of the Upper Palaeolithic in European or southwest Asian terms (which is a curious omission in view of the extraordinary amount of both biological and cultural evolution of the last fifty thousand years). Now I want to suggest that we can see those same three characteristics of hominin evolution operating within our Epipalaeolithic-Neolithic transformation, but at an extraordinary rate of acceleration that is completely new when seen against the long term of human evolution. This relatively sudden and dramatic acceleration sets the scene for all that follows in human cultural evolution. It is common to point to the beginnings of agriculture as being the reason for the importance of the Neolithic in human history, but there is much more to the Epipalaeolithic-Neolithic transformation than that, as some non-archaeologists have noted. Paul Seabright, for example, a professor of economics, writes in his book *The Company of Strangers* about "the remarkable strangeness, and fragility, of our everyday lives" in contemporary urban society. He recognizes that we owe "our teeming, industrialised, networked existence . . to an extraordinary experiment launched a mere ten thousand years ago". The "extraordinary experiment" to which he refers is the formation of the first large, sedentary communities of the Neolithic, which had the capacity to devise institutions that enabled social trust. From those networks of Neolithic communities have evolved those institutions such as "cities, armies, empires, corporations, nation states, political movements, humanitarian organizations, even internet communities" that provide the foundations of social trust on such an extraordinary scale in today's world (Seabright 2004, 3). With similar insight the medieval historian Daniel Lord Smail, writing a "deep history" of humankind, explained that such an enterprise must treat of the Palaeolithic together with "the Postlithic", that is everything that follows from the Neolithic, which he labels "the fulcrum of the great

transformation" (Smail 2008, 2-3). Non-archaeologists with such insight into the significance of the Neolithic challenge us archaeologists to explain our period in detail within its context of human history.

The characteristics of human evolution in general that clearly take on a new tempo are (a) the acceleration of the rate of cultural change, (b) the expansion in the range of cultural products, skills, capacities, and (c) the growth in the scale of human societies, and of population density. These can be recognized within the e-Neolithic revolution.

The accelerating rate of cultural change is implicit in the way that we archaeologists have defined our archaeological periods in terms of their changing material culture. Tracing cultural change within the tens of thousands of years of the later Middle Palaeolithic has proved extremely difficult, although archaeologists have studied the chipped stone assemblages carefully to see if they can identify Neanderthal from *Homo sapiens* industrial traditions. By contrast the Upper Palaeolithic is much shorter, while the Epipalaeolithic is half the length of the Upper Palaeolithic. In the Levant the epal is broken down into three main sub-periods (and several more facies of chipped stone). The phases within the Pre-Pottery Neolithic are shorter again. Where we count in tens of thousands of years at the beginning of that sequence, we count in a few centuries for each sub-period towards the end of the Neolithic. The material culture repertoire can equally be seen to expand over time, and over the Pre-Pottery Neolithic new skills were being added.

We can get a proxy handle on the growth of population and population density by means of occupation sites and settlements. Nigel Goring-Morris and Anna Belfer-Cohen (2011) brought together the data on the number of sites in different parts of southwest Asia between the beginning of the Upper Palaeolithic (around 50,000 years ago) and the late Neolithic (around 8000 years ago). For the purposes of graphing the data (Goring-Morris and Belfer-Cohen 2011, 199, Fig. 2, S199, Fig. 2), the number of sites were normalised relative to the duration of each sub-period. For the southern Levant, where the best data has accumulated from more than a century of fieldwork, the number of sites grows steadily from period to period in a roughly straight line. Over recent decades there has been a concentration of salvage archaeology on the upper Euphrates and Tigris rivers; although we do not yet have early sites in that region, the trend from the beginning of the Holocene, the beginning of the Neolithic, is similar. Both curves under-play actual population growth, because across time (a) sites became larger, and (b) they were occupied more permanently, and (c) our archaeological periods through the Epipalaeolithic and the Neolithic get shorter with time. Ian Kuijt (2000) collected data on Neolithic settlement size for the southern Levant. His graph (Kuijt 2000, 83, Fig. 2) shows that site size increases across the Pre-Pottery Neolithic in an accelerating upward curve. He also collected information on the ratio of built space to open space, which shows that, as settlements

grew in size, so did the density of buildings within them, amplifying the crescendo of growth in settlement size and making the acceleration of population growth even more dramatic.

