UDK 903.28'14(292.46)"633/634":636
Documenta Praehistorica XXXVI (2009)

The materiality of dung: the manipulation of dung in Neolithic Mediterranean caves

Dimitrij Mlekuž
Ghent University, Faculty of Arts and Philosophy, Department of Archaeology and ancient history of Europe, BE
Dimitrij.Mlekuz@UGent.be

ABSTRACT – *This paper discusses the formation of layers of burnt herbivore dung in Neolithic, Eneolithic and Bronze Age Mediterranean caves. While these layers are clearly connected with transhumant pastoralism and the practice of keeping herds in the caves, their formation should not be seen as the result of purely practical and 'rational' reasons. In this paper, I develop an argument that they are remnants of a complex manipulation of substances which includes burning dung to make white ash. Thus instead of seeing dung as a culturally neutral refuse which has to be disposed of, we might see its burning and deposition as the cultural manipulation of potent substance.*

IZVLEČEK – *Članek se ukvarja z nastankom plasti sežganega živalskega gnoja v neolitiku, eneolitiku in bronasti dobi v jamah Sredozemlja. Te plasti so nedvomno povezane s transhumantnim pašništvom in prakso zapiranja živali v jame, a njihovega nastanka ne moremo pripisati zgolj praktičnim in 'racionalnim' razlogom. Članek razvija argument, da so te plasti rezulat kompleksnega manipuliranja s snovmi, ki vključuje tudi sežig gnoja in njegovo transformacijo v bel pepel. Gnoj ni bil kulturno nevtralen odpad, ki se ga je potrebno znebiti; premikanje, sežig in odlaganje pepela je potrebno razumeti kot kulturno manipulacijo potencialno močne substance.*

KEY WORDS – *archaeology; Neolithic; Mediterranean; herding; dung; materiality*

Introduction

Neolithic, Copper and Bronze age occupation levels in Mediterranean caves often consist of curious white powdery sediments. They were recently identified as layers of burnt herbivore dung. They represent the remnants of complex manipulations of matter, which includes the burning of dung to create white ash. These sediments pose a number of interesting question, not only on how and why they were produced, but also what meanings are objectified in the materiality of dung and the daily practices associated with it.

Overview: burnt animal dung

The pioneering work of Jacques É. Brochier (*1991; 1992; 1996; 2002; 2006*) has demonstrated that mineralized dung residues in archaeological deposits can be identified by the occurrence of spherulites, microscopic crystals of calcium salt and grass phytolits. This leads to the identification of herding strategies and penning practices in Mediterranean caves from the Neolithic onwards. Thus, in the Neolithic, Eneolithic and the Bronze Age, caves were used as pens for domestic animals, mostly sheep and goat. This is further supported by the identification of shed milk teeth often found in stable deposits. However, there is also evidence that caves were probably used simultaneously for domestic activities. Caves were obviously seasonal stations in the system of transhumance (*Boschian and Montagnari Kokelj 2000; Mlekuž 2005; Miracle and Forenbaher 2005*).

A unique depositional practice identified in many of these caves consisted of the burning of animal dung. This practice can be recognized in layers of either alternating black and white lenses (so called 'layer-

DOI: 10.4312/dp.36.14

cake' deposits), or white powdery lenses embedded in the sediment. The thin, layered lenses suggest that the process was repeated cyclically, probably over a long period.

Herbivore dung

Herbivores can produce large quantities of dung. Modern sheep breeds can produce around 1.5kg per day, which amounts to between 500 and 900 kg/year per animal; goats are even more productive. Cattle can produce up to 10 000kg of dung per year per animal (*Slicher van Bath 1963*). And even if animals do not stay in caves for the whole year and only part of the day (night, midday), a small herd can produce a large quantity of dung. Thus a herd of 100 sheep, which spends 8 hours per day in a cave for a month, can accumulate around 4000kg of fresh dung.

Cow dung has a high water content – around two to three times its dry weight (fresh dung is 75–60% water), but this greatly depends on diet and season (*Dickinson et al. 1981.129–41*). Sheep and goat dung has a lower water content.

Experiments on cow pats have shown that water content falls rapidly (to below 100% of dry weight) over the first few weeks following excretion if it is protected from rainfall. Dung contains around 50% of organic content, which is highly dependent on diet regimes. Protected dung pats show little loss of water content in the first months after excretion. Even less noticeable is the loss of calorific values (*Dickinson et al. 1981*).

In dry, warm conditions a thick crust is formed over the pat, which protects it from leaching. In caves where sheep are penned, the formation of 'migon', a dried surface comprised of a trampled accumulation of soft sheep dung can be observed. It consists of a dark, compacted organic paste, which breaks into platelike shapes; deep desiccation cracks form during the dry season (*Dickinson et al. 1981*).

However, in the long term (decades, centuries), a process of mineralization, the loss of degradable organic matter through oxidation, slowly transforms dung into a layer of phytolits, calcareous spherulites and detritic dust.

Dung as fuel

Dung can burn and, is used as fuel in many parts of the world, especially where firewood is not readily available. Cattle dung is formed into 'cakes' which are dried in the sun and stored as fuel for cooking and heating fires.

'Buffalo chips' or 'bois de vache', bison dung, were collected and used as fuel in the plains of north America (*Brink 2008*). Various travelers reported that dung "*in dry weather is a an excellent substitute for wood, but when moistened by rain, the smoldering pile will smoke for hours before it condescends to burn*" (cited in *Brink 2008.198*) and that smoke from buffalo chips "*produces an ardent, but transient flame, sufficient for cooking our daily food; but evolves a smoke, which, to the nasal organs of a stranger, is far from agreeable*" (*Brink 2008.198*).

Experiments suggest that cow dung fueled fire can reach a maximum temperature of 640 degrees Celsius and sheep dung maximum of 570 degrees C. Sheep pellets can smolder for quite some time (*Shahack Gross 2008*).

The burning of dung depends on many variables, first and most important being water content. Dung that is improperly dried can produce a lot of smoke and can be very difficult to ignite. The second factor is oxygen supply. Some reports suggest that dung fueled fire needs steady a supply of air in order to burn properly; without sufficient wind, it smolders, produces a lot of smoke and gives off little heat. The third variable is composition, which depends on animal species and diet.

In some cases, piles of fresh dung can ignite and burn spontaneously, due to the heat released during the decomposition and oxidation of cellulose material. In large dung piles with a limited oxygen supply, a smoldering fire starts when organic material reaches ignition temperature. This type of fire produces smoke and heat, but no flame. When more oxygen is present, a glowing fire can occur, producing smoke, more heat and higher temperatures. With abundant oxygen, a flaming fire with very high temperatures will ensue (*James 1928.481–5*).

Deposition practices

Lets return to the black and white sediments in the Mediterranean caves. We now know that the major quantity of deposits derives from herbivore dung altered in many ways, either by burning, by the slow process of mineralization and different kinds of reworking. But how exactly did these formation pro-

cesses operate; how were dung deposits manipulated?

One of the most distinctive features are 'layer cake' sediments of alternating white and black lenses. The layers are thin and form stacks that can be up to several meters thick. Theses sediments cover large areas of the caves (Fig. 1).

Layer cake sediments are the result of the periodical burning of the dried and trampled dung deposited on the cave floor (migon). Thus in layer cake sediments, with alternating black/white layers each combination of white and black layer is a remnant of a single burning event and probably relates to a single occupation of the cave. White ashy layers are the result of properly burned dung, while thinner black layers comprise the bottom and lateral parts of the burnt dung, and contain charred and partially burned organic matter (*Brochier 2002*).

The formation of such sediments was observed in Greek and Sicily caves (*Acovitsioti-Hameau et al. 1988; Brochier et al. 1992*). At the end of autumn, after a summer period of drying, shepherds burn the dung deposited in sheep pens. All except the wettest areas are burnt. Contact between the burnt and unburnt material results in a black carbonaceous layer at the bottom and edges of the burnt ashy layer. The ashy layer is discontinuous and, like examples from archaeological excavations, has an irregular outline (Fig. 2).

There are many practical reasons for burning dung. Probably one of the main reasons was to reduce the volume of manure deposits, as dung loses about 97% of its volume and 95% of its mass as a result of degradation by burning (*Shahack-Gross et al. 2005. 1417–31*). Other reasons include the disinfection of caves and the protection of animals from parasites in the dung.

The distribution and shape of layer cake sediments in the caves can be therefore be explained by the pattern of less dry dung in the cave, the result of precipitation and dripping from cave roofs.

However, not all deposits can be explained in this way. It seems that layer cake deposits are relatively late phenomena, associated with the Copper and Bronze ages. In the Neolithic, we come across other types of sediment derived from dung that are clearly not the result of this depositional practice. Many caves contain thick, rather homogenous brownish

Fig. 1. 'Layer cake' deposits from Eneolithic and Bronze Age layers of Grotta Cotariova/Čotarjeva jama, Italy (after* Montagnari Kokelj et al. 2002. Fig. 8*).

deposits, with abundant cultural remains. At microscopic scale, they appear to be a mix of several components, such as large charcoal fragments, organic matter at various stages of ageing or charring, bone, snail shells, ash, phytoliths, and faecal spherulites (*Boschian 2006*).

Boschian proposed that they were the result of the trampling and reworking of layer cake deposits (*Boschian and Montagnari Kokelj 2000.331–71*), but there is no evidence of large-scale displacements of sediment. On the other hand, they contain plentiful evidence of human daily activities in the cave (cooking, knapping, butchering etc), and the presence of animals (spherulites), and can be interpreted as occupation debris accumulated when people stayed in the cave with their herd.

Within these layers, small heaps of white ash appear. Thus in Pupićina Cave (*Boschian 2006*), the ash patches have irregular shapes and are often clustered in groups that lie on the same surface. Boschian suggests that they are the result of the disturbance of wider lenses. On the other hand, elsewhere

(for example in Mala Triglavca), they appear in thick, circular piles which seem to be undisturbed (Fig. 3).

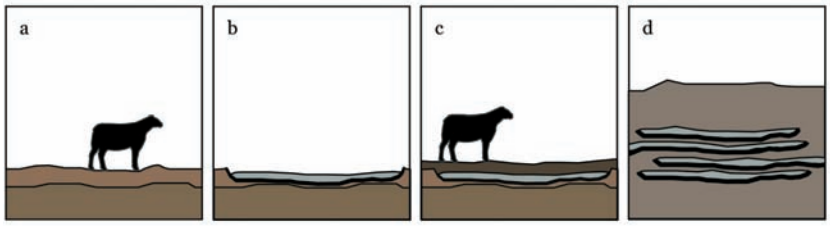

Fig. 2. Model of formation of 'layer cake' deposits. Herbivore dung is accumulated during penning of animals (a); dried and trampled dung deposited on the cave floor (migon) is burned, dark, carbonised material marks the edge between ash and unburnt dung (b); subsequent pennings introduce new layers of dung (c). Slow mineralisation process reduces dung deposits to their mineral contents, while ash and carbonised material stays in place (after* Brochier 2002.Fig. 9*).

There is a distinctive spatial pattern, where heaps of ash are located near the cave walls, while in the central parts of the caves, usually well lit and high enough for a person to stand upright, there are homogenous deposits (*Boschian 2006*). Therefore, the distribution of dung derived sediments cannot be explained only by the level of moisture due to precipitation from the cave roof.

Caves were not only pens for herds of animals, but also places where shepherds lived at the same time. Thus the spatial distribution of dung derived sediments testify to the human organization of the living space and the manipulation of dung.

There are many possible scenarios: either ash was raked and heaped together at the cave walls, or dung was cleared from the central part of the cave, heaped in an area near the cave wall, left to dry and ignited. However, it seems that dung was heaped before burning, probably when it was still wet and untrampled, as the evidence of preserved coprolite structures in ash piles suggest. The dung was then left to dry and ignited. Another possibility was the spontaneous ignition of dung.

There is no evidence of regular patterns of dung burning, such as in the case of layer cake sediments. The rhythm of burning of dung heaps was much slower and less regular; perhaps it was burned every few years, or even every few decades.

All this care and work involved in its transformation suggests that the dung accumulated in the living spaces of Mediterranean caves was not neutral 'refuse'. It was a substance that played an active role in the articulation and negotiation of social relations between people, animals and places.

The materiality of dung transformation: some questions

To tackle the active role of dung and its tranformation in the negotiation of relations between people, animals and places, it is essential to examine the specific qualities and contexts of manipulation, transformation and discarding of dung. In order to address these matters, to approach the materiality of dung, of its transformation and its end product, we must have a closer understanding of the operational sequence of burning dung. There are still many unanswered question, which can be resolved only through practical, experimental engagement with dung and re-creations of dung burning events.

Drying and ignition. How long does dung in a cave dries? How long does it take to dry when it is heaped, and how long when it is spread on the cave floor? When is it dry enough? When can dung be ignited? How can it be ignited? What are the mechanics of igniting dung? How can a heap of dung be burnt? How can a dried and trampled dung surface (migon) be burnt? When does spontaneous combustion occur? Can these conditions be regularly re-created, or do they depend on many random, uncontrollable variables?

Combustion. How does dung burn? With a hot, visible flame, or does it only smolder? At what temperature does dung burn? What variables govern the burning of dung? What effect does the temperature of a dung fire have on the transformation of dung into ash, or on other material organic matter such as twigs, or litter? How do combustion and the temperatures reached affect material buried in dung (*e.g.* bone, pottery)? How does it affect the surface/living floor where it was deposited? Does it change the colour of material; does ash adhere to the material?

Duration. How long does dung burn – for weeks, months, seasons?

Smoke. How much smoke does it produce – enough to fill a cave, enough to be visible from a distance? How is smoke related to variables such as the water

Fig. 3. Circular heap of burnt herbivore dung from Neolithic layers of Mala Triglavca cave, Slovenia.

content in dung? What is the colour of the smoke? Smell?

Quantity. How much dung was burned in a single event? An on-site burning experiment by Ruth Shahack-Gross (*Shahack-Gross et al. 2005*) suggests that volume change related to dung degradation by burning is around 97%. This implies that if a 100cm layer of dung accumulated, after volume reduction, only a 3cm layer of ash will remain.

