This volume forms the proceedings of the International Workshop *Harbours and Maritime Networks as Complex Adaptive Systems* at the Römisch-Germanisches Zentralmuseum in Mainz, 17–18.10.2013, within the framework of the Special Research Programme (DFG-SPP 1630) *Harbours from the Roman Period to the Middle Ages*.

The study of ancient and medieval harbours, like other fields of archaeology over the past half century, is being subjected to a re-examination, refining and reorientation process that attempts to render the discipline more formal and quantifiable in its methodology and results. This is proving a positive process, particularly with regard to maritime networks, which has stimulated new thought, fresh approaches and illuminating discussions in the world’s conference halls and in print.1 The present volume under review, *Harbours and Maritime Networks as Complex Adaptive Systems*, offers a variety of papers that contribute to our understanding of ancient and medieval harbours within the framework of complexity theory. This is an important collection of essays, well worth a close reading and full consideration of the innovative perspective it brings to a broad range of harbour investigations. Above all, the volume does an admirable job of addressing an audience that may be composed not only of already seasoned masters but also of apprentices and journeymen in the subject of complexity theory and other formal approaches to harbour studies, who will find its articles provocative and enlightening.

Complex systems, writes co-editor J. PREISER-KAPELLE, are networks of individual components – in this case, harbours – in which small interactions at a microscopic level affect the entire system, by producing changing complex patterns of behaviour at a macroscopic level. Such systems are ‘non-linear,’ as they respond to certain stimuli through feedback mechanisms in a dynamic, sometimes unexpected way. Their nature depends on both current conditions and their history. In general, they are stable but open systems, affected by their environments in complex ways, which occasionally exhibit transitions from one stable state to another through a build-up of small interactions that may reinforce each other. Given the innate character of harbours, then, or preferably ‘ports,’ as central or connecting nodes within complex, dynamic networks, it is clear that the complexity-

theory approach espoused in this volume represents a highly appropriate conceptual framework for their study.

Before proceeding further, a word about terminology. PREISER-KAPELLER’s initial discussion of what constitutes an anchorage, harbour or port leaves something to be desired, as does the volume’s title itself. Although topographical definitions are instructive and useful, social and economic aspects must quickly be factored into them to attain a full sense of a maritime facility’s significance. Thus, while the term ‘port’ can indeed connote a permanent, complex, infrastructurally developed ‘port town’ that functions primarily as ‘a major node in a maritime network’, the term also encompasses more minor sites — as, for example, comparative premodern coastal evidence (‘proxy data’) in Cyprus illustrates.² Such small ports were similarly permanent but often seasonally exploited, relatively or completely undeveloped and uninhabited anchorages and other small, local economic outlets that served as commercial gateways to/from the sea in mostly outlying, agricultural areas. Such local ports in premodern times point to the existence also in antiquity of networks of small ports that composed the lifeblood of the ‘micro-regions’ and ‘micro-ecologies’ distinguished by P. HORDEN and N. PURCELL,³ or the ‘small worlds’ more recently described by T. TARTARON.⁴ Ports, in the more complex sense of dynamic coastal sites that emerged, functioned interactively and faded away, are the true subjects of this volume, not merely ‘harbours’ in a more static topographical or general sense.

Ports constitute a particularly challenging class of archaeological sites. The life-cycle of a port (its establishment, use, maintenance, abandonment and in some cases later renewed use and further development) depends on a complex background of agents, forces and interactions that encompass the port site itself, its socio-economic hinterland (‘Umland’) and its greater region and neighbouring areas, parts of which may compose the port’s foreland. A host of local and regional characters, as well as networks of such individuals, are typically involved in the workings of a port, while its overall success or failure is governed by an array of dynamic economic, environmental and social factors. Into this mix of considerations, needed for a far-reaching analysis of ports, can be added more specific factors of culture, tradition, navigation and choice of sea routes. The whole question of decision-making, as PREISER-KAPELLER argues in the volume’s introduction, represents a fundamental issue in port studies, since every aspect of a port’s life-cycle is governed by decisions and, in analytical retrospect, can perhaps better be

understood or hypothetically predicted through formal, systematic scrutiny and the modelling of potential or suspected decision-making processes.

Network analysis, modelling and other such formal heuristic tools aid in visualizing the connectedness of ports, but they are not without limitations. A key contribution to the volume is that of S.M. SINDBÆK, whose paper offers valuable insight and balance on the advantages and disadvantages of formal archaeological analysis. Network analysis largely involves characterizing the structural pattern of a known set of interactions. Archaeological data, however, is by nature fragmentary. Network analysis, SINDBÆK asserts, may contribute to ‘better contextualization’ of archaeological material ‘as evidence of past communication’, but also may present models ‘whose basis is difficult to assess, and whose predictions may be equally difficult to validate.’ He suggests this formal analysis is better suited to synthesizing archaeological data and evaluating its strengths and limitations.