An important feature of successful and resilient societies is their intensive connectivity. Whatever the means by which they assured their internal social cohesion, our Neolithic settlements did not exist in isolation. We have known for a long time about some elements of their systems of exchange by means of the circulation of Anatolian obsidian. Now we know a good deal more about other materials and artefacts that were exchanged. We also know that the connections that made up this extensive network were already in existence in the Epipalaeolithic period, and the steady growth in the amount of obsidian and the range of other materials in the network can be charted. But recent work by Juan José Ibáñez, David Ortega and colleagues takes us much further (Ibañez et al. 2015, 2016; Ortega et al. 2014, 2016). The Spanish group has simulated exchange networks and shown that it is necessary to suppose a "small-world network", in which every settlement is linked with its neighbours, but some participants bypass their neighbours and access "distant links" directly, exchanging with partners up to 180 km from home. The best fit to the archaeological distribution map for the later pre-Pottery Neolithic, however, is called "optimized distant link" networking, in which certain communities emerge as significant distribution centres, and these distribution centres obtain their obsidian direct from other centres that were nearer the Anatolian sources. In other words, the Spanish group are proposing there came into existence in the early Neolithic complex and hierarchical systems of interaction and exchange of symbolically important materials, genes (through exchange of marriage partners), and the pooling of ideas, innovations and experiences.

We Neolithic archaeologists tend to think in terms of the autonomous community represented by a settlement site. We should be thinking in terms of super-communities made up of networked settlements (Watkins 2008). In addition to the proxy evidence of generally increasing population density (more and more settlements), and increasing numbers of people living permanently together (larger and larger co-resident communities), the true measure of the scale of the social group is the regional or supra-regional super-community. We will see later that such a social structure greatly encourages cultural and technical innovation and its efficient and wide dissemination.

Something else was new in the Neolithic, emerging out of Epipalaeolithic prototypes—monumental community architecture. Because of its recent publication, Jerf el Ahmar offers the best example (Stordeur 2015). This small settlement site beside the Euphrates in north Syria was never occupied after the early Pre-Pottery Neolithic. Danielle Stordeur was therefore able to expose most of the settlement of the early Pre-Pottery Neolithic. In an early phase of its existence, at the centre of a cluster of buildings was a massive subterranean construction, 7m in diameter and dug 3m deep into the ground (Stordeur et al. 2000). There was a similar massive building

at an earlier stage in the settlement's history, and there was a succession of similar circular, subterranean buildings, but with open interiors, in later phases. The excavators infer that the cells in the earliest examples had served as a storage facility for the community's cereals and legumes. Around the communal storage building there were several communal kitchen buildings, each equipped with multiple grinding stones—these are stone bases from which the grinding stones have been removed. The houses of the community were smaller, simpler buildings that clustered around this central communal area, Although the community was larger than a typical mobile forager band, and although they were (very probably) engaged in the cultivation of crops (Willcox and Stordeur 2012), the community seems to have continued the sharing ethic of hunter-gatherer societies. Indeed, their communal food storage was monumentalised in this massive central building.

The most dramatic examples of monumental architecture and sculpture have been found at the site of Göbekli Tepe on a bare limestone mountain ridge near Urfa in southeast Turkey (Schmidt 2011). The now famous large, circular buildings of the earlier phase at the site date to the early Pre-Pottery Neolithic, contemporary with the settlements like Jerf el Ahmar that have similarly monumental communal buildings. During the early Pre-Pottery Neolithic Göbekli Tepe seems to have functioned as a "central place"—the excavator, the late Klaus Schmidt, compared it to the neutral ceremonial meeting place of an ancient Greek amphictyony.

I want to turn back for a moment to Jerf el Ahmar, where Danielle Stordeur reported the finding of the first small stone plaques with incised signs on both surfaces. Some of those motifs, like the wriggling snake with the triangular head, are frequently seen on monoliths at Göbekli Tepe. We now have examples of these small stone plaques from a number of early Pre-Pottery Neolithic settlement sites in north Syria and southeast Turkey. It seems likely that the motifs are signs that are elements in a "semasiographic" sign-system, that is a writing system whose signs are symbolic, rather than "logographic" (that is, referencing words, syllables or sounds). The writing systems of the early central American civilizations are now known to be semasiographic, storing complex and detailed information about individuals, events, and calendrical dates. Contemporary mathematicians and theoretical physicists use semasiographic (algebraic) sign-systems that embody some of the most complex and mind-stretching information that humans have contrived to discover. Such sign-systems can function very well as modes of storing and sharing complex information. We can say that, in the early Pre-Pottery Neolithic, there were regional super-communities whose shared "cognitive frames" made their groups of carved signs, sculptures and architecture meaningful.