End products. Burning transforms dung into a white ashy powdery substance. What properties does dung ash have? Consistency? Colour? Smell? Can it be used as a raw material (as a pigment, for example)?

Postdepositional transformations. Can it be trampled easily? How is a layer of dung ash affected by trampling? Does it mix with other sediments?

Discussion

Why was dung regularly burned? Most explanations focus on the practical aspects of disposing of dung. While there might be a number of practical reasons for burning dung, but they are not necessary same as 'our', western, modern, practical reasons; they might be completely different and still completely valid for the culture which practiced the burning of dung. We cannot assume that refuse disposal and site maintenance practices obey some universally applicable notion of functionality and hygiene (*Brück 1999.313*). Dung is not necessarily a dirty, polluted substance, refuse, which has to be disposed of.

Since Mary Douglas' seminal Purity and Danger (*1966*), dirt and garbage offer an important insight into the beliefs, rituals and practices of every society. Cross-culturally, attitudes to refuse and dirt are extremely variable. For excample, Ian Hodder reports that the Nuba of Sudan are not concerned with the practicalities of cleanliness, but will cook and eat surrounded by refuse (*Hodder 1982*). Roma groups keep their caravans very clean, even though their camp-sites may be littered with refuse. This is because rubbish, a dirty and dangerous substance, is used to mark out boundaries between Roma and other societies by highlighting the hazards and tensions inherent in relations between both groups. Refuse therefore plays an active role in the negotiation of relations between people and places (*Okely 1983*). For the Dogon, dirt and refuse in the household compounds is an index of life, activity and reproduction. Littering, the deposition of smoke and dirt – thus, refuse – imbues the household with life and vitality (*Douny 2007*).

Therefore, dung in other cultures may have completely different meanings. For example, burnt animal dung is the main constituent of ashmounds, monumental landscape features of the Neothlithic in the Indian sub-continent. The huge volumes of the ashmounds indicate that the material was accumulated periodically over a long time. They can be related to pastoralism, as they are associated with cattle pens and butchering floors. Ashmounds probably originated in daily activities associated with stock enclosure maintenance. Its association with animals (as an animal product) and the fertility of the land (as fertilizer), transformed the everyday manipulation of dung from a maintenance activity into a cyclical practice, which included the ritual destruction of dung, a highly valued substance (*Johansen 2004.309–30*).

Manipulation – the burning of dung – is also a symbolic manipulation of matter. The burning of dung is a process which transforms dung into new substance, white ash. The process involves burning the dung,

subjecting it to fire, which produces large quantities of smoke and heat, and can take quite a long time. During the long process of transformation, the material changes colour, texture, smell and volume. The regular and formalized nature of these depositional episodes suggests that they were an important part of occupational episodes in maintaining the floors of the living space in caves.

Dung is a product of daily routines and is therefore a cultural construct. It is invested with particular meanings, according to the context and its state. Although dung dropped from animals can be seen as a form of disorder, by being processed and burned, and redeposited it induces ontological order (*Douglas 1966*).

Dung is also an animal product; it is literally a digested, condensed landscape brought into a cave by the agency of animals. Deposits of burnt herbivore dung are produced in pastoral societies, where people share their lives with their animals and are closely dependent on them. Therefore, the proper manipulation, burning, and deposition of burnt dung can be an important part of maintaining relations between people and animals, places and landscape.

These practices have a clear temporal dimension. The dung takes a significant period to dry, and then to burn or smolder. The burning marks a period when a cave is abandoned and empty. The act of burning is literally an act of temporally un-making, dismantling the camp in a cave. Here we can point to similarities with Balkan Neolithic houses, which appear to have conventionally been burnt at the end of their use, and Ruth Tringham suggests that this burning may have taken place on the death of the head of the household (*Tringham 1991.93–131*).

The regular deposition of dung in the same place, near the cave wall, suggests that deposition practices were concerned mainly with the maintenance of the relation with previous occupations and continuity of cave use. This is further supported by the fact that heaps of ash appear to be undisturbed and sometimes carefully preserved from trampling by covering with plate-like rocks. In this perspective, burnt animal dung can be seen as a 'stuff of memory', a material record of previous occupations and the activity of ancestors. Repetition of material practices of dung manipulation might have been a way of constantly retaining and renewing the association of people, animals and places.

Summary

Deposits of burnt animal dung in Mediterranean caves are strong indicators of a pastoral way of life. The cyclical deposition of these sediments testify to a rhythm of repeated activities connected with seasonal (transhumant?) movements and the use of caves as shelters for herds and people.

It appears that the distribution of different types of dung derived sediments is not merely the result of natural conditions (water in sediment due to dripping from the roof), but the effect of human activities which structured the cave space. Dung, being an animal product, thus played an active role in the negotiation of activities between people, animals, places and landscape. Cyclical, regular and highly structured activities connected with the transformation of dung mean that deposits of burnt dung from previous occupations constitute a material memory which established relations with past occupations and ancestors.

Thus, instead of seeing dung as culturally neutral refuse which has to be disposed of, we might see its burning and deposition as the cultural manipulation of a potent substance.

REFERENCES

ACOVITSIOTI-HAMEAU A., BROCHIER J. É. and HAMEAU P. 1988. Témoignages et marqueurs du pastoralisme actuel en Grèce: une ethnographie des gestes et des restes et les applications archaéologiques corrélées. *Ethnologia 6–7: 93–135*.

BOSCHIAN G. 2006. Geoarchaeology of Pupićina Cave. In P. T. Miracle and S. Forenbaher (eds.), *Prehistoric herders of nortehern Istria. The archaeology of Pupićina cave. Volume 1*. Monografije i katalozi 14, Arheološki muzej Istre, Pula: 123–162.

BOSCHIAN G. and MONTAGNARI KOKELJ E. 2000. Prehistoric Shepherds and Caves in the Trieste Karst (Northeastern Italy). *Geoarchaeology: An International Journal 150(4): 331–371*.

BRINK J. 2008. *Imagining Head-Smashed-In: Aboriginal Buffalo Hunting on the Northern Plains*. AU Press, Edmonton.

BROCHIER J. É. 1991. Géoarchéologie du monde agropastoral. In J. Guilaine (ed.), *Pour une archéologie agraire*. A. Colin, Paris: 303–322.

1996. Feuilles u fumiers? Observations sur rôle des poussièers sphérolitiques dans l'interprétation des dépôts archéologiques holocèenes. *Anthropozoologica 24: 19–30*.

2002. Les sédiments anthropiques. Méthodes d'étude et Perspectives. In C. Miskovsky (ed.), *Géologie de la préhistoire: méthodes, techniques, applications*. Geopré, Paris: 459–477.

2006. Des hommes et des bêtes: une approche naturaliste de l'histoire et des pratiques de l'élevage. In J. Guilaine (ed.), *Populations néolithiques et environnements*. Collection des Hespérides, Errance, Paris: 137–152.

BROCHIER J. É. , VILLA P., GIACOMARRA M. and TAGLIACOZO A. T. 1992. Shepherds and Sediments: Geo-archaeology of pastoral sites. *Journal of Anthropological Archaeology 11: 47–102*.

BRÜCK J. 1999. Ritual and Rationality: Some Problems of Interpretaton in European Archaeology. *European Journal of Archaeology 2(3): 313*.

DICKINSON C. H., UNDERHAY V. S. H. and ROSS V. 1981. Effect of season, soil fauna and water content on the decomposition of cattle dung pats. *New Phytologist 88(1): 129–141*.

DOUGLAS M. 1966. *Purity and Danger – an analysis of concepts of pollution and taboo*. London, Routledge & Kegan Paul.

DOUNY L. 2007. The Materiality of Domestic Waste: The Recycled Cosmology of the Dogon of Mali. *Journal of Material Culture 12(3): 309–331*.

HODDER I. 1982. *Symbols in Action: Ethnoarchaeological Studies of Material Culture*. Cambridge University Press, Cambridge.

JAMES L. H. 1928. An observed case of "spontaneus" ignition in stable manure. *Journal of Agricultural Research 36(5): 481–485*.

JOHANSEN P. G. 2004. Landscape, monumental architecture, and ritual: a reconsideration of the South Indian ashmounds. *Journal of Anthropological Archaeology 23(3): 309–330*.

MIRACLE P. T. and FORENBAHER S. 2005. Neolithic and Bronze-Age Herders of Pupićina Cave, Croatia. *Journal of Field Archaeology 30: 255–281*.

MLEKUŽ D. 2005. The ethnography of the Cyclops: Neolithic pastoralists in the eastern Adriatic. In M. Budja (ed.), *12th Neolithic Studies, Documenta Praehistorica 32: 15–51*.

MONTAGNARI KOKELJ E., GREIF T. and PRESELLO E. 2002. La Grotta Cotariova nel Carso Triestino (Italia nordorientale). Materiali ceramici degli scavi 1950–70. *Aquileia Nostra 73: 37–190*.

OKELY J. 1983. *The Traveller-Gypsies*. Cambridge University Press, Cambridge.

SHAHACK GROSS R. 2008. Heat of dung-fueled fires (archived e-mail message). In N. M. Miller (ed.), *An Idiosyncratic and Not Exhaustive Bibliography for Animal Dung and Archaeology*. http://www.sas.upenn.edu/~nmiller0/dung.html (accessed 2.12.2008).

SHAHACK GROSS R., ALBERT R. M., GILBOA A., NAGAR-HILMAN O., SHARON I. and WEINER S. 2005. Geoarchaeology in an urban context: The uses of space in a Phoenician monumental building at Tel Dor (Israel). *Journal of Archaeological Science 32(9): 1417–1431*.

SLICHER VAN BATH H. 1963. *The Agrarian History of Western Europe AD 500–1850*. Arnold, London.

TRINGHAM R. 1991. Households with Faces: The Challenge of Gender in Prehistoric Architectural Remains. In J. M. Gero and M. W. Conkey (eds.), *Engendering Archaeology: Women and Prehistory*. Blackwell Publishing, New York: 93–131.

UDK 903'12/'15(497.11)"633/634":314.17
Documenta Praehistorica XXXVI (2009)

Some thoughts on social versus cultural complexity

Rastko Cvekić
Department of Anthropology, University of Toronto, CA
rastko.cvekic@utoronto.ca

ABSTRACT – *Socially complex hunter-gatherers are characterised by (1) inherited, permanent leadership and (2) sustained control over non-kin labour. Archaeologists have tended to infer social complexity through evidence of cultural complexity (i.e., artistic elaboration, composite tool technology, religion, etc). Complexity theory, however, indicates that patterns suggestive of social complexity can be produced through simple behavioural rules that do not necessitate social hierarchies. Therefore, evidence of cultural complexity cannot be used to infer social complexity in archaeological societies, nor should social complexity be emphasized in discussions of hunter-gatherer achievement or evolution of food production.*

IZVLEČEK – *Socialno kompleksne skupnosti lovcev in nabiralcev označuje (1) dedno, trajno vodstvo in (2) nepretrgan nadzor nad ne-sorodstvenim delom. Arheologi so se s pomočjo dokazov o kulturni kompleksnosti (i.e., umetniškem delovanju, tehnologiji sestavljenih orodij, religiji, itd.) nagibali k oceni o socialni kompleksnosti. Vendar teorija kompleksnosti kaže, da so vzorci, ki kažejo na socialno kompleksnost, lahko produkt enostavnih pravil obnašanja, ki ne zahtevajo socialne hierarhije. Zato dokazov o kulturni kompleksnosti ne moremo uporabiti za sklepe o socialni kompleksnosti arheoloških skupnosti, niti ne bi smeli poudarjati socialne kompleksnosti v razpravah o lovsko-nabiralskih dosežkih ali razvoju pridelovanja hrane.*

KEY WORDS – *complex hunter-gatherers; complexity theory; Mesolithic; sociocultural evolution*

> *[In] literature as a whole, successful farmers have social relations with one another, while hunter-gatherers have ecological relations with hazelnuts.* (Bradley 1984.11)

This paper examines recent attempts to consider social relations in the European Mesolithic that led to the portrayal of the Mesolithic as a social evolutionary stage characterised by socially complex hunter-gatherers. Social complexity consists of (1) hereditary social differentiation and (2) control over non-kin labour. Increasing cultural complexity, on the other hand, refers not only to socio-economic organisation, but to all aspects of culture, including art, technology, and religion. The paper begins by reviewing debates about complex hunter-gatherers and about Mesolithic hunter-gatherers. This is followed by a consideration of archaeological applications of complexity theory. I critique the use of complexity theory in the creation of a new social evolutionism. We should consider culture in its entirety, rather than just socio-economic organisation, as the non-linear adaptive system whose evolution we want to study. Essentially, this is the same adaptationist argument that Peter Rowley-Conwy (*2001*) and many others before him have made, although as archaeologists we cannot hear it often enough. The final sections of this paper review recent debates about the social organisation of the Levantine Natufian and the Lepenski Vir culture of the Iron Gates Gorges; both regions appear to be characterised by culturally rather than socially complex hunter-gatherers.

DOI: 10.4312/dp.36.15

Complex hunter-gatherers

The dominant discourse in the West has traditionally portrayed hunter-gatherers as radically altern Others, highly mobile in their day-to-day food quest and living a simple life without social differentiation. They are thought of as closer to nature than to culture (*i.e.*, civilisation), and their situation has often been clearly juxtaposed, for better or for worse, to that of our modern selves (*Pluciennik 1999; Tringham 2000; Hernando 2002; Kotsakis 2003; Borić 2005*). Thus, Thomas Hobbes famously described this supposedly natural state of humankind as having "*no Culture of the Earth [*i.e.*, no cultivation]; [...] no Knowledge of the face of the Earth; no account of Time; no Arts; no Letters; no Society; and which is worst of all, continuall feare, and danger of violent death; And the life of man, solitary, poore, nasty, brutish, and short*." (*Hobbes 2003[1651].102*).

