Networks, Bronze Age and Iron Age

ALEX R. KNODELL

Networks are now widely discussed in ancient history and archaeology, especially among scholars interested in the Bronze Age and Iron Age Mediterranean. At a fundamental level, networks represent relationships (links or edges) between a set of entities (nodes or vertices). The types of entities and relationships represented by links and nodes vary widely, and so too do the aspects of network theory employed. In discussing the networks of the Bronze Age and Iron Age, scholars examine issues of trade (*see* TRADE, ANCIENT NEAR EAST and TRADE, GREEK), movement, craft production, the diffusion of innovations, religion, and writing, among other things. Theoretical and analytical approaches range from descriptive and explanatory accounts of interaction and CONNECTIVITY (Malkin 2011) to more quantitative methods derived from network science and the formal analysis of complex systems (Brughmans *et al.* 2016).

Archaeologists have been interested in network analysis for a long time, most notably concerning early applications of systems theory (Clarke 1968). Renfrew (1972) brought this approach to the BRONZE AGE AEGEAN to explain the emergence of social complexity and ultimately states. Methods of modeling the interaction of communities through nearest neighbor networks were deployed by Terrell (1977), working in the Pacific, and later brought to another island setting with Broodbank's (2000) application to the Bronze Age Cyclades.

Interest in networks in the Mediterranean world stems from larger concerns with connectivity (Horden and Purcell 2000; Broodbank 2013). It has become commonplace to discuss networks as sets of interconnections across various geographical scales, even if not invoking specific aspects of network theory.

More formally, networks provide models or generalizing frameworks concerning the behavior of interacting systems. Studies of social networks often invoke concepts of "small worlds," centrality, and scale-free growth. In small-world networks, nodes tend to interact frequently with their near neighbors, to which they are linked by "strong" ties. The addition of only a single connection beyond this small world can have a major impact on the network, since it creates a link to another (possibly large) set of nodes and attendant interactions. This phenomenon is referred to as the "strength of weak ties." Levels of centralization are linked to network efficiency and stability. Principles of scale-free growth describe essentially the "rich-get-richer" phenomenon, where nodes preferentially attach to other nodes that are already well connected.

Such principles have been invoked in studies of maritime interaction in the Early and Middle Bronze Age (Broodbank 2000), MYCENAEAN "coastal worlds" (Tartaron 2013), and the transition from the Late Bronze Age to Early Iron Age (Knodell 2013). In the historical period, these themes have been used to describe the emergence of early notions of a common Hellenic identity in the wake of Archaic colonization (Malkin 2011). Other historical approaches include the study of religious networks, trade, and other interactive social phenomena. Other network studies frameworks are derived from science and technology studies, especially Actor-Network Theory, focusing on issues of relationality, agency, and affordances (e.g., Knappett 2011).

Moving beyond conceptual frameworks, the application of formal network analysis (or network science) to archaeological datasets is a rapidly expanding area of scholarship, which often involves interdisciplinary collaboration (Knappett 2013; Brughmans *et al.* 2016). Such studies typically involve the quantification of large corpora of material culture in order to detect and explain ties between different sites, regions, workshops, and so on. While analytical approaches often deal with aspects of trade and economy, they also engage themes of production, technology, and style, for example through the analysis of ceramics from the Bronze Age Aegean and Italy (Knappett 2011; Blake 2014).

The Encyclopedia of Ancient History. Edited by Roger S. Bagnall, Kai Brodersen, Craige B. Champion, and Andrew Erskine.

DOI: 10.1002/9781444338386.wbeah30451

Networks may also be presented as abstract models in which places or artifacts are linked by largely conceptual ties (e.g., shared stylistic elements), which are often represented visually. One area for potential growth involves combining the conceptual and formal analyses described above in a setting that takes into account real geographical space, especially through spatial analysis and geographic representation (Knodell 2013; Collar *et al.* 2015).

Studies of networks in the Bronze Age and Iron Age Mediterranean are now well established, but there is little unity in scope, methods, or outlook. This diversity signals the wide range of past interactions that can be represented by networks and the variety of methodological and theoretical frameworks that can be used to understand them.

SEE ALSO: Colonization, Greek; Colonization, Phoenician; Dark Age Greece; Minoan society and culture; *Polis*; Port of trade; Pottery trade; Regionalism; Redistribution; Transportation technology; Uluburun shipwreck.

REFERENCES AND SUGGESTED READINGS

Blake, E. (2014) *Social networks and regional identity in Bronze Age Italy*. Cambridge.

Broodbank, C. (2000) *An island archaeology of the early Cyclades*. Cambridge.

Broodbank, C. (2013) *The making of the Middle Sea: a history of the Mediterranean from the beginning to the emergence of the classical world*. London.

Brughmans, T., Collar, A., and Coward, F., eds. (2016) *The connected past: challenges to network studies in archaeology and history*. Oxford.

Clarke, D. (1968) *Analytical archaeology*. London.

Collar, A., Coward, F., Brughmans, T., and Mills, B. J. (2015) "Networks in archaeology: phenomena, abstraction, representation." *Journal of Archaeological Method and Theory* 22: 1–32.

Horden, P. and Purcell, N. (2000) *The corrupting sea: a study of Mediterranean history*. Malden.

Knappett, C. (2011) *An archaeology of interaction: network perspectives on material culture and society*. Oxford.

Knappett, C., ed. (2013) *Network analysis in archaeology: new approaches to regional interaction*. Oxford.

Knodell, A. R. (2013) *Small-world networks and Mediterranean dynamics in the Euboean Gulf: an archaeology of complexity in Late Bronze Age and Early Iron Age Greece*. PhD diss., Brown University.

Malkin, I. (2011) *A small Greek world: networks in the ancient Mediterranean*. Oxford.

Renfrew, C. (1972) *The emergence of civilisation: the Cyclades and the Aegean in the third millennium* B. C. London.

Tartaron, T. (2013) *Maritime networks in the Mycenaean world*. Cambridge.

Terrell, J. (1977) *Human biogeography in the Solomon Islands*. Chicago.