Within each settlement, each community, and among the communities that together made up the super-community, these—from monumental communal architecture, to small, hand-held plaques bearing signs—were the means of ensuring what Jan Assmann called the essential

"cultural memory" (Assmann 1988). Assman's ideas were formed through his study of Egyptian architecture, imagery, and ritual; he concluded that the constant repetition of the representation of physical traditions assured the Egyptians of their "cultural memory", which told them who they were and where that identity came from. The philosopher-sociologist Maurice Halbwachs (1992) similarly recognized the social significance of architecture and ritual in the formation and maintenance of a society's "collective memory".

There is a lot more—some two thousand years—of Pre-Pottery Neolithic after this initial burst of dramatic architecture and art. There are many and varied signs in the archaeological record of the continuing importance of special buildings and ritual practices, especially those concerned with the dead and the ancestors (Croucher 2012; Goring-Morris and Belfer-Cohen 2020). In every way the Pre-Pottery Neolithic is an extraordinarily dynamic period. Through the Pre-Pottery Neolithic everything is scaled up, and the tempo of the processes of cultural change increases with time. Near the end of the Pre-Pottery Neolithic, around the beginning of the Pottery Neolithic, there is a short phase within which, in many parts of the hilly flanks of the Fertile Crescent, and in central Anatolia, there are rapid and major changes in the settlement pattern in many regions, the form of settlements, architecture, the practicalities of farming, and material culture in general. The dramatic changes through the latter stages of the Pre-Pottery Neolithic and the following Pottery Neolithic form a subject in their own right, for which there is not space here.

Advances in Cultural Evolutionary Theory

Over the last 20 plus years evolutionary theory has been expanding and diversifying radically. It has been called "evolution in four dimensions" (Jablonka and Lamb 2005). By contrast with the "modern synthesis" or "the standard evolutionary theory" of the middle of the twentieth century, today's advances (the emergence of epigenetics as a sub-discipline, evolutionary developmental biology, and niche construction theory in particular) have been labelled "the extended evolutionary synthesis" (Laland et al. 2015; Zeder 2017). Directly or indirectly the extended evolutionary synthesis offers us three related components that are very important for thinking about cultural evolution.

We have already encountered gene-culture co-evolution in Dunbar's social brain hypothesis, although Dunbar himself does not use the term. Gene-culture co-evolution can occur when a new cultural practice has the effect of favouring a particular genetic variant, which then increases in frequency to become dominant in that population, in turn favouring the intensification of the cultural practice (Boyd et al. 2010; Feldman and Laland 1996). The frequently quoted example is that of lactase tolerance in adults, a characteristic of some populations that have relied heavily on milk in their diets. Another is the sickle-cell allele that confers resistance

to malaria, which has been traced back to the particular way that certain West African groups cleared forest in order to cultivate their yams, inadvertently creating conditions that favoured mosquito populations (Laland 2017, 220-224).