Although Marshall Sahlins' concept of the original affluent society (*Sahlins 1968; 1972*; see also *Lee and DeVore 1968*) allowed for a more positive view of hunter-gatherers, the belief remained that they had a comparatively simple social organisation (*Solway 2006*). The explanation for this lack of social complexity hinged on the fact that hunter-gatherer communities were relatively small, while social complexity was understood to generally increase with a rise in population (*e.g., Carneiro 1967*). Moreover, the criteria for measuring complexity were set with Western capitalist states always at the top of the ladder (*Rowlands 1988*).

Socially complex non-agricultural societies, like those of the Northwest Coast of North America and to a lesser extent Siberia (*e.g., Suttles 1968; Donald and Mitchell 1975*; sources cited in *Shnirelman 1992. 15–16*) tended to be explained away as rare anomalies (starting with *Grosse 1896*). Archaeologically, they did not fit the evolutionary scheme that associated any form of transegalitarian[1] social organisation with agriculture. Bakhta (*1986*) sums up this stance by specifically differentiating early farmers from hunter-gatherers based on (1) sedentism, (2) storage, (3) delayed return economy (*cf. Woodburn 1980*), (4) socially differentiated relations of production, (5) intensification of productivity, and (6) specialisation of labour. This view is still very much alive in the Western political and popular imagination (*e.g., Horst Köhler and Günther Oettinger in Licher 2007.8,10*). Rowley-Conwy (*2001*) pointed out that the highly mobile, egalitarian hunter-gatherers came to be (wrongfully) seen as the baseline from which all subsequent human evolution took place. This criticism of presupposing a directional evolutionary trajectory towards greater complexity applies not merely to Victorian social evolutionists, but to Marxist, processual and ecological archaeologists (*Trigger 1998.10*) as well as to pre-Darwinian Enlightenment thinkers (*Chapman 2003.5*). Complex societies are consistently valued more highly (*sensu Shanks and Tilley 1987.164*) than their simple counterparts.

Carneiro (*1967*) perceived population growth as a sufficient cause for more complex social organisation, with sufficient population growth in turn only made possible by the greater productivity allowed for by agriculture. From the social evolutionist viewpoint, this increase in social complexity was defined as the development of social structure (*Spencer 1873*), predicated on growth in the units of society (namely, population growth). Evolution implied both the growth of structural units and the development of new structural units at a higher level of organisation (*Spencer 1866*). Carneiro created a yardstick (*cf. Naroll 1956*) for measuring social complexity based on the presence or absence of 205 traits in 46 societies, concluding that "*the more traits a society had, [and, thus, the more socially complex it was,] the higher its culture level*" (*Carneiro 1967.235*). While presumably devising a measure of social complexity, Carneiro went on to make a value judgment about cultural complexity.[2] The interchangeable use of social and cultural complexity (*e.g., Carneiro 1967.235; Matson 1983.125–126; Maschner 1991; Price 1995b. 423–424; Tainter 1996a.4–8*; and to a lesser extent *Arnold 1996.80*) has caused considerable confusion about what scholars are actually referring to, although they have generally agreed that both types of complexity tend to be associated with agriculturalists.

Since the 1960s, Richard Lee (*1968; 1992; Solway and Lee 1990*), and others, saw the unifying characteristic of all hunter-gatherer 'band societies' in their egalitarian ideology of sharing. This is what Ingold

1 Transegalitarian refers to a degree or level of social complexity intermediate between egalitarian bands and stratified chiefdoms (*Hayden 1993; cf. Johnson and Earle 1987*).

2 See Newell and Constandse-Westermann (*1984*) for a more nuanced argument for the interconnectedness of population growth and density, social complexity, and archaeologically visible complex technology.

(*1988*) calls the hunter-gatherer 'mode of production', a social type implying not only a hunter-gatherer mode of subsistence, but also egalitarian social relations (*sensu Ingold*) and ideology (*sensu Lee*). In Marxist approaches, dialectical materialism specifies a straightforward relationship where the subsistence base determines social relations, which are further reinforced through ideology. Tainter (*1996b*) indicated that hunter-gatherers thus doomed to simplicity, were reckoned to demand little respect from archaeologists more concerned with societies closer in complexity to their own. Sir Mortimer Wheeler even compared a bad archaeological fieldworker to a hunter-gatherer, "*master of a skill, perhaps, but not creative in the wider terms of constructive science*" (*Wheeler 1954.152*). Hunter-gatherers were thus summarily dismissed.

It is in this context that a discourse on 'complex hunter-gatherers' (CHG) emerged in archaeology during the early 1980s (*Koyama and Thomas 1981; Price and Brown 1985a*). At least some hunter-gatherers, as was known, were complex in all the characteristics identified by Bakhta (*1986*) as indicators of a food producing economy. Archaeological correlates of complex hunter-gatherers that have often been proposed include: sedentism (*Matson 1985*); higher overall population, population density, and population growth; storage (*Testart 1982*); delayed return economy (*Woodburn 1980*); logistical collector subsistence-settlement pattern (*Binford 1980*); property rights and territoriality (*Coupland 1985b*); elaboration of ceremony and art (*Soffer 1985*); trade and inter-group networking; technological and labour specialisation; and a division of labour that goes beyond close kin, sex, and age (*Arnold 1996*).

Considering the previous emphasis on agriculture as the enabling precondition of complex social organisation and cultural elaboration, it is perhaps little wonder that early CHG studies focused on the ecological conditions necessary for increasing complexity. Resource intensification (*Dyson-Hudson and Smith 1978; Matson 1983*) was seen as the most crucial variable in the transition from simple to complex hunter-gatherers (*e.g., Price and Brown 1985b; Henry 1989*) and more generally in the transition from the Late Pleistocene to the Holocene (*Hayden 1981*).[3] Zvelebil (*1998*) elaborated on Ingold's (*1988*) scheme of the hunter-gatherer mode of production: some 'hunter-gatherers' existed without the ideology (and social relations) of egalitarianism and sharing, while other 'hunter-gatherers' did not rely on an exclusively non-agricultural subsistence. It is not merely the mode of production, but rather the relations of production and the efficiency of particular economic adaptations to their specific environments that are important in the appearance of social complexity (*Shnirelman 1992*). This point, however, had been lost on many researchers. As Warren (*2005a*) and others pointed out, the CHG discourse made a generalising social evolutionary stage out of complex hunter-gatherers (*e.g., Hayden 1993; 2003. 3*), rather than enabling analysis of variability in their social organisation (*cf. Kelly 1995; Ames 2004*). Levantine archaeologists, for example, now saw the Natufian (complex) hunter-gatherers as a pre-agricultural foundation of Western Civilization (*Bar-Yosef 1991.394*, and less explicitly in *1998.159*).

Like the Man the Hunter conference (*Lee and DeVore 1968*), the CHG debate was originally envisioned to help humanise hunter-gatherer studies. Complexity, as defined by Jeanne Arnold, consists of two things: (1) ascribed and permanent inequality (*i.e.* hereditary social differentiation) and (2) labour relations characterised by sustained, on-demand control by elites over non-kin labour (*Arnold 1996. 78–79*). Arnold (*1996.94*) identifies (social) complexity through mortuary contexts and household architecture and content as evidence for social differentiation, and through production contexts, residential settings and cemeteries as evidence for labour relations. Other aspects of (cultural) complexity – such as art, ritual and symbolism – were previously used by some scholars to infer hunter-gatherer complexity (*e.g., Soffer 1985*). These aspects of cultural complexity not associated with social organisation are seen as "*epiphenomenal*" in Arnold's scheme (*1996.78*); they are merely idiosyncratic features of particular cultures and are thought to be dependent on social organisation. Such a definition sees social complexity as a necessary first step in cultural complexity.

Complex hunter-gatherers have been opposed to 'simple', egalitarian hunter-gatherers (*e.g., Price and Brown 1985b; Ames 1995; Arnold 1996*) – whom Sahlins (*1968; 1972*) called the original affluent society, because they are efficient in satisfying their daily subsistence needs (see also *Rowley-Conwy 2001; Solway 2006*). The distinction between these

3 This has also been described as a switch from *K*-selected to *r*-selected resources (*e.g., Hayden 1981; Gamble 1986*), terms borrowed from animal ecology (*cf. Pianka 1972*).

two societal types is found in the direction of within-group material transfers: from those who temporarily have more to those who have less (*i.e.* sharing) in simple societies, and from those who chronically have less to those who have more (*i.e.* exploitation) in complex societies (*Cowgill 1996*). Complexity was correlated with more people interacting with one another on a daily basis in order to meet everyday needs. Cohen (*1985*) identified scalar stress within such situations, in which interpersonal conflict is more likely to arise, as the driving force in a shift from egalitarian to ascribed, hierarchical social organisation. In this account, social inequality was understood as functional and beneficial to the community as a whole, since higher-level social units were thought to be necessary for dealing with scalar stress. However, Rathje and McGuire (*1982*) demonstrated that cross-culturally such complexity is exploitative – those with power gain more from it than those without power. Tainter goes as far as to call complexity an "*abnormal condition of human organization*" (*1996b.12*, see also *Henry 1989.5*), while Rowley-Conwy (*2001.65*) proposes that it is, in fact, egalitarianism that is the "*most remarkable and specialised social form that humans have ever evolved*".

Many scholars have critiqued the simple-complex dichotomy in hunter-gatherer studies and its social evolutionary heritage (*e.g., McGuire 1996; Rowley-Conwy 2001; Ames 2004; Warren 2005a*). Variability in hunter-gatherer social organisation lies on a continuum or spectrum (*Kelly 1995*), and opposing the two ends of this spectrum needlessly simplifies things. This critique has led to revisions of the simple-complex dichotomy. For example, Arnold (*2004*) now adds an 'affluent' stage between egalitarian and complex hunter-gatherers; this 'affluent' stage is characterised by cultural complexity, but lacks the hereditary inequality and sustained control of non-kin labour characteristic of her (socially) 'complex' hunter-gatherers.[4] Such approaches, and Rowley-Conwy's (*2001*) own four-stage model, have been criticised as still not going beyond the social evolutionary discourse. Warren (*2005a.70*) contends that while "*it is possible to argue that the discussion of 'complex hunter-gatherers' served an archaeological purpose during the 1980's it is now time to move on*" and look at more humanising aspects of the past (*e.g., Warren 2005b*). While applauding the call for a more humanising archaeology, I do not entirely agree with Warren's assessment. Arnold (*2004*) argues that for the Northwest Coast and Plateau of North America, a major anthropological goal remains to discern the exact type of social organisation of the prehistoric populations in these areas. I believe that the same applies to the Natufian, Lepenski Vir and other prehistoric hunter-gatherer societies that have been recently described as socially complex. Although social organisation does not determine other aspects of culture, we should not ignore it altogether as an object of study.

Mesolithic hunter-gatherers

Whereas the preceding discussion of complex hunter-gatherers juxtaposed them to simple hunter-gatherers, studies of the European Mesolithic tend to juxtapose hunter-gatherers (regardless of social organisation) to Neolithic farmers (*Price 1985; Zvelebil 1998*). Wilmsen and Denbow (*1990*; see also *Woodburn 1988*) believe that the egalitarian ideology of many modern hunter-gatherers and their social relations based on sharing (*cf. Lee and DeVore 1968*) are a result of encapsulation by pastoralists; they consider 'simple' hunter-gatherers as a very recent phenomenon. This helped question the idea that simple hunter-gatherers were a baseline of social evolution (*Rowley-Conwy 2001*), which had important repercussions for interpretations of the Mesolithic-Neolithic transition in Europe (*Radovanović 2006; cf. Spielmann and Eder 1994*).

When Lubbock (*1865*) split up the Stone Age, he distinguished the Neolithic from the Palaeolithic on the basis of the presence of (1) polished stone tools, to which others later added the presence of (2) modern fauna (*i.e.*, Holocene epoch), (3) agriculture (in the form of domesticated plants and animals), and (4) pottery. To Victorian social scientists, the Neolithic was simply a chronological stage on an implicit social evolutionary progression from primitive hunter-gatherers to British civilisation (*Pluciennik 1998; Zvelebil 1998*). It was not until V. Gordon Childe's (*1925*) concept of the 'Neolithic Revolution' that the Neolithic came to be seen as a societal type, characterised by a specific social organisation determined by an agricultural mode of subsistence. Zvelebil (*1996*) points out that analogies for the technological and economic aspects of the Neolithic are taken from ethno-historical (and folk studies) accounts of the European peasantry, creating a sense of the Neolithic as an ancestral form of our own societies.

4 In the Japanese tradition (*e.g. Koyama and Thomas 1981*), 'affluent' hunter-gatherers have more in common with Price and Brown's (*1985a*) 'complex' hunter-gatherers, than with Sahlins' (*1972*) 'original affluent societies' (see *Koyama and Uchiyama 2006*).

Aspects of Neolithic social life, on the other hand, are generally taken from ethnographic analogies from outside Europe (*e.g.*, Papua New Guinea), because the European peasantry is considered to have evolved socially (and morally), making it an inadequate source of analogy for early farmers from several thousand years ago (*Zvelebil 1998.12–13*). The last two decades have seen an icreased interest in providing a more coherent reconstruction of Neolithic mentality (*e.g., Hodder 1990; Thomas 1991; Cauvin 2000*). Post-processualists have identified a fundamental wild/tame duality as the basis for many other binary oppositions structuring thought during the Neolithic. Although Zvelebil (*1998*) has shown that Mesolithic hunter-gatherers may already have distinguished the wild from the tame, Cauvin (*2000*) was unwavering about Natufian hunter-gatherers having a fundamentally different mindset than people in the Neolithic, something akin to Ingold's hunter-gatherer ideology of egalitarianism. When combined with the 'cultural circles' approach (*e.g., Kossinna 1911*), which assumes a direct correspondence between archaeological cultures and distinct ethnicities and which is still conventional in much of central and eastern Europe (*Chapman and Dolukhanov 1993*), the definition of regional Neolithic cultures and their Mesolithic 'opponents' takes on both nationalist (*Zvelebil 1996*) and imperialist overtones (*Pluciennik 1998*). The Neolithic was variously understood as both the foundation of European civilisation and as a precedent for (as well as justification of) 19th and early 20th century European imperialism.

