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Cover by Kristin Parknert. Drawing from Karlsson *et al*. in this volume, p. 38, fig. 18

(51). The Rome of Stendahl and Piranesi was eradicated and replaced with rationalist architecture and grand avenues such as Via dell'Impero (today's Via dei Fori Imperiali). A famous photograph showing Mussolini with a pickaxe inaugurating the demolition for the Piazzale Augusto Imperatore is reproduced (fig. 4). Particular attention is given to the spatial relationship between ancient Rome and the new, modern capital of Fascist Italy.

As is clear from the heading, Chapter 4 ('The totalitarian museum: The Mostra Augustea della Romanità, 1937–1938'), deals solely with this major propaganda event of the Fascist regime—the exhibition organized to celebrate the two thousandth anniversary of the birth of Augustus. Arthurs rightly calls this moment "the apex of *romanità* in Fascist political culture" (7). The chapter describes the exhibition in great detail and also how it was received by contemporary critics.

Chapter 5 ('Empire, race, and the decline of *romanità*, 1936–1945') covers the final decade of Mussolini's Fascist Empire. The Italian victory in Abyssinia in 1936 was a crucial event in this period. In Libya the colonization was intensified under the governorship of Italo Balbo. Archaeology played a very important role in Libya where it was used in demonstrating how the colonization by Fascist Italy in fact was a *riconquista* of land that once had been Roman. Thus the propaganda claimed that it was only right that the Italians—the descendants of the ancient Romans—returned to North Africa, their "fourth shore" of the Mediterranean, and farmed the land again. Perhaps more could have been said about the Libyan adventure, given the importance of archaeology there, but Arthurs gives a good summary of the events in this colony. The fall of the regime in July 1943, the subsequent German occupation of Rome and the Anglo-American conquest of the city in June 1944 end the chapter.

In the conclusion some important points deserve mention, in particular the "stain of collaboration" that "marked an entire generation of Italian classicists, archaeologists and ancient historians" (151). Galassi Paluzzi, for example, tried to distance the Istituto di Studi Romani from Fascism. The institute still operates today under the name of the Istituto Nazionale di Studi Romani and the journal *Roma* has been renamed *Studi Romani*. One can also note that the great Mostra Augustea della Romanità in a downscaled way lives on in the Museo della Civiltà Romana at EUR. The ancient monuments in the city of Rome, as we know them today, are largely a result of the Fascist period "liberation". The new constructions of the regime also remain intact to a surprising degree, most conspicuously at the Foro Italico with the "Mussolini Dux" obelisk, around the Mausoleum of Augustus and at EUR.

The goal of the book is "to integrate *romanità* into current discussions about Fascist culture and its relationship to modernity" (5). Although much of what is presented is not new, Arthurs is to be congratulated on having gathered information from many Italian archives and other sources into a coherent structure and analysed the material in a commendable way. This book will be of great value for any historian wishing to understand the concept of *romanità* and the complex relationship between Mussolini's Italy and Rome, both as a place and an idea.

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Robert Spain, *The power and performance of Roman watermills. Hydro-mechanical analysis of vertical-wheeled watermills* (BAR-IS, 1786). Oxford: Archaeopress 2008, xiv + 107 pp. ISBN 978-1-4073-0217-1.

For quite a long time, scholarship concerning ancient watermills has been dominated by archaeologists and historians, but even engineers and other technically educated scholars have devoted more of their energy to questions such as diffusion and breakthrough than to strictly technical matters. As pointed out by Robert Spain (66), Luigi Jacono's publication of the Venafro water-wheel (1938) was the first attempt to present a hydro-mechanical analysis of an ancient water-mill. But his followers have remained remarkably few, and their calculations are often ill-founded or simply wrong. Spain's explicit ambition is to provide a less shaky foundation for future analyses, even though few ancient mill sites offer sufficient information.

As early as 1976, Spain made a detailed analysis of the mechanism of the Haltwhistle Burn Head mill, in order to establish the total friction losses at its bearings (6). In 1985, he "designed and commissioned the making of a pair of millstones from Mayen". They were designed according to extant, ancient stones, even though rather small for Roman ones (7). His studies of these constituted the basis for his 1992 dissertation—never published, but to large extents included in his present book.