There are multiple examples of gene-culture evolution, including the theory that the human facility of language has co-evolved with the cognitive evolution of the human brain (Dor and Jablonka 2014). These co-evolutionary feedback loops (labelled "reciprocal causation" by evolutionary scientists) involve a closed-circuit interaction with one another in which each encourages the other, which leads us to the second recently developed component of the extended evolutionary synthesis, niche construction theory. The evolutionary biologist Kevin Laland was one of those who first proposed the theory (Odling-Smee et al. 1996, 2003). The simplest definition of the term appears in a paper in which Laland and archaeologist Michael O'Brien set out to explain the significance of (cultural) niche construction for archaeology: niche construction is "the capacity of organisms to modify natural selection in their environment and thereby act as co-directors of their own, and other species', evolution" (Laland and O'Brien 2010, 303). Niche construction exists throughout the biological world, among many animals which manufacture nests, burrows, webs, and pupal cases, and including plants that change levels of atmospheric gases and modify nutrient cycles, as well as fungi that decompose organic matter, and bacteria that fix nutrients. Humans have become the most active niche constructors because of their capacity for culture. Humans operate within niches which they themselves have formed, and which becomes the effective environment that accommodates them and to which they accommodate (Laland and O'Brien 2011; Laland et al. 2001). Biologists are interested in the backwards and forwards interaction between human practices and the biology of the humans, and the species that humans have taken into their cultural niche with domestication. Psychologists are equally interested in the ways that the humanly constructed cultural niche in turn affects the cognitive functioning of its builders. Linguists interested in the evolution of language, for example, juggle with the co-evolution of the unique human vocal tract, theory of mind (which allows us to take into consideration the situation of the person we are speaking to as we plan what we want to say to them), and the cognitive capacity to attribute significance and meaning to symbols such as words. We also learn to read and write, and developmental psychologists have shown that acquiring the practice of reading changes the way that the brain works. Dietrich Stout's theory, referred to above, concerning the co-evolution of brain size, stone-toolmaking skills and language, Antón et al., thinking in terms of the complex web of interactions within the cultural niche of the earliest *Homo*, bring together increasing brain size, increased tool-making, transport from a distance of quality raw material for stone tools, expansion of diet, and greater developmental plasticity (the capacity to adjust to different or changing environmental conditions (Antón et al. 2014).

Cultural niche construction has been a vital element in human cultural evolution. It enables the third element, cumulative cultural evolution, which is (almost) unique to humans. We are the only species that have evolved forms of cultural niche within which people can not only accurately and safely transmit complex bodies of cultural knowledge, practices and skills (by teaching and learning), but can also continually produce and accumulate cultural innovations. Kim Sterelny is an eminent philosopher whose interest in evolutionary theory and in particular human cultural evolution. In his book *The Evolved Apprentice* Kim traces the long-term development of cooperation, and the evolution of social and cognitive skills embedded in a cultural niche adapted for cultural transmission (Sterelny 2011). Certainly by the time of *Homo sapiens*, young learners had become adept at identifying the best teachers from whom to learn advanced cultural skills, and there were cultural norms that enabled skilled and experienced older people to transmit their skills—what Sterelny calls apprentice learning. *Homo sapiens* cultures of the Upper Palaeolithic were already highly sophisticated, complex and diverse.

On the basis of decades of research teamwork in ethnographic fieldwork and intensive laboratory experiments, Joe Henrich argues that *The Secret of Our Success* lies in the power of the cultural learning niche for the safe inter-generational transfer of complex knowledge and diverse skills (Henrich 2015). The cultural accumulation of innovations is likewise dependent on the existence of very cohesive social groups and a cultural niche that provides for the tutoring, acquisition and practice of complex skills. The sub-title of his book says something very important: "*How Culture Is Driving Human Evolution, Domesticating Our Species, and Making Us Smarter*". His message, as that of a number of researchers, is that the human propensity for prosociality, cooperation and working collectively is more important than individual intelligence.

There is a demographic component to this evolved cultural learning niche: at its most basic level, there must be relatively large numbers of people if there are to be several wise and experienced practitioners of complex skills, such as, for example, building a kayak, making a harpoon, and engaging in hunting seals in the Arctic Ocean. There is also an equally important component in the social structure of populations. Recent anthropological and experimental work shows that small-scale foraging band societies are subtly structured to maximise inter-connections between bands and interactions between non-related individuals or groups (Derex and Mesoudi 2020, which gives a detailed and up-to-date survey with plentiful references). Analysis shows that much innovation involves the refinement of existing things or the recombination of elements from existing things, for which purpose maximizing the ways that people from one group encounter another group improves the chances of the emergence of innovations. Recent experimental work has shown that the best environment for transferring knowledge or encouraging innovation is to set a task to several small groups of people, but to allow individuals to move between groups, comparing notes, as it were, and thus generating insights. These experimental

groups closely mirror the social structures identified in contemporary hunter-gatherer societies, suggesting that hunter-gatherer societies have evolved and retained forms of cultural niche that best fit them for their lives as mobile small-scale bands whose members sometimes visited other bands, or moved from one band to another.