Meanwhile, the Mesolithic was first defined by Westropp (*1872*, and later by *Reboux 1873* and *Brown 1893*) and originally referred to what we now know as the Upper Palaeolithic (*Ayarzagüena Sanz 2000*). The Mesolithic was supposed to have bridged the apparent hiatus between the Old and New Stone Ages proposed by de Mortillet (*1872*).[5] Zvelebil (*1998*) argues that unlike the Neolithic, the Mesolithic never came to be characterised by its own societal type; even Childe (*1947*) dismissed it as a mere chronological stage because it did not fit preconceived models of social evolution: "*the Mesolithic was regarded as a period of decline, not of progress, whose diminutive stone tools – microliths – neatly symbolised the irrelevance of the period*" (*Zvelebil 1998.2, cf. Clark 1978.3*). The 1980s attempts to define the Mesolithic as a unique complex hunter-gatherer societal type based on a largely fishing mode of subsistence (*e.g. Price 1985*), and moreover representing a progressive stage on the social evolutionary ladder (*e.g., Hayden 1993; 2003*), were not widely accepted by European scholars (*e.g., Price 1995a; Zvelebil 1998.3*).[6] The view that sees the European Mesolithic and the Levantine Natufian as populated by complex hunter-gatherers only became institutionalised in a few North American introductory textbooks (*e.g., Fagan 2001; Hayden 1993*). Because they are foundational histories (*sensu Leone 2006*), however, these textbooks have shaped the preconceptions of a whole generation of students, myself included, that relied on them.

Beyond the Neolithic and the Mesolithic, a third term – the Epipalaeolithic – has gained currency. The Natufian, originally defined as a Mesolithic industry (*Garrod 1957*), was later called Epipalaeolithic, based on its re-dating to the Terminal Pleistocene (*Belfer-Cohen 1991*). In the Levant, then, the distinction between Epipalaeolithic and Mesolithic was based on the Pleistocene-Holocene boundary. In the Iron Gates Gorges and southern Europe generally, on the other hand, the Epipalaeolithic refers to Holocene (rather than Pleistocene) hunter-gatherers, distinguished from the Mesolithic based on the presumed continuity of life-ways with the Upper Palaeolithic (*Boroneanț and Dinu 2006; Radovanović 1996.12–15*). In the Levant, however, the Natufian Epipalaeolithic (though usually not the preceding Kebaran and Geometric Kebaran) have come to stand for the same evolutionary threshold between simple hunter-gatherers and farmers as the Mesolithic in some areas of Europe (*e.g., Bar-Yosef 1991; 2002; Henry 1985; 1989*). Some scholars therefore label the Natufian a Mesolithic entity (*Clark 1980; Hayden 1993*).

Because they were originally conceived of as chronological markers, the co-existence of Mesolithic and Neolithic was for a long time thought to be impossible. This created problems in areas such as the Iron Gates Gorges, where scholars defined the Lepenski Vir culture as either Neolithic or pre-Neolithic (or

5 De Mortillet (*1883*) concluded that the Palaeolithic inhabitants of Europe moved out and were replaced by Neolithic populations from the Near East after a period of no occupation. This theory had profound implications for future studies of the Natufian, Lepenski Vir, and the Mesolithic-Neolithic transition in southeast Europe generally (*e.g., Childe 1929*).

6 What Zvelebil considers the prevailing view of the Mesolithic would best be summed up by Laurent's humorous drawing of Mesolithic hunters chasing landsnails with microlith-tipped spears in rainy weather (*Laurent 1965.81*, reproduced in *Radovanović and Voytek 1997.20*).

Mesolithic) based on whether they accepted the contemporaneity of pottery and trapezoidal house floors (*e.g., Srejović 1969; 1972 contra Jovanović 1969*). The contemporaneity of at least parts of the LV I layer at Lepenski Vir with the Early Neolithic of surrounding regions to the south eventually led to models of Mesolithic-Neolithic contact (*e.g., Chapman 1989; Voytek and Tringham 1989; Radovanović 1996; Roksandić 2000*). These arguments were often based on Zvelebil and Rowley-Conwy's (*1986*) 'availability model of the moving frontier' of interaction between hunter-gatherers and farmers during the transitions from the Mesolithic to later prehistoric periods in various areas of Europe.[7] However, Alexander (*1977*) had introduced the frontier analogy with explicit reference to Frederick Jackson Turner's (*1893*) 'American Frontier.' He distinguished between an initially 'moving frontier' and four versions of the ensuing 'static frontier' resulting in hunter-gatherers either (1) being 'destroyed', or (2) being absorbed by farmers, or (3) retreating into isolation, or (4) creating a symbiotic relation with farmers. Because of this connection with the manifest destiny of American imperialism, as well as the fact that 'Neolithic farming' eventually predominated over 'Mesolithic hunting and gathering', Pluciennik (*1998; 1999; see also Borić 2005*) felt that Mesolithic-Neolithic frontier models predisposed an eventual static frontier always characterised by the annihilation of the hunter-gatherers. One has to point out, however, that Zvelebil and Rowley-Conwy (*1986*) were arguing precisely against such a position.

The Mesolithic, as currently conceived, is closely tied to hunter-gatherers, if not necessarily to Ingold's (*1988*) hunter-gatherer mode of production. Mesolithic social organisation has been variously interpreted as either simple or complex, as has the general 'state of culture'. However, most research on the Mesolithic has taken an ecological approach (*Price 1995b; Zvelebil 1995a*), focusing on hunter-gatherers' relations with their environment rather than with each other (*Bradley 1984*). While Tringham (*1991*), among others, argued for a focus on ideology, meaning and social relations, Jochim (*1998*) criticises all such approaches as unscientific in their 'sweeping interpretations' unsupported by archaeological data and in failing to take into account alternate hypotheses. Although this does not mean that we should abandon such innovative research altogether, Jochim (*1998.28*) is correct in urging for a clarification of terms and stronger support of arguments by data. In this context, one should point out that Natufian and Lepenski Vir scholars have reconsidered the archaeological evidence for social complexity (see below). A shift in socio-cultural evolutionary theory has accompanied these meticulous reconsiderations of the type of social organisation of temporally and spatially distinct hunter-gatherer groups.

Complexity theory

Complexity theory, as a novel approach to the study of non-linear adaptive systems through computer simulation, was popularised in the 1990s (*Lewin 1992; Waldrop 1992; Gell-Mann 1994*). Essentially, there is feedback in complex adaptive systems between (1) the interaction of constituent parts at the local level and (2) global structures and patterns that emerge from these local interactions (*Mol and Law 2002; Bentley 2003; van Kooten Niekerk and Buhl 2004*). Such an approach is juxtaposed to the reductionist systems theory characteristic of processual archaeology, where the importance of feedback between global- and local-scale phenomena had been understated. Vitalists explained away local phenomena as being determined by some inexplicable global structure, while mechanists explained away global phenomena as being determined by their constituent parts. The insight from complexity theory is that global structures emerge from local interactions, but are more than the arithmetic sum of the system's constituent parts at the local level and, in turn, act back on these constituent parts.

Complexity theory can trace its beginnings to several sources, one of which is the debate on the origins of multicellular life immediately prior to the Cambrian period. Christopher Langton (*1986*) proposed that such life could emerge from interactions of simple single-celled organisms. Once they come to exist, these more complex multicellular organisms propagate themselves, form diverse and ever more complex life-forms, and oscillate periodically between florescence and collapse (*Lewin 1992.63*). They are said to evolve to the edge of chaos (*Langton 1990*), a state precariously poised between order and chaos, characterised by ever-increasing complexity (*i.e.*, species diversity), with periodic collapses of catastrophic dimensions. Langton (*1986*) used cellular automata in his computer model to simulate the

7 According to Zvelebil and Rowley-Conwy, the hunter-gatherers were conceptualised as having diverse and historically specific social organisation (see also *Zvelebil 1998*).

emergence of multicellular life from the interactions of single-celled, inanimate organisms. However, because they are inanimate, cellular automata work best for simulating spatial phenomena that can be conceptualised as stationary, as opposed to kinetic and dynamic systems such as past human cultural systems (*Epstein and Axtell 1996.17–19*).

While much early complexity theory dealt with biological phenomena, it is increasingly being applied to the social sciences (*e.g., Epstein and Axtell 1996; Mol and Law 2002*). Joshua Epstein and Robert Axtell's (*1996*) Sugarscape was a pioneering effort in this direction. Sugarscape is an example of agent-based modelling of artificial societies. These are computer simulations of complex systems involving artificial agents interacting with each other and with an artificial environment modelled on cellular automata. The Sugarscape environment is modelled as a torus-shaped landscape of cells with differing amounts of a resource (called sugar). Sugarscape agents, on the other hand, are modelled as heterogeneous individuals that move through the artificial landscape in search of the sugar they need to live and prosper. Object-oriented programming languages allow this decoupling of landscape and agents (*Epstein and Axtell 1996.179–181; Kohler 2000*). While such artificial societies are not perfect replications of the real world, they allow for a 'bottom-up', generative social science that allows for a positivist testing of competing hypotheses of diachronic trajectories (*Bentley and Maschner 2003b.4*). Agent-based modeling, moreover, (1) allows social scientists to move beyond concepts of equilibrium, linearity and homogeneity, (2) enables a study of emergent phenomena, and (3) is more realistic than deterministic models that fail to account for agents' actions at the local level (*Bentley 2003.21*).

There are two ways of applying complexity theory in archaeology (*Bentley and Maschner 2003b*): empirical and theoretical. Empirically, we can juxtapose observed patterns in the archaeological record to those created by bottom-up agent-based modelling or other simulations of complex, adaptive systems (*e.g., Banning 1996; Dean et al. 2000; Lake 2000*; other contributions to *Kohler and Gumerman 2000*). Theoretically, we can use concepts such as emergence and the edge of chaos as explanatory mechanisms without relying on specific models or simulations as go-betweens (*e.g., Hayden 1993*; several contributions in *Bentley and Maschner 2003a*). On a theoretical level, complexity theory can also support the argument made here that increasing cultural complexity does not necessarily mean increased social complexity.

Agent-based modelling has often served a 'spoiler role' in archaeology (*Kohler 2000.12*). It has been used to derail theories that postulated a need for global rules and centralized processes to account for complex global patterns, which in reality could have been generated by simple rules of interaction at the local level (*Bentley 2003.14*). Banning (*1996*), for example, shows how simple rules of local behaviour can account for patterned village layout in Near Eastern prehistory, a phenomenon Childe (*1950*) attributed to political complexity and centralized control over 'town planning'. In a similar vein, Banning (*2003.8–9*) notes that the standardisation of house shape in the Near Eastern Neolithic could have arisen out of simple local rules of what a house should look like, rather than from a centralised monopoly on house construction by architect specialists. The spoiler role, of course, only provides alternative explanations, as it does not disprove the competing interpretation, but merely shows that a simpler explanation can account for whatever phenomenon is being investigated. However, agent-based modeling also appeals to archaeologists because it can be used as a 'dialogic resource' that allows for experimentation with different scenarios (*McGlade 2003.117*). By specifying different rules for agents, researchers can compare the (hopefully different) outcomes of these rules with patterns observed in archaeological cases, thus narrowing down the possible sets of rules that governed prehistoric behaviour. This allows for a consideration of contingency (*Kohler 2000.14*), as differences in model outcomes can be matched to differences in initial conditions and/or agent rules.[8] An example of this second application of agent-based modelling is Dean et al.'s (*2000*) Artificial Anasazi Project. This project simulated historical trajectories for the 96 km^2 region of Long House Valley, Arizona. The model outcomes indicated that the archaeological evidence for total abandonment of the region at 1300 CE could not have been due to environmental degradation alone, but must also have been due to 'cultural' factors not yet accounted for by the model (*Dean et al. 2000*).

8 In this context, the 'docking' of different agent-based models (*Axtell et al. 1997*), that is, the comparison of model outcomes, is an important undertaking because it compares artificial societies that are potentially structured (coded) differently. Because it compares different models, 'docking' is a stronger test than the comparison of outcomes of runs of the same model, in which each run has different initial inputs of agent attributes, but the rules of agent-agent and agent-environment interaction are coded the same way.

On the theoretical level, the application of complexity theory to archaeology has largely resulted in worldviews of an inevitable diachronic trajectory to ever-increasing inequality. Of course, this is not entirely a new idea: social scientists of the Victorian era argued that human evolution is characterised by increasing complexity over time, where only the most complex societies were believed to be ultimately fit to survive (*Chapman 2003*). Some applications of complexity theory have taken a neo-Victorian stance on increasing complexity (though see *Tainter 1996a; 1996b*). They equate increased complexity with increased social complexity; that is, they see an inevitable trajectory towards ever-increasing social inequality. Brian Hayden (*1993.448–466*) provides the most discomforting example of this, when, in his introductory textbook, he discusses the potential of archaeology to predict the future. He first warns his readers that the "*images may be disconcerting to some people*" and that the archaeology of the future "*requires a total stilling of the self, great objectivity, and complete divorce from the emotional values that structure [one's] daily profane thought*" (*Hayden 1993.448*). He claims that we are heading for ever greater inequality, where the rich get richer and the poor get poorer. There is no way of stopping this, because "*there is no doubt that evolution will continue; if not now, then later; if not here, then elsewhere; if not on this planet, then on another; if not by our hands, then by others*" (*Hayden 1993.466*). Because introductory textbooks are foundational histories (*sensu Leone 2006. 139*), in the sense that they shape the underlying paradigms of whole generations of archaeologists, the ethical consequences of such texts always need to be scrutinized. In Hayden's case, evolution is provided with a purpose, and the only type of human agency that is seen as adaptationally successful in this case is rugged individualism. This is the adaptation to the edge of chaos applied to human societies, whereby catastrophic collapses of complex systems occur, but the complex systems always re-emerge and are more complex (*i.e.*, characterised by greater inequality) each time. This is a very pessimistic view, and one that serves the interests of certain, well-off sectors of modern society. It is not a value-neutral stance. Moreover, it is not necessarily logically valid.