SINDBÆK provides an overview of network analysis in archaeology, noting it may assist in filling gaps between traditional tools and methods (maps, statistics, Global Positioning System programs) by integrating spatial and non-spatial patterns. He then presents an instructive model that graphically represents ‘the relative relatedness’ and ‘centrality’ of nodes (ports) involved in the medieval cooking ware trade in tenth-century Northern Europe. SINDBÆK examines the model’s redeeming features and negative aspects, concluding that ultimately it illuminates not actual past behaviour, but our own understanding thereof. Lastly, he highlights eight important points: network analysis requires large data-sets, which are rare in archaeology and, when found, generally too heterogeneous; sample biases are amplified in network analysis and even small flaws can have a major effect on results; archaeological data is subject to arbitrary boundaries in space and time; defining of nodes is a subjective process; archaeological assemblages are ‘the unpredictable result of multiple dynamics’; and archaeological sites are complex formations characterized not by specific, directional links, but by ‘clusters of affiliations’. Harking back to the fundamental issue of site formation, SINDBÆK stresses that, for any single artefact, there can be ‘a number of equally plausible itineraries through social and spatial networks’ to explain its deposition. Archaeological studies should include both formal approaches and flexible, informal approaches that may lead to ‘self-evident answers’ unattainable through purely formal analyses.

The four papers by F. GODDIO et al., M. VEIKOU, F. KARAGIANNI and P. ARNAUD represent less formal, narrative approaches to complexity theory. Goddio underscores the role of socio-economic and possibly environmental factors in a harbour’s emergence and decline, describing the life-cycle of the western Nile-delta port of Thonis-Heracleion in Egypt from the rise of the Saïte Dynasty (664–525 BC) through its eclipse by Alexandria in 331 BC.

M. VEIKOU considers similar factors in the development of Byzantine ports and small local outlets throughout the Eastern Mediterranean. Although the paper rambles and needs a thorough editing, the breadth of the author’s perspective is inspiring. Perhaps her most interesting point is one with timeless implications: during the economically active Byzantine period, ‘there seems to be no correlation between extensive commercial activity and the use of ports with built harbours’.

F. KARAGIANNI delivers a descriptive report packed with data concerning Black Sea trade connections, especially at its peak during the ninth through the thirteenth century. Among the more intriguing evidence are travellers’ souvenirs that reveal ties between pilgrimage centres all around the Eastern Mediterranean and Black Seas. P. ARNAUD offers a fascinating glimpse into the evidence (or lack thereof) for Roman management and development of maritime facilities. Theirs was more a bottom-up than top-down system, in which provincial governors, cities and individuals made micro-interventions, while large infrastructure projects were the realm of imperial euergetism. The forces that ultimately drove port works were self-glorification, personal or collective status and relationships (networks) between individuals and groups.

The final paper, by J. PREISER-KAPELLE, is an impressive display of network-analysis muscle that brings to mind SINDBJÆK’s earlier cautionary remarks. There is much to be learned here, as the author presents different model types and probes the potentially vast reach of network analysis. Somewhat tedious are the formal terms, as (to name only a few) a case study becomes a ‘relational toolkit;’ links – ‘entanglements;’ time periods – ‘time slices;’ dynamics – ‘logics;’ and trade – ‘affiliation networks’ or ‘ties of similarity’. More useful is ‘logic of cabotage’, referring to how spatial proximity contributes to port emergence in networks. In many cases, PREISER-KAPELLE’s discussion seems to reach conclusions about ports, ships and seafaring that we already know. Nevertheless, his remarks both here and in the volume’s introduction stimulate the imagination and encourage port analysts to go further. The application of hard science to archaeology is sometimes startling, as insect communication systems become points of comparison for past trade networks, but one never knows from where the next great breakthrough will come. The significance of ‘mental maps’ (i.e., traditional knowledge) and the phenomenon of indirect communication (attested by ant networks) are just two of the many intriguing concepts advanced in this volume worth further attention.

From a production standpoint, a number of typographical errors, including incorrect punctuation, missing or excessive articles and occasionally unintelligible language (e.g., ‘If we stick to our decision to stark from the controversies …’ p. 131), tend not to detract significantly from the overall high quality of the volume.

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