Henrich announces that he has learned that "cultural evolution became *the primary driver of our species' genetic evolution*" (those are his italics: Henrich 2015, 57-58). The process "can be described as *autocatalytic*," he says, "meaning that it produces the fuel that propels it." The multiple positive feedback loops produce a runaway—that is, an accelerating—cumulative process. The Upper Palaeolithic societies, made up of scattered, small, forager bands, were very successful, but arguably they were at the limits of their capacity to sustain sufficiently large numbers of people, who could maintain meaningful contact with one another; the rate of cumulative cultural evolution had reached a plateau.

The leading evolutionary biologist Kevin Laland's research over more than two decades, summarised and expounded in his recent book, *Darwin's Unfinished Symphony*, has converged on Joe Henrich's understanding of the importance of human cultural niche construction for the support of cumulative cultural evolution (Laland 2017). Laland was one of the architects of niche construction theory, and has done fascinating work on the development of cultural niche construction theory. The title of his book alludes to the advances in the understanding of (Darwinian) evolutionary theory, while its sub-title (How culture made the human mind) announces Laland's understanding of the centrality of culture as the driver in human evolution.

There is a growing body of experimental and observational evidence that larger social groups are better able both to sustain a complex cultural heritage, to innovate and incorporate innovations, and to withstand competition. And there has been a massive growth of research papers appearing across an extraordinary range of journals, some of them recently established to represent an emerging sub-discipline. We are fortunate, however, that three of the leading figures in this inter-disciplinary field, each having decades of active research experience, have published very accessible books in recent years (Henrich 2015; Laland 2017; Sterelny 2011). The central thesis of both Joe Henrich and Kevin Laland is the critical importance of the human facility for cumulative culture within an increasingly complex cultural niche. The key features of human cultural and social evolution have therefore been to ensure that there are sufficient, preferably growing, numbers in the population, with maximum interconnectedness: the larger and more complex the body of cultural knowledge, ideas, and behaviours, the greater the scale of population that is required to support it, and the greater the need for intensive sociality and social interaction within that population unit.

It is worth finishing this section with a quotation from Laland's book in which he summarizes what he has learnt about human cultural evolution through his research career: the cultural

niche that humans have evolved at each stage maximises cumulative cultural evolution, with accompanying implications for the co-evolution of cognition and the human brain and mind. His analysis and conclusion closely parallels what Henrich has to say in his book.

"The evolution of the truly extraordinary characteristics of our species—our intelligence, language, cooperation, and technology—have proven difficult to comprehend because, unlike most other evolved characters, they are not adaptive response to extrinsic condition. Rather, humans are creations of their own making … Human genetic data … testified to an unprecedented interaction between cultural and genetic processes in human evolution, fueling a relentless acceleration in the computational power of our brains" (Laland 2017, 30).

The Epipalaeolithic-Neolithic Transformation in Cultural Evolutionary Context

The developments that we see in our Epipalaeolithic-Neolithic transformation, I think, exemplify Sterelny's, Laland's and Henrich's ideas; they are a microcosm within their macrocosm. Their use of the mechanisms of gene-culture evolution and cultural niche construction enabling cumulative cultural evolution offers us the framework within which to explain and better understand the processes in the Epipalaeolithic-Neolithic transformation (Sterelny and Watkins 2015; Watkins 2017, 2018).

The direction of the long-term cultural evolutionary trajectory of humans has been to devise cultural niches that support larger numbers of people living in social groups that maximise their inter-connectedness within the group (for most of the time, forms of mobile foraging band) and between groups. From the beginning of the Epipalaeolithic, at least in the Levant, there were important new developments: the group who left us the site of Ohalo II beside the Sea of Galilee lived there repeatedly and for long seasons of the year, if not year-round. Their exploitation of the diverse options for local food resources is a text-book example of Flannery's broad-spectrum strategy. In addition they were harvesting, drying, storing and processing cereals and grasses (Nadel et al. 2012; Snir et al. 2015). This was the beginning of the move towards sedentism in permanently co-resident communities, which involved, of course, corresponding adaptations to the subsistence strategies. From Jordan we now have early Epipalaeolithic aggregation sites like Kharaneh IV, where different groups came together seasonally, constructing huts, burying some of their dead, and learning and exchanging from each other (Maher 2020; Maher and MacDonald 2020).