According to Clifford Geertz (*1973.5*), who in turn traces the idea back to Max Weber, humans are essentially cultural creatures, and they function in cultural systems of meaning. These cultural systems constitute larger-scale phenomena that subsume aspects of social organisation. In this sense, then, a diachronic trajectory to greater complexity can be applied to human 'evolution' without implying increasingly differentiated or stratified social organisation. As archaeologists, we observe complex cultural phenomena, such as patterned settlement layouts or monumental architecture, at a 'global' level, and social organisation merely provides the local rules of behaviour followed by people in the past. Agent-based modelling and complexity theory, generally, have taught us that simple rules at the local level suffice to create complex patterns, and no centralised structure characteristic of 'complex' social organisation is necessary. This brings us to the Natufian and to Lepenski Vir, where social complexity has often been assumed rather than demonstrated.

The Natufian example

The Natufian was first discovered in Shukbah Cave, Wadi en-Natuf, in 1928 (*Garrod 1942*) and more extensively investigated at El-Wad in the Wadi el-Mughara (*Garrod and Bate 1937*). It dates to 14 900/14 600 to 12 000/11 700 calBP in the Terminal Pleistocene (*Byrd 2006*), and has received a lot of attention as the period preceding the first appearance of domesticated plants and animals in the Old World (*Valla 1975; 1995; Bar-Yosef and Belfer-Cohen 1989; 1992; Byrd 1989; Bar-Yosef and Valla 1990; 1991b; Belfer-Cohen 1991; Schyle 1996.175–209; Poyato Holgado 2000*). Based largely on its chipped and ground stone assemblages and its erroneous placement within the Holocene, the Natufian was originally interpreted as a Mesolithic industry by Garrod (*1932; 1957*) and Neuville (*1934*). Though it is now considered the terminal phase of the Epipalaeolithic sequence, some authors (*e.g., Clark 1980; Hayden 1993*) have continued to see it as Mesolithic, while others (*e.g., Gilead 1984*) consider it Upper Palaeolithic. Such terminology is about more than mere lithic industries, as each term implies a reconstructed mode of production and differing levels of continuity with preceding and subsequent phases. Because it is closest in time to the Neolithic, the Natufian has generally been assumed to be more complex than the preceding Kebaran and Geometric Kebaran (*e.g., Henry 1989*; but see *Kaufman 1992* for a different opinion).

Very briefly, the Natufian chipped stone industry is characterised by a predominance of lunate microliths and by the microburin technique. Ground stone tools include mortars and pestles and are thought to occur in greater frequency than in preceding periods. The bone industry includes decorative items, such as

pendants and beads, shaped by grinding. Artistic expression, although present throughout the Epipalaeolithic (*e.g., Hovers 1990*), now includes a few zoomorphic figurines. Stone-built architecture, in the form of small- to medium-sized circular structures, is present on some sites. Burial customs included decorated burials in the Early Natufian, and secondary burial with skull removal during the Late Natufian.

The Natufian material culture extends over much of the (southern) Levant, though there appear to be diachronic changes in its extent. The differently shaped microliths are generally thought to represent stylistic variation and have therefore been used to identify ethnic groups or cultures in the 'culture circles' sense (*e.g., Henry 1989*). Neeley and Barton (*1994*) have suggested, however, that they might actually represent different stages in reduction sequences. Starting with Henry (*1981*) and Wright (*1978*), the Natufians have frequently been considered complex hunter-gatherer chiefdoms with high levels of social complexity (*Bar-Yosef 2002*). This complexity, according to Henry (*1981; 1985; 1989*) was made possible by intensified wild cereal collection – a type of proto-cultivation that eventually led to domestication in the Pre-Pottery Neolithic. Smith (*1987*), for example, proposes that reduced robusticity and size of mandibles in the Late Natufian, along with evidence for increased dental disease, indicates increased reliance on cereals in the Late Natufian diet, at least at Nahal Oren. Dubreuil (*2004*) comes to a similar conclusion on the basis of an increased reliance on, and improvement of, grinding slabs. This intensification, in turn, was said to have been made possible by the expansion of wild cereals from the Last Glacial Maximum refugia to the highlands of the Mediterranean phytogeographic zone, considered the Natufian 'homeland'. Such an interpretation has, however, never been fully accepted (*e.g. Olszewski 1991; 1993; Kaufman 1992; Byrd 2005; Boyd 2006*). Wild cereals may have played a noteworthy role in Epipalaeolithic diet well before Natufian times (*e.g., Nadel and Hershkowitz 1991; Weiss et al. 2004*), and a broad spectrum of other plants may, in fact, have overshadowed the importance of cereals even during the Natufian (*Olszewski 1993*). On the other hand, on the basis of dental microwear, Mahoney (*2005*) infers an increased reliance on ground plant foods occurring in the Pre-Pottery Neolithic rather than the Natufian.

Natufian settlement patterns include large sites in the core area, for which sedentism is assumed (*e.g., Henry 1985*), medium sites in the hillsides, and small sites in the hillsides and in desert areas. Various explanations of this pattern have been offered, some relying on the socio-economic organisation characteristic of Arnold's (*1996*) complex hunter-gatherers, while many do not (*e.g., Perlès and Phillips 1991; Kaufman 1992; Lieberman 1993*). Henry (*1981*) suggested that Natufian adaptation was significantly different from that of mobile hunter-gatherers' during preceding periods. The expansion of wild cereals into the Mediterranean hill zone (which has better soil than the Pleistocene refugia, *Henry 1989*) allowed for sedentism based on intensified reliance on wild cereals as a dietary staple. This caused the population growth and expansion of the Natufians. Later, claims Henry, climatic deterioration meant that Natufians could no longer support themselves by intensive reliance on wild cereals alone. This lead to two different responses:

1) a change to a food producing economy with the domestication of cereals (Pre-Pottery Neolithic in the 'homeland'), and
2) the 'return' to mobile foraging (Harifian in marginal zones).

Byrd (*2005*) indicates that more reliable palaeoenvironmental data are needed if we want to correlate climatic change with specific cultural changes at the beginning and end of the Natufian; these cultural changes need not have been causally determined by environmental changes.[9] One aspect of complexity theory that differs from processualist linear systems theory is the possibility for change to occur without stimuli external to the system.

Olszewski (*1991*) charges Henry relies too much on sedentism as a necessary component of Natufian social complexity. This social complexity has been inferred from burial data, population density, base camps, local group size, storage, and territoriality. Olszewski (*1991*) debunks all these possible sources of evidence for social stratification and chiefdom organisation. Wright's (*1978*) conclusion for the existence of social stratification on the basis of an analysis of grave goods from El-Wad, too, has been discredited by several scholars (*Olszewski 1991; Belfer-Cohen 1995; Byrd and Monahan 1995; Kuijt 1996*). Hayden (*2004*), while also disagreeing with the idea

9 Despite his apparent environmental determinism, Henry acknowledges the contingency of the Near Eastern trajectory that eventually led to agriculture. Were it not for "*some Neanderthal driven to grinding pigment for ritual purposes*" Henry (1989.236) claims, "*it is unlikely that most of the world would be sustained by agriculture today*" because mortars and pestles would not have been invented and there would therefore not have been a technology for processing cereals several millennia later.

of Natufian chiefdoms, argues that the burial record still indicates a high degree of social complexity with a heterarchical social organisation; here, inequality would exist between corporate kin groups without an inter-settlement political hierarchy. In a circular argument, Hayden (*2004*) reasons that transegalitarian societies are characterised by feasting, and if the Natufian were complex it would have evidence of feasting; despite a lack of 'secure' evidence for feasting (*2004.274*), feasting is then used to reconstruct a complex social organisation for the Natufian (*2004.276*). Bocquentin and Rouais (*2004*) conclude that a differentiation of tasks within sequences of production requiring the use of teeth as tools took place at Ain Mallaha, on the basis of intensive tooth wear on two individuals (out of 306!). This could be an indication of labour specialisation and social complexity, although it could be interpreted in a myriad of other ways.

The very concept of Natufian sedentism has been criticized by several scholars (*Kaufman 1986; 1992; Boyd 2006*). On the one hand, evidence for year-round sedentism during the Natufian is problematic at best (*Boyd 2006*). On the other hand, even during the Early Epipalaeolithic, evidence for a reoccupation of specific locations exists, for example at Ohalo II (*Nadel and Werker 1999*). The huts at Ohalo II had up to three superimposed floors, a number that compares favourably with that of the Final Natufian layers at Ain Mallaha (*Samuelian et al. 2006*). Hardy-Smith and Edwards (*2004*) argue that garbage disposal patterns indicate that the Natufians had not yet 'gotten used to' sedentary living, assuming they were sedentary in the first place. Zooarchaeological analyses indicate a general increase in mobility (and decrease in sedentism) during the Late Natufian (*Munro 2004*). Overall, the archaeological data have been interpreted by different scholars as indicating varying degrees of sedentism and social complexity. While social organisation and other aspects of culture appear to have varied throughout the duration of the Natufian, there is little support for the contention that these were socially complex hunter-gatherers.

The Lepenski Vir example

At Lepenski Vir, we see a similar debate. Srejović (*1966*) initially considered the LV I trapezoidal house floors to be Neolithic, because at the time he subscribed to a Hobbesian worldview that could not imagine attributing such a complex cultural phenomenon to hunter-gatherers. Only when it became stratigraphically apparent that the architecture and art at Lepenski Vir (LV I) clearly predated the overlying layers of Early Neolithic pottery (LV III) did he begin to consider the socio-economic conditions that may have been responsible for this culturally complex hunter-gatherer settlement (*Srejović 1967*).[10] Srejović eventually came to the conclusion that the planned village layout at Lepenski Vir 'presupposes complex socio-economic relationships' (*1969.14; 1972.12*), even convincing Sir Mortimer Wheeler that hunter-gatherers are indeed worthy of study (*Wheeler in Srejović 1972.8–9*). Although this is hardly ever acknowledged, the discoveries at Lepenski Vir paved the way for the complex hunter-gatherer debates of the 1980s and 1990s. Eventually, several scholars came to reassert that Lepenski Vir was a site of socially complex hunter-gatherers (*e.g., Voytek and Tringham 1989; Radovanović and Voytek 1997*), thus earning the Iron Gates a mention in a North American overview of world prehistory as an example of a European Mesolithic society analogous to the supposed social evolutionary stage that the Natufian occupied in the Levant (*e.g., Fagan 2001*). As Cvekić (*2007, in prep*) has pointed out, however, Banning's (*1996*) insights from complexity theory and the Near East bring into question the necessity of relying on complex social organisation to explain the pattern at Lepenski Vir.

Over the years, several scholars have questioned the idea of social complexity at Lepenski Vir. Kulišić (*1972*), for example, proposed that the large, central houses previously identified as chiefly residences (*Srejović 1969*) were in fact men's houses for unmarried youth who used stone sculptures in rituals of initiation into manhood. This interpretation, however, does not account for the presence of sculptures in smaller houses throughout the settlement, nor does it account for the standardisation of house layout. A more serious threat was presented by Radovanović's (*1996*) reinterpretation of LV I sub-phases on the basis of hearth construction, which suggested only 5–10 houses were occupied contemporaneously at any point in time, meaning that the population of the village would have been only 25–50. Radovanović (*2006*) eventually made explicit that these would therefore have been settlements of egalitarian hunter-gatherers, although her re-phasing of

10 Some researchers have questioned the validity of stratigraphic interpretation at Lepenski Vir (*e.g., Milisauskas 1978; Borić 2002*). Perić and Nikolić (*2004*) point out that these arguments are marred by a rather superficial knowledge of the site, and in any case should not be conflated with debates about the chronometric dating of Lepenski Vir.

LV I has proven faulty on several accounts (*Bonsall et al. 2000*).

My own analyses of variation in house size and content do not indicate the presence of social complexity at Lepenski Vir (*Cvekić 2007, in prep*). Bonsall (*2008*) also came to argue against social complexity in the Iron Gates on the basis of a lack of evidence for year-round sedentism, storage, internal division of houses (*cf. Kent 1990*), and warfare (*cf. Roksandic et al. 2004*). Bonsall suggests that the intensified occupation and artistic elaboration of LV I was due to interaction with Neolithic communities in nearby areas. Radiocarbon dates from nearby Vlasac (*Borić et al. 2008*), however, indicate a more intense occupation at this site beginning several centuries prior to the Contact Period of LV I (8250–7950 calBP). Moreover, the continuities in design between LV I art and earlier Mesolithic art have long been emphasized (*e.g., Srejović and Babović 1983*). Although there is wide agreement that Lepenski Vir was not socially complex, there is no need to conceptualise the Mesolithic inhabitants of the Iron Gates as socially inert prior to the appearance of the first farming communities in the Morava Basin to the south. Rather, social organisation and other aspects of culture varied over time, as in the Levantine Natufian.

In lieu of a conclusion

It has become increasingly apparent that the Natufian and Lepenski Vir may not have been characterised by the social complexity posited in a 'Mesolithic societal type' connecting simple hunter-gatherers and complex farmers. In fact, social complexity might not characterise any part of the European Mesolithic (*Spikins 2008.10; Bailey 2008.369*). However, that Natufian and Lepenski Vir hunter-gatherers were not socially complex does not mean they were egalitarian. Their society could have been characterised by inequality, but not necessarily hereditary inequality. I also do not wish to argue that we should confine ourselves to investigations of non-directional, multilinear, culturally specific social evolution (*cf. Rowley-Conwy 2001*). Studies that have limited themselves to this social aspect of culture have largely failed to move beyond social evolutionism (*Warren 2005a; Cvekić 2006*). Instead, we should consider all aspects of culture taken together as the dynamic, non-linear system that is the object of study in archaeology. When the physical or social environment changes, humans do not need to respond by adapting their social organisation; they can respond equally well by changing technology, religion, artistic expression, or any other aspect of culture. If there is any trend towards greater complexity at all, it is greater complexity in the cultural system as a whole, rather than in its social subsystem. Although I find social organisation a fascinating topic, the other aspects of culture are equally important and equally interesting to study.

ACKNOWLEDGEMENTS

This paper is a revision of the theory sections of my Master's thesis. I would like to thank Mirjana Roksandić, Gary Coupland and Slaviša Perić for facilitating my research, and the University of Toronto and the Vedanta Society of Toronto for financially aiding it.

∴

REFERENCES

ALEXANDER J. 1977. The 'Frontier' Concept in Prehistory: The End of the Moving Frontier. In J. V. S. Megaw (ed.), *Hunters, Gatherers and First Farmers Beyond Europe: An Archaeological Survey*. Leicester University Press, Leicester: 25–40.

AMES K. M. 1995. Chiefly Power and Household Production on the Northwest Coast. In T. D. Price and G. M. Feinman (eds.), *Foundations of Social Inequality*. Plenum Press, New York: 155–187.

2004. Supposing Hunter-Gatherer Variability. *American Antiquity 69(2): 364–374*.

ARNOLD J. E. 1995. The Archaeology of Complex Hunter-Gatherers. *Journal of Archaeological Method and Theory 3(2): 77–126*.

2004. A Transcontinental Perspective on the Evolution of Hunter-Gatherer Lifeways on the Plateau. In W. C. Prentiss and I. Kuijt (eds.), *Complex Hunter-Gatherers: Evolution and Organization of Prehistoric Communities on the Plateau of Northwestern North America*. University of Utah Press, Salt Lake City: 171–181.

AXTELL R., AXELROD R., EPSTEIN J. M. and COHEN M. D. 1996. Aligning Simulation Models: A Case Study and Re-

sults. *Computational and Mathematical Organization Theory 1(2): 123–141*.

AYARZAGÜENA SANZ M. 2000. Surgimiento y Creación del Concepto de Meoslítico. *Espacio, Tiempo y Forma, Serie I, Prehistoria y Arqueología 13: 11–32*.

BAILEY G. 2008. Mesolithic Europe: Overview and New Problems. In G. Bailey and P. Spikins (eds.), *Mesolithic Europe*. Cambridge University Press, Cambridge: 357–371.

BAKHTA V. M. 1986. Sotsial'nyje Posledstvija ot Prisvaivajushchej Ekonomiki k Proizvodiashchej. In Y. K. Pletnikov (ed.), *Problemy Perekhodnogo Perioda i Perekhodnykh Obshchestvennykh Otnoshenij*. Nauka, Moskva: 107–119.

BAMFORD S. 2007. *Biology Unmoored: Melanesian Reflections on Life and Biotechnology*. University of California Press, Berkeley.

BANNING E. B. 1996. Pattern or Chaos? New Ways of Looking at "Town Planning" in the Ancient Near East. In D. A. Meyer, P. C. Dawson and D. T. Hanna (eds.), *Debating Complexity: Proceedings of the Twenty-Seventh Annual Chacmool Conference*. Archaeological Association of the University of Calgary, Calgary: 510–518.

2003. Housing Neolithic Farmers. *Near Eastern Archaeology 66(1/2): 4–21*.

BAR-YOSEF O. 1991. Stone Tools and Social Context in Levantine Prehistory. In G. A. Clark (ed.), *Perspectives on the Past: Theoretical Biases in Mediterranean Hunter-Gatherer Research*. University of Pennsylvania Press, Philadelphia: 371–395.

1998. The Natufian Culture in the Levant, Threshold to the Origins of Agriculture. Evolutionary *Anthropology 6(5): 159–177*.

2002. Natufian: A Complex Society of Foragers. In B. Fitzhugh and J. Habu (eds.), *Beyond Foraging and Collecting: Evolutionary Change in Hunter-Gatherer Settlement Systems*. Kluwer/Plenum, New York: 91–149.

BAR-YOSEF O. and BELFER-COHEN A. 1989. The Origins of Sedentism and Farming Communities in the Levant. *Journal of World Prehistory 3(4): 447–498*.

1992. From Foraging to Farming in the Mediterranean Levant. In A. B. Gebauer and T. D. Price (eds.), *Transitions to Agriculture in Prehistory*. Monographs in World Archaeology No. 4, Prehistory Press, Madison: 21–48.

BAR-YOSEF O. and VALLA F. R (eds.) 1991a. *The Natufian Culture in the Levant. Archaeological Series 1, International Monographs in Prehistory*. Ann Arbor.

BAR-YOSEF O. and VALLA F. R. 1990. The Natufian Culture and the Origin of the Neolithic in the Levant. *Current Anthropology 31(4): 433–436*.

1991b. The Natufian Culture – An Introduction. In O. Bar-Yosef and F. R. Valla (eds.), *The Natufian Culture in the Levant*. Archaeological Series 1, International Monographs in Prehistory, Ann Arbor: 1–10.

BELFER-COHEN A. 1991. The Natufian in the Levant. *Annual Review of Anthropology 20: 167–186*.

1995. Rethinking Social Stratification in the Natufian Culture: The Evidence from Burials. In S. Campbell and A. Green (eds.), *The Archaeology of Death in the Ancient Near East*. Oxbow Monograph 51, Oxbow Books, Oxford: 9–16.

BELFER-COHEN A. and BAR-YOSEF O. 2000. Early Sedentism in the Near East: A Bumpy Ride to Village Life. In I. Kuijt (ed.), *Life in Neolithic Farming Communities: Social Organization, Identity, and Differentiation*. Kluwer/Plenum, New York: 19–37.

BENTLEY R. A. 2003. An Introduction to Complex Systems. In R. A. Bentley and H. D. G. Maschner (eds.), *Complex Systems and Archaeology: Empirical and Theoretical Applications*. The University of Utah Press, Salt Lake City: 9–23.

BENTLEY R. A. and MASCHNER H. D. G. (eds.) 2003a. *Complex Systems and Archaeology: Empirical and Theoretical Applications*. The University of Utah Press, Salt Lake City.

2003b. Preface: Considering Complexity Theory in Archaeology. In R. A. Bentley and H. D. G. Maschner (eds.), *Complex Systems and Archaeology: Empirical and Theoretical Applications*. The University of Utah Press, Salt Lake City: 1–8.

BINFORD L. R. 1980. Willow Smoke and Dogs' Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation. *American Antiquity 45(1): 4–20*.

BOCQUENTIN F. and ROUAIS F. 2004. Utilisation des Dents comme Outils Dans la Population Natoufienne de Mallaha (Israël). In Le Secréteriat du Congrès (ed.), *Actes du XIVème Congrès UISPP, Université de Liège, Belgique, 2–8 septembre 2001, Section 7: Le Mésolithique*. BAR International Series 1302, Archaeopress, Oxford: 137–144.

BONSALL C. 2008. The Mesolithic of the Iron Gates. In G. Bailey and P. Spikins (eds.), *Mesolithic Europe*. Cambridge University Press, Cambridge: 238–279.

BONSALL C., COOK G., LENNON R., HARKNESS D., SCOTT M., BARTOSIEWICZ L. and MCSWEENEY K. 2000. Stable Isotopes, Radiocarbon and the Mesolithic-Neolithic Tran-

sition in the Iron Gates. In M. Budja (ed.), *7th Neolithic Studies, Documenta Praehistorica 27: 119–132*.

BORIĆ D. 2002. The Lepenski Vir Conundrum: Reinterpretation of the Mesolithic and Neolithic Sequences in the Danube Gorges. *Antiquity 76: 1026–1039*.

2005. Fuzzy Horizons of Change: Orientalism and the Frontier Model of the Meso-Neolithic Transition. In N. Milner and P. Woodman (eds.), *Mesolithic Studies at the Beginning of the 21st Century*. Oxbow Books, Oxford: 81–105.

BORIĆ D., FRENCH C. and DIMITRIJEVIĆ V. 2008. Vlasac Revisited: Formation Processes, Stratigraphy and Dating. In M. Budja (ed.), *15th Neolithic Studies, Documenta Praehistorica 35: 261–287*.

BORONEANȚ A. and DINU A. 2006. The Romanian Mesolithic and the Transition to Farming. A Case Study: The Iron Gates. *Studii de Preistorie 3: 41–76*.

BOYD B. 2006. On 'sedentism' in the Later Epipalaeolithic (Natufian) Levant. *World Archaeology 38(2): 164–178*.

BRADLEY R. 1984. *The Social Foundations of Prehistoric Britain: Themes and Variations in the Archaeology of Power*. Longman, London and New York.

BROWN J. A. 1893. On the Continuity of the Palaeolithic and Neolithic Periods. *Journal of the Royal Anthropological Institute 22: 65–98*.

BYRD B. F. 1989. The Natufian: Settlement Variability and Economic Adaptations in the Levant at the End of the Pleistocene. *Journal of World Prehistory 3(2): 159–197*.

2005. Reassessing the Emergence of Village Life in the Near East. *Journal of Archaeological Research 13(3): 231–290*.

BYRD B. F. and MONAHAN C. M. 1995. Death, Mortuary Ritual, and Natufian Social Structure. *Journal of Anthropological Archaeology 14: 251–287*.

CARNEIRO R. L. 1967. On the Relationship between Size of Population and Complexity of Social Organization. *Southwestern Journal of Anthropology 23(3): 234–243*.

CARR C. and CASE D. T. 2006. The Gathering of Hopewell. In C. Carr and D. T. Case (eds.), *Gathering Hopewell: Society, Ritual, and Ritual Interaction*. Springer, New York: 19–50.

CAUVIN J. 2000. *The Birth of the Gods and the Origins of Agriculture, T. Watkins (trans.)*. Cambridge University Press, Cambridge.

CHANG K. C. 1962. A Typology of Settlement and Community Patterns in Some Circumpolar Societies. *Arctic Anthropology 1: 28–41*.

CHAPMAN J. 1989. Demographic Trends in Neothermal South-East Europe. In C. Bonsall (ed.), *The Mesolithic in Europe*. John Donald Publishers, Edinburgh: 500–515.

1993. Social Power in the Iron Gates Mesolithic. In J. Chapman and P. Dolukhanov (eds.), *Cultural Transformations and Interactions in Eastern Europe*. Worldwide Archaeology Series 6, Avebury, Aldershot: 71–121.

2000. *Fragmentation in Archaeology: People, Places and Broken Objects in the Prehistory of South-Eastern Europe*. Routledge, London and New York.

CHAPMAN J. and DOLUKHANOV P. 1993. Cultural Transformations and Interactions in Eastern Europe: Theory and Terminology. In J. Chapman and P. Dolukhanov (eds.), *Cultural Transformations and Interactions in Eastern Europe*. Worldwide Archaeology Series 6, Avebury, Aldershot: 1–36.

CHAPMAN R. 2003. *Archaeologies of Complexity*. Routledge, London and New York.

CHILDE V. G. 1925. *The Dawn of European Civilisation*. Kegan Paul and Co., London.

1929. *The Danube in Prehistory*. Clarendon Press, Oxford.

1947. *The Dawn of European Civilisation, 4th edition*. Kegan Paul and Co., London.

1950. The Urban Revolution. *Town Planning Review 21: 3–17*.

CLARK J. G. D. 1975. *The Earlier Stone Age Settlement of Scandinavia*. Cambridge University Press, Cambridge.

1978. Neothermal Orientations. In P. Mellars (ed.), *The Early Postglacial Settlement of Northern Europe*. Duckworth, London: 1–11.

1980. *Mesolithic Prelude: The Palaeolithic-Neolithic Transition in Old World Prehistory*. Edinburgh University Press, Edinburgh.

COHEN N. M. 1985. Prehistoric Hunter-Gatherers: The Meaning of Social Complexity. In T. D. Price and J. A. Brown (eds.), *Prehistoric Hunter-Gatherers: The Emergence of Cultural Complexity*. Academic Press, Orlando: 99–119.

COUPLAND G. 1985a. Household Variability and Status Differentiation at Kitselas Canyon. *Canadian Journal of Archaeology 9(1): 39–56*.

1985b. Restricted Access, Resource Control and the Evolution of Status Inequality Among Hunter-Gatherers. In M. Thompson, M. T. Garcia and F. J. Kense (eds.), *Status, Structure and Stratification: Current Archaeological Reconstructions*. Proceedings of the 16th Annual Conference, Archaeological Association of the University of Calgary, Calgary: 217–226.

2006. A Chief's House Speaks: Communicating Power On The Northern Northwest Coast. In E. A. Sobel, D. A. Trieu Gahr and K. M. Ames (eds.), *Household Archaeology on the Northwest Coast*. International Monographs in Prehistory, Archaeological Series 16, Ann Arbor: 80–96.

COWGILL G. L. 1996. Population, Human Nature, Knowing Actors, and Explaining the Onset of Complexity. In D. A. Meyer, P. C. Dawson, and D. T. Hanna (eds.), *Debating Complexity: Proceedings of the Twenty-Seventh Annual Chacmool Conference*. Archaeological Association of the University of Calgary, Calgary: 16–22.

CVEKIĆ R. 2006. Getting to the Root of It: The Plateau's Contribution to the Archaeological Study of Hunter-Gatherer Complexity. *The Midden 38(4): 20–22*.

2007. *Complex Hunter-Gatherers Revisited: Complexity Theory and the Decoupling of Social Organisation from Cultural Elaboration at Lepenski Vir*. Unpublished M. A. Thesis, Department of Anthropology, University of Toronto, Toronto.

in prep. Prilog proučavanju složene društvene organizacije na Lepenskom Viru / A Contribution to the Study of Complex Social Organization at Lepenski Vir. Manuscript in preparation.

DEAN J. S., GUMERMAN G. J., EPSTEIN J. M., AXTELL R. L., SWEDLUND A. C., PARKER M. T. and MCCARROLL S. 2000. Understanding Anasazi Culture Change Through Agent-Based Modeling. In T. A. Kohler and G. J. Gumerman (eds.), *Dynamics in Human and Primate Societies: Agent-Based Modeling of Social and Spatial Processes*. Oxford University Press, New York and Oxford: 179–205.

DE MORTILLET G. 1872. *Classificattion de l'Âge de la Pierre*. Matériaux pour l'Histoire Positive et Philosophique de l'Homme, année VII, 2éme serie, vol. III. Paris.

1883. *Le Préhistorique*. Reinwald, Paris.

DONALD L. and MITCHELL D. H. 1975. Some Correlates of Local Group Rank among the Southern Kwakiutl. *Ethnology 14(4): 325–346*.