We saw earlier the accelerating curve of settlement numbers and settlement size through the Epipalaeolithic and Pre-Pottery Neolithic that accompanies the increasing permanence of settlement. In parallel with the growth and permanence of settlement there was a steadily

expanding growth in the intensity and extent of exchange networks, among whose functions, I have argued, was the sustaining of regional super-communities. Everything worked together to transform the typical Upper Palaeolithic cultural niche into something on a much larger scale, with larger populations more intensively interconnected. The accelerating rate of cultural change, marked by archaeologists in their differentiation of successive archaeological periods and sub-periods, is evidence for impressive new rates of cumulative culture. The cultivation of cereals and pulses, leading to their emergence as domesticated species, and the herding of sheep and goats, again producing domesticated forms, are the most obvious examples of gene-culture co-evolution within the cultural niche, and the growth in the range of skills and cultural practices involved in developing an agricultural economy represent defining characteristics of cumulative culture. In sum, the Epipalaeolithic-Neolithic transformation represents a chapter in the story of recent human cultural evolution, but a chapter within which the pace of cultural evolution moves relatively swiftly into a higher gear. Some cultural evolutionary theorists are experimenting with the idea of punctuated equilibria, pioneered in geology and palaeontology by Gould and Eldredge (1977), in cultural systems (e.g., Kolodny et al. 2015). The experimental models in that study involved theoretical stone tool-kits, and explored the conditions under which a sudden "cultural explosion", a sudden rapid cultural accumulation of new tools might occur. Perhaps what we see in the Epipalaeolithic-Neolithic transformation is something similar, a punctuated burst affecting the whole of the cultural niche as it develops into something new and potentially more productive of cultural growth.

The changing cultural niche came at a cost. The expansion of the scale of the co-resident social group, permanent sedentism, and the sustaining of a high degree of connectivity and shared identity throughout that expanded super-community required new and costly modes of cultural community-building. The modes of material symbolism that we see in our Neolithic, seen particularly in the early Pre-Pottery Neolithic, constitute a very significant development of the cultural niche, because they direct and constrain the cognition of those who were party to the community that shared them. Andy Clark and Steven Pinker are two scientist-philosophers who write about "the cognitive niche" (Clark 2005; Pinker 2010). In both cases they are excited by the way that language materializes thought in words, creating structures that are themselves proper objects of perception, manipulation, and (further) thought.

Clark and Pinker don't differentiate between spoken and written language, as the evolutionary psychologist Merlin Donald emphatically does. Donald labels the third stage in his evolutionary account of culture and cognition "theoretic culture" (Donald 1991, 2001). Although he was thinking primarily—as a good academic should—in terms of written texts as the medium of storage and transmission of all kinds of knowledge, he also discusses the capacity of art and architecture to serve as shared "external symbolic storage" (Donald 2009). Donald argues that

our brains and minds during their development are deeply affected by symbolic elements of the cultural world in which we grow up, to such an extent that the operational structure of the cognitive system can actually be remodelled. What Donald is saying refers to the capacity of humans to make something like the enclosures and sculptures of Göbekli Tepe, or the architecture, furnishing, mosaics and frescoes of a medieval European cathedral, into feedback loop between symbolic material culture and the essential cognitive capacities of a community. What Göbekli Tepe lacks, of course, is what we know of an early church and the way that it would have framed the movements, gestures, words—and the emotions, thinking and beliefs—of those involved in the liturgy. The new forms of expensive investment in material culture, including monumental architecture and highly symbolic sculptures enabled people to share and experience their collective identities as very large social groups—the prototype from which, ultimately, our present world has evolved, in which, as Paul Seabright says, we live in multicultural communities of millions and tens of millions, in the company of strangers.

In one sense it is helpful to be able to see the Epipalaeolithic-Neolithic transformation in historical context, connecting and relating prehistoric processes to our own experience. In another sense, it is enlightening to see that transformation as a dramatic development within the broad context of human cultural evolution. Best of all, however, is the recognition that we can explain that transformation within the framework of cultural evolution, gene-culture co-evolution, niche construction and a continual drive to cumulative culture. And in that multi-disciplinary scientistic endeavour archaeologists can play a key role.

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