DORAN J. E. 2000. Trajectories to Complexity in Artificial Societies: Rationality, Belief, and Economics. In T. A. Kohler and G. J. Gumerman (eds.), *Dynamics in Human and Primate Societies: Agent-Based Modeling of Social and Spatial Processes*. Oxford University Press, New York and Oxford: 89–105.

DUBREUIL L. 2004. Long-Term Trends in Natufian Subsistence: A Use-Wear Analysis of Ground Stone Tools. *Journal of Archaeological Science 31(11): 1613–1629*.

DYSON-HUDSON R. and SMITH E.A. 1978. Human Territoriality: An Ecological Reassessment. *American Anthropologist 80(1): 21–41*.

EPSTEIN J. M. and AXTELL R. 1996. *Growing Artificial Societies: Social Science from the Bottom Up*. Brookings Institution Press, Washington and MIT Press, Cambridge.

FAGAN B. M. 2001. *People of the Earth: An Introduction to World Prehistory, 10th edition*. Prentice-Hall, Upper Saddle River.

GAMBLE C. 1986. *The Palaeolithic Settlement of Europe*. Cambridge University Press, Cambridge.

GARROD D. A. E. 1932. A New Mesolithic Industry: The Natufian of Palestine. *Journal of the Royal Anthropological Institute 62: 257–269*.

1942. Excavations at the cave of Shukbah, Palestine, 1928. *Proceedings of the Prehistoric Society 8: 1–15*.

1957. The Natufian Culture: The Life and Economy of a Mesolithic People in the Near East. *Proceedings of the British Academy 43: 211–227*.

GARROD D. A. E. and BATE D. M. A. 1937. *The Stone Age of Mount Carmel: Excavations at the Wadi el-Mughara, vol. 1*. Clarendon Press, Oxford.

GEERTZ C. 1973. Thick Description: Toward an Interpretive Theory of Culture. In C. Geertz (ed.), *The Interpretation of Cultures*. Basic Books, New York: 3–30.

GELL-MANN M. 1994. *The Quark and the Jaguar: Adventures in the Simple and the Complex*. W. H. Freeman, New York.

GILEAD I. 1984. Is the Term "Epipalaeolithic" Relevant to Levantine Prehistory? *Current Anthropology 25(2): 227–229*.

GROSSE E. 1896. *Die Formen der Familie und die Formen der Wirtschaft*. Mohr, Freiburg.

HARDY-SMITH T. and EDWARDS P. C. 2004. The Garbage Crisis in Prehistory: Artefact Discard Patterns at the Early Natufian Site of Wadi Hammeh 27 and the Origins of Household Refuse Disposal Strategies. *Journal of Anthropological Archaeology 23(3): 253–289*.

HAYDEN B. 1981. Research and Development in the Stone Age: Technological Transitions among Hunter-Gatherers. *Current Anthropology 22(5): 519–548*.

1993. *Archaeology: The Science of Once and Future Things*. W. H. Freeman, New York.

2003. Preface. In B. Hayden (ed.), *The Ancient Past of Keatley Creek, Vol. 3: Excavations and Artifacts*, CD ROM. Publication No. 28, Arch Press, Simon Fraser University, Burnaby.

2004. Sociopolitical Organization in the Natufian: A View from the Northwest. In C. Delage (ed.), *The Last Hunter-Gatherers in the Near East*. BAR International Series 1320, John and Erica Hedges, Oxford: 263–308.

HENRY D. O. 1981. An Analysis of Settlement Patterns and Adaptive Strategies of the Natufian. In J. Cauvin and P. Sanlaville (eds.), *Préhistoire du Levant: Chronologie et Organisation de l'Espace Depuis les Origines Jusqu'au VIe Millénaire*. Colloques Internationaux du CNRS No 594, Éditions du CNRS, Paris: 421–432.

1985. Preagricultural Sedentism: The Natufian Example. In T. D. Price and J. A. Brown (eds.), *Prehistoric Hunter-Gatherers: The Emergence of Cultural Complexity*. Academic Press, Orlando: 365–384.

1989. *From Foraging to Agriculture: The Levant at the End of the Ice Age*. University of Pennsylvania Press, Philadelphia.

HERNANDO A. 2002. *Arqueología de la Identidad*. Ediciones Akal, Madrid.

HOBBES T. 2003 [1651]. *Leviathan, Vol. 2*, ed. by G. A. J. Rogers and K. Schuhman. Thoemmes Continuum, Bristol.

HODDER I. 1990. *The Domestication of Europe: Structure and Contingency in Neolithic Societies*. Basil Blackwell, Oxford.

HOVERS E. 1990. Art in the Levantine Epi-Palaeolithic: An Engraved Pebble from a Kebaran Site in the Lower Jordan Valley. *Current Anthropology 31(3): 317–322*.

INGOLD T. 1988. Notes on the Foraging Mode of Production. In T. Ingold, D. Riches and J. Woodburn (eds.), *Hunters and Gatherers, Vol. 1: History, Evolution and Social Change*. Berg, Oxford: 269–285.

JOCHIM M. A. 1998. *A Hunter-Gatherer Landscape: Southwest Germany in the Late Paleolithic and Mesolithic*. Plenum Press, New York and London.

JOHNSON A. W. and EARLE T. 1987. *The Evolution of Human Societies: From Foraging Group to Agrarian State*. Stanford University Press, Stanford.

JOVANOVIĆ B. 1969. Chronological Frames of the Iron Gate Group of Early Neolithic Period. *Archaeologia Iugoslavica 10: 23–38*.

KAUFMAN D. 1986. A Reconsideration of Adaptive Change in the Levantine Epipaleolithic. In L. G. Straus (ed.), *The End of the Paleolithic in the Old World*. BAR International Series 284, Oxford: 117–128.

1992. Hunter-Gatherers of the Levantine Epipalaeolithic: The Socioecological Origins of Sedentism. *Journal of Mediterranean Archaeology 5(2): 165–201*.

KELLY R. L. 1995. *The Foraging Spectrum: Diversity in Hunter-Gatherer Lifeways*. Smithsonian Institution Press, Washington.

KENT S. 1990. A Cross-Cultural Study of Segmentation, Architecture, and the Use of Space. In S. Kent (ed.), *Domestic Architecture and the Use of Space: An Interdisciplinary Cross-Cultural Study*. Cambridge University Press, Cambridge: 127–152.

KOHLER T. A. 2000. Putting Social Sciences Together Again: An Introduction to the Volume. In T. A. Kohler and G. J. Gumerman (eds.), *Dynamics in Human and Primate Societies: Agent-Based Modeling of Social and Spatial Processes*. Oxford University Press, New York and Oxford: 1–18.

KOHLER T. A. and GUMERMAN G. J. (eds.) 2000. *Dynamics in Human and Primate Societies: Agent-Based Modeling of Social and Spatial Processes*. Oxford University Press, New York and Oxford.

KOSSINNA G. 1911. *Die Herkunft der Germanen: Zur Methode der Siedlungsarchäologie*. Mannus-Bibliothek 6, Kabitzsch, Würzburg.

KOTSAKIS K. 2003. From the Neolithic Side: The Mesolithic/Neolithic Interface in Greece. In N. Galanidou and C. Perlès (eds.), *The Greek Mesolithic: Problems and Perspectives*. The British School at Athens, London: 217–221.

KOYAMA S. and THOMAS D. H. (eds.) 1981. *Affluent Foragers: Pacific Coasts East and West*. Senri Ethnological Studies 9, National Museum of Ethnology, Osaka.

KOYAMA S. and UCHIYAMA J. 2006. Why "Beyond Affluent Foragers"? Looking Back at the Original Affluent Foragers Concept. In C. Grier, J. Kim and J. Uchiyama (eds.), *Beyond Affluent Foragers: Rethinking Hunter-Gatherer Complexity*. Proceedings of the 9th Conference of the International Council of Archaeozoology, Durham, August 2002, Oxbow Books, Oxford: 1–3.

KUIJT I. 1996. Negotiating Equality through Ritual: A Consideration of Late Natufian and Prepottery Neolithic A Period Mortuary Practices. *Journal of Anthropological Archaeology 15: 313–336*.

KULIŠIĆ Š. 1972. Etnološka razmatranja o Lepenskom Viru. Centar za Balkanološka Ispitivanja ANUBiH 7, *Godišnjak 9: 161–176*.

LAKE M. 2000. MAGICAL Computer Simulation of Mesolithic Foraging. In T. Kohler and G. Gumerman (eds.), *Dynamics in Human and Primate Societies: Agent-Based Modeling of Social and Spatial Processes*. Oxford University Press, New York and Oxford: 107–143.

LANGTON C. G. 1986. *Studying Artificial Life with Cellular Automata*. Physica D: Nonlinear Phenomena 22: 120–149.

1990. Computation at the Edge of Chaos: Phase Transitions and Emergent Computation. *Physica D: Nonlinear Phenomena 42: 12–37*.

LAURENT P. F. 1965. *Heureuse Préhistoire*. Éditions Fanlac, Périgueux.

LEE R. B. What Hunters Do for a Living, or, How to Make Out on Scarce Resources. In R. B. Lee and I. DeVore (eds.), *Man The Hunter*. Aldine, Chicago: 30–43.

1992. Art, Science, or Politics? The Crisis in Hunters-Gatherer Studies. *American Anthropologist 94(1): 31–54*.

LEE R. B. and DEVORE I. (eds.) 1968. *Man the Hunter*. Aldine, Chicago.

LEONE M. 2006. Foundational Histories and Power. *Archaeological Dialogues 13(2): 139–144*.

LÈVI-STRAUSS C. *1982. The Way of the Masks, S. Modelski (trans.)*. University of Washington Press, Seattle.

LEWIN R. 1992. *Complexity: Life at the Edge of Chaos*. McMillan, New York.

LICHTER C. (ed.) 2007. *Vor 12.000 Jahren in Anatolien – Die ältesten Monumente der Menschheit*. Badisches Landesmuseum, Karlsruhe.

LIEBERMAN D. E. 1993. The Rise and Fall of Seasonal Mobility Among Hunter-Gatherers: The Case of the Southern Levant. *Current Anthropology 34(5): 599–631*.

LUBBOCK J. 1865. *Pre-historic Times*. Williams and Norgate, London.

MAHONEY P. 2005. *Dental Microwear in Natufian Hunter-Gatherers and Pre-Pottery Neolithic Agriculturalists form Northern Israel*. BAR International Series 1418, British Archaeological Reports, Oxford.

MASCHNER H. D. G. 1991. The Emergence of Cultural Complexity on the Northern Northwest Coast. *Antiquity 65: 924–34*.

MATSON R. G. 1983. Intensification and the Development of Cultural Complexity: The Northwest versus the Northeast Coast. In R. J. Nash (ed.), *The Evolution of Maritime Cultures on the Northeast and the Northwest Coasts of America*. Publication No. 11, Department of Archaeology, Simon Fraser University, Burnaby: 125–148.

1985. The Relationship Between Sedentism and Status Inequalities Among Hunters and Gatherers. In M. Thompson, M. T. Garcia and F. J. Kense (eds.), *Status, Structure and Stratification: Current Archaeological Reconstructions*. Proceedings of the 16th Annual Conference, Archaeological Association of the University of Calgary, Calgary: 245–252.

MATSON R. G. and COUPLAND G. 1995. *The Prehistory of the Northwest Coast*. Academic Press, San Diego.

MCGLADE J. 2003. The Map Is Not the Territory: Complexity, Complication, and Representation. In R. A. Bentley and H. D. G. Maschner (eds.), *Complex Systems and Archaeology: Empirical and Theoretical Applications*. The University of Utah Press, Salt Lake City: 111–119.

MCGUIRE R. H. 1996. Why Complexity is Too Simple. In P. C. Dawson, and D. T. Hanna (eds.), *Debating Complexity: Proceedings of the Twenty-Seventh Annual Chacmool Conference*. Archaeological Association of the University of Calgary, Calgary: 23–29.

MILISAUSKAS S. 1978. *European Prehistory*. Academic Press, New York.

MOL A. and LAW J. 2002. Complexities: An Introduction. In J. Law and A. Mol (eds.), *Complexities: Social Studies of Knowledge Practices*. Duke University Press, Durham and London: 1–22.

MUNRO N. D. 2004. Zooarchaeological Measures of Hunting Pressure and Occupation Intensity in the Natufian: Implications for Agricultural Origins. *Current Anthropology 45(S): S5–S33*.

NADEL D. and HERSHKOVITZ I. 1991. New Subsistence Data and Human Remains from the Earliest Levantine Epipalaeolithic. *Current Anthropology 32(5): 631–635*.

NADEL D. and WERKER E. 1999. The Oldest Ever Brush Hut Plant Remains from Ohalo II, Jordan Valley, Israel (19,000 BP). *Antiquity 73: 755–764*.

NAROLL R. 1956. A Preliminary Index of Social Development. *American Anthropologist 58(4): 687–715*.

NEELEY M. P. and BARTON C. M. 1994. A New Approach to Interpreting the Pleistocene Microlith Industries in Southwest Asia. *Antiquity 68: 275–288*.

NEUVILLE R. 1934. Le Préhistorique de Palestine. *Revue Biblique 54: 237–259*.

NEWELL R. R. and CONSTANDSE-WESTERMANN T. S. 1984. Population Growth, Density and Technology in the Western European Mesolithic: Lessons from Analogous Historical Contexts. *Palaeohistoria 26: 1–18*.

OLSZEWSKI D. I. 1991. Social Complexity in the Natufian? Assessing the Relationship of Ideas and Data. In G. A. Clark (ed.), *Perspectives on the Past: Theoretical Biases in Mediterranean Hunter-Gatherer Research*. University of Pennsylvania Press, Philadelphia: 322–340.

1993. Subsistence Ecology in the Mediterranean Forest: Implications for the Origins of Cultivation in the Epipaleolithic Southern Levant. *American Anthropologist 95(2): 420–435*.

PERIĆ S. and NIKOLIĆ D. 2004. Stratigraphic, Cultural and Chronological Characteristics of the Pottery from Lepenski Vir – 1965 Excavations. In S. Perić (ed.), *The Neolithic in the Middle Morava Valley, No. 1*. Archaeological Institute, Belgrade, Regional Museum Jagodina, and Regional Museum Paraćin: 157–217.

PERLÈS C. and PHILLIPS J. 1991. The Natufian Conference – Discussion. In O. Bar-Yosef and F. R. Valla (eds.), *The Natufian Culture in the Levant*. Archaeological Series 1, International Monographs in Prehistory, Ann Arbor: 637–644.

PIANKA E. R. 1972. On r and K selection or b and d selection? *The American Naturalist 106(951): 581–588*.

PLUCIENNIK, M. 1998. Deconstructing 'the Neolithic' in the Mesolithic-Neolithic Transition. In M. R. Edmonds and C. Richards (eds.), *Understanding the Neolithic of North-Western Europe*. Cruithne Press, Glasgow: 61–83.

1999. Archaeological Narratives and Other Ways of Telling. *Current Anthropology 40(5): 653–678*.

POYATO HOLGADO M. del C. 2000. *El Natufiense del Mediterráneo Oriental: Un Modelo de las Sociedades Postpaleolíticas en Transición*. Ediciones de la Universidad de Castilla-La Mancha, Cuenca.

PRICE T. D. 1985. Affluent Foragers of Mesolithic Southern Scandinavia. In T. D. Price and J. A. Brown (eds.), *Prehistoric Hunter-Gatherers: The Emergence of Cultural Complexity*. Academic Press, Orlando: 341–360.

1995a. Social Inequality at the Origins of Agriculture. In T. D. Price and G. M. Feinman (eds.), *Foundations of Social Inequality*. Plenum Press, New York: 129–151.

1995b. Some Perspectives on Prehistoric Coastal Adaptations and Those who Study Them. In A. Fischer (ed.), *Man and Sea in the Mesolithic: Coastal Settlements Above and Below Present Sea Level*. Proceedings of the International Symposium, Kalundberg, Denmark 1993, Oxbow Monographs 53, Oxbow Books, Oxford: 423–424.

PRICE T. D. and BROWN J. A. (eds.) 1985a. *Prehistoric Hunter-Gatherers: The Emergence of Cultural Complexity*. Academic Press, Orlando.

PRICE T. D. and BROWN J. A. 1985b. Aspects of Hunter-Gatherer Complexity. In T. D. Price and J. A. Brown (eds.), *Prehistoric Hunter-Gatherers: The Emergence of Cultural Complexity*. Academic Press, Orlando: 3–20.

RADOVANOVIĆ I. 1996. *The Iron Gates Mesolithic*. Archaeological Series 11, International Monographs in Prehistory, Ann Arbor.

2006. Further Notes on Mesolithic-Neolithic Contacts in the Iron Gates Region and the Central Balkans. In M. Budja (ed.), *13th Neolithic Studies, Documenta Praehistorica 33: 107–124*.

RADOVANOVIĆ I. and VOYTEK B. 1997. Hunters, Fishers or Farmers: Sedentism, Subsistence and Social Complexity. *Analecta Praehistorica Leidensia 29: 19–31*.

RATHJE W. L. and MCGUIRE R. H. 1982. Rich Men ... Poor Men. *American Behavioral Scientist 25(6): 705–715*.

REBOUX M. 1873. Recherches Paléontologiques sur le Bassin de Paris. In Congrés International d'Anthropologie et d'Archéologie Préhistorique, 5éme session, Bologna 1871. Bologna: 98–102.

ROKSANDIĆ M. 2000. Between Foragers and Farmers in the Iron Gates Gorge: Physical Anthropology Perspective. In M. Budja (ed.), *7th Neolithic Studies, Documenta Praehistorica 27: 1–100*.

ROKSANDIC M., DJURIĆ M., RAKOČEVIĆ Z. and SEGUIN K. 2006. Interpersonal Violence at Lepenski Vir Mesolithic/Neolithic Complex of the Iron Gates Gorge (Serbia-Romania). *American Journal of Physical Anthropology 129: 339–348*.

ROWLANDS M. J. 1988. A Question of Complexity. In D. Miller, M. Rowlands and C. Tilley (eds.), *Domination and Resistance*. Allen & Unwin, London: 29–40.

ROWLEY-CONWY P. 2001. Time, change and the archaeology of hunter-gatherers: how original is the 'Original Affluent Society'? In C. Panter-Brick, R. H. Layton and P. Rowley-Conwy (eds.), *Hunter-Gatherers: An Interdisciplinary Perspective*. Cambridge University Press, Cambridge: 39–72.

SAHLINS M. 1968. Notes on the Original Affluent Society. In R. B. Lee and I. DeVore (eds.), *Man the Hunter*. Aldine, Chicago: 85–89.

1972. *Stone Age Economics*. Aldine, Chicago.

SAMUELIAN N., KHALAILY H. and VALLA F. R. 2006. Final Natufian Architecture at 'Eynan ('Ain Mallaha): Approaching the Diversity Behind Uniformity. In E. B. Banning and M. Chazan (eds.), *Domesticating Space: Construction, Community, and Cosmology in the Late Prehistoric Near East*. ex oriente, Berlin: 35–41.

SCHYLE D. 1996. Das Epipaläolithikum und der Übergang zum Neolithikum in der Levante und in Ägypten. In D. Schyle and H.-P. Uerpmann (eds.), *Das Epipaläolithikum des Vorderen Orients, Vol. 1, Pt. 1*. Beihefte zum Tübinger Atlas des Vorderen Orients, Reihe B, Nr. 85/1. Dr. Ludwig Reihert Verlag, Wiesbaden.

SERVICE E. 1964. *Primitive Social Organization: An Evolutionary Perspective*. Random House, New York.

SHANKS M. and TILLEY C. 1987. *Social Theory and Archaeology*. Polity Press, Cambridge.

SHNIRELMAN V. A. 1992. Complex Hunter-Gatherers: Exception or Common Phenomenon? *Dialectical Anthropology 17(2): 183–196*.

SMITH P. 1987. Paleonutrition and Subsistence Patterns in the Natufians. In I. Hershkovitz (ed.), *People and Culture in Change: Proceedings of the Second Symposium on Upper Palaeolithic, Mesolithic and Neolithic Populations of Europe and the Mediterranean Basin, Vol. 2*. BAR International Series 508(ii), Oxford: 375–384.

SOFFER O. 1985. Patterns of Intensification as Seen from the Upper Paleolithic of the Central Russian Plain. In T. D. Price and J. A. Brown (eds.), *Prehistoric Hunter-Gatherers: The Emergence of Cultural Complexity*. Academic Press, Orlando: 235–269.

SOLWAY J. 2006. "The Original Affluent Society": Four Decades On. In J. Solway (ed.), *The Politics of Egalitariansim: Theory and Practice*. Berghahn Books, New York and Oxford: 65–77.

SOLWAY J. and LEE R. B. 1990. Foragers, Genuine or Spurious? *Current Anthropology 31(2): 109–145*.

SPENCER H. 1866. *The Principles of Biology, Vol. 1*. D. Appleton and Co., New York.

1873. *The Study of Sociology*. D. Appleton and Co., New York, NY.

SPIELMANN K. A. and EDER J. F. 1994. Hunters and Farmers: Then and Now. *Annual Review of Anthropology 23: 303–323*.

SPIKINS P. 2008. Mesolithic Europe: Glimpses of Another World. In G. Bailey and P. Spikins (eds.), *Mesolithic Europe*. Cambridge University Press, Cambridge: 1–17.

SREJOVIĆ D. 1966. Lepenski Vir – a new prehistoric culture in the Danubian region. *Archaeologia Iugoslavica 7: 13–18*.

1967. [Lepenski Vir]. In L. Trifunović (ed.), *Lepenski Vir, Katalog*. Narodni Muzej, Beograd: 11–22.

1969. *Lepenski Vir: Nova Praistorijska Kultura u Podunavlju*. Srpska Književna Zadruga, Beograd.

1972. *Europe's First Monumental Sculpture: New Discoveries at Lepenski Vir, L. F. Edwards (trans.)*. Thames and Hudson, London.

SREJOVIĆ D. and BABOVIĆ L. 1983. *Umetnost Lepenskog Vira*. Jugoslavija, Beograd.

SUTTLES W. 1968. Coping with Abundance: Subsistence on the Northwest Coast. In R. B. Lee and I. DeVore (eds.), *Man the Hunter*. Aldine, Chicago: 56–68.

TAINTER J. A. 1996a. Introduction: Prehistoric Societies as Evolving Complex Systems. In J. A. Tainter and B. B. Tainter (eds.), *Evolving Complexity and Environmental Risk in the Prehistoric Southwest*. Santa Fe Institute Studies in the Sciences of Complexity, Addison-Wesley, Reading: 1–23.

1996b. Valuing Complexity. In D. A. Meyer, P. C. Dawson, and D. T. Hanna (eds.), *Debating Complexity*. Proceedings of the Twenty-Seventh Annual Chacmool Conference. Archaeological Association of the University of Calgary, Calgary: 10–15

TESTART A. 1982. The Significance of Food Storage Among Hunter-Gatherers: Residence Patterns, Population Densities, and Social Inequalities. *Current Anthropology 23(5): 523–537*.

THOMAS J. 1991. *Rethinking the Neolithic*. Cambridge University Press, Cambridge.

TRIGGER B. G. 1998. *Sociocultural Evolution*. Blackwell, London.

TRINGHAM R. E. 1991. Households with Faces: the Challenge of Gender in Prehistoric Architectural Remains. In J. M. Gero and M. W. Conkey (eds.), *Engendering Archaeology: Women and Prehistory*. Blackwell, Oxford: 93–131.

2000. Southeastern Europe in the Transition to Agriculture in Europe: Bridge, Buffer or Mosaic. In T. D. Price (ed.), *Europe's First Farmers*. Cambridge University Press, Cambridge: 19–56.

TURNER F. J. 1893. The Significance of the Frontier in American History. *Annual Report of the American Historical Association (1893): 190–227*.

VALLA F. R. 1975. *Le Natoufien: Une Culture Préhistorique en Palestine*. Cahiers de la Revue Biblique 15, Gabalda Éditeurs, Paris.

1995. The First Settled Societies – Natufian (12,500–10,200 BP). In T. E. Levy (ed.), *The Archaeology of Society in the Holy Land*. Leicester University Press, London: 169–187.

VAN KOOTEN NIEKERK K. and BUHL H. 2004. Introduction: Comprehending Complexity. In K. van Kooten Niekerk and H. Buhl (eds.), *The Significance of Complexity: Approaching a Complex World Through Science, Theology and the Humanities*. Ashgate, Aldershot: 1–18.

VOYTEK B. A. and TRINGHAM R. E. 1989. Rethinking the Mesolithic: The Case of South-East Europe. In C. Bonsall (ed.), *The Mesolithic in Europe*. John Donald Publishers, Edinburgh: 492–499.

WALDROP M. M. 1992. *Complexity: The Emerging Science at the Edge of Order and Chaos*. Simon and Schuster, New York.

WARREN G. 2005a. Complex Arguments... In N. Milner and P. Woodman (eds.), *Mesolithic Studies at the Beginning of the 21st Century*. Oxbow Books, Oxford: 69–80.

2005b. *Mesolithic Lives in Scotland*. Tempus, Stroud.

WATTS D. J. 2002. A Simple Model of Global Cascades on Random Networks. *Proceedings of the National Academy of Sciences of the USA 99: 5766–5771*.

WEISS E., KISLEV M. E., SIMCHONI O. and NADEL D. 2004. Small-Grained Wild Grasses as Staple Food at the 23000-Year-Old Site of Ohalo II, Israel. *Economic Botany 58(S): S125–S134*.

WESTROPP, H. M. 1872. *Prehistoric Phases, or Introductory Essays in Prehistoric Archaeology*. London.

WHEELER M. 1954. *Archaeology from the Earth*. Clarendon, Oxford.

WILMSEN E. N. and DENBOW J. R. 1990. Paradigmatic History of San-Speaking Peoples and Current Attempts at Revisionism. *Current Anthropology 31(5): 489–524*.

WOODBURN J. 1980. Hunter-Gatherers Today and Reconstructing the Past. In E. Gellner (ed.), *Soviet and Western Anthropology*. Columbia University Press, New York: 94–118.

1988. African Hunter-Gatherer Social Organization: Is it Best Understood as a Product of Encapsulation? In T. Ingold, D. Riches and J. Woodburn (eds.), *Hunters and Gatherers, Vol. 1, History, Evolution, and Social Change*. Berg, Oxford: 31–64.

WRIGHT G. A. 1978. Social Differentiation in the Early Natufian. In C. Redman, M. J. Berman, E. V. Curtin, W. T. Langhorne, Jr., N. M. Versaggi and J. C. Wanser (eds.), *Social Archaeology, Beyond Subsistence and Dating*. Academic Press, New York: 201–223.

ZVELEBIL M. 1986. Mesolithic Prelude and Neolithic Revolution. In M. Zvelebil (ed.), *Hunters in Transition: Mesolithic Societies of Temperate Eurasia and their Transition to Farming*. Cambridge University Press, Cambridge: 167–187.

1995a. A Final Word of 'Man and Sea in the Mesolithic' – good news for women? In A. Fischer (ed.), *Man and Sea in the Mesolithic: Coastal Settlements Above and Below Present Sea Level*. Proceedings of the International Symposium, Kalundberg, Denmark 1993. Oxbow Monographs 53, Oxbow Books, Oxford: 421–422.

1995b. Farmers Our Ancestors and the Identity of Europe. In P. Graves-Brown, S. Jones and C. Gamble (eds.), *Cultural Identity and Archaeology*. Routledge, London: 145–166.

1998. What's in a Name: the Mesolithic, the Neolithic, and Social Change at the Mesolithic-Neolithic Transition. In M. R. Edmonds and C. Richards (eds.), *Understanding the Neolithic of North-Western Europe*. Cruithne Press, Glasgow: 1–36.

ZVELEBIL M. and ROWLEY-CONWY P. 1986. Foragers and Farmers in Atlantic Europe. In M. Zvelebil (ed.), *Hunters in Transition: Mesolithic Societies of Temperate Eurasia and their Transition to Farming*. Cambridge University Press, Cambridge: 67–93.