In Part one (1–12), Spain presents the problems inherent in the study and his methods of approaching and solving them. In 'Introduction' (1–2), he argues for the need of a functional analysis "in contrast to the static, descriptive analysis made by the archaeologists"—in its turn divided into a theoretical analysis based on the physical laws of motion and practical tests using modern replicas.

In the next chapter, 'The dynamics of a water-mill and the limitations of evidence and analysis' (2–3), the author establishes the conditions for his study. When basic facts concerning a

particular mill are known, the productivity can be calculated by theoretical analysis, with exception for the friction. Basing his argument, particularly, on finds from the Athenian Agora, the Baths of Caracalla, Hagendorn and Zugmantel, together with an educated guess that the runner-stone rotated at *c*. 60 rpm, he concludes that the friction losses at bearings and gears were insignificant (*c*. 9%) compared to those at the runner-stone (*c*. 90%).

In the chapter on 'Hydro-mechanical analysis' (4–12) Spain starts by criticizing the orthodox division of water-powered mills into overshot, breastshot and undershot ones: "To avoid confusion, the classification of water-wheels used in this study is based upon the two components of water-power, the impulse (caused by velocity) and the weight (caused by gravity) of the water" (4). Modern consensus allots 15–35% efficiency to undershot wheels and 50–70% to overshot ones (Spain hesitates to allow for more than 60%).

When torque and wheel-speed can be estimated, we can calculate the power available. This is easiest to do concerning wheels driven by impulse. In theory, the efficiency is greatest (50%), when the paddles move at half the speed of the running water, but in practice it is better if they move slightly slower. The potential power of a weight-driven, overshot wheel should be worked out by adding the separate buckets. This complicated method is actually what the author tries to apply in Part two.

The greatest uncertainties concern the wooden gears. Their size and, thus, mechanical ratio can very seldom be ascertained. Accordingly, the author bases his calculations on various possible ratios. He estimates the power losses at the gears to *c*. 5%. It is also difficult to estimate the friction between the two millstones: the necessary torque is proportional to the weight of the runner, which decreases constantly through wear during the stone's life-cycle.

Part two (13–74) is a catalogue of 29 water-powered installations chosen for the simple reason that they provide information essential for Spain's study (marked on the map, fig. 5). First come the mills powered by bucket-wheels/weight (nos. 1–5), then those powered by radial paddles (nos. 6–29): "Within these two broad categories, there are many sites having little difference in their hydraulic arrangements, so that the order in which they are given is unimportant" (13). This may well be, but the lack of a clear order (chronological, topographical or alphabetic) makes the book more difficult to consult.

Spain's presentations of the separate mills vary much in length, always depending on their pertinence to his inquiry. They are lavishly illustrated by his own drawings (no photographs), artistically first-class as well as technically illuminating. Most entries are based exclusively on one fundamental publication, supplemented by the author's own arguments, when possible confirmed by autopsy. Apart from visiting most accessible mill sites, he has, for instance, studied ten millstones from Barbegal (no. 1) at the Arles museum (18); he can supply much unpublished information regarding the Fullerton mills (no. 6); and he presents the first printed description of a possible, 2nd-century tide-mill in London (no. 28)—a technological advance unknown before the 7th century until recently.

In some cases, Spain makes critical examinations—mostly convincing—of earlier studies (including one of my own: 72). He rightly rejects various bizarre misunderstandings about the Venafro wheel (64), and with good reasons argues that the upper Lösnich wheel (no. 26) was breastshot rather than overshot. But one would have appreciated some comments on the doubts raised concerning the Chesters Bridge (no. 12) and Willowford Bridge (no. 13) mills.

Part three, 'Summary and conclusions' (75–90), combines the theoretical analyses presented in Part one with the case studies of Part two. In the chapter 'Mill production' (75–77), Spain discusses the power absorbed by hourglass-shaped animal-mills in relation to that of disc-shaped, water-powered millstones, pointing out that we know nothing of how such stones would react when rotating faster than usual (as in the Nahal Tanninim water-mill, no. 25).

In the next chapter, 'Incidence' (78), Spain explains the difference between the over-driven stones (mostly from animal-mills) and under-driven ones (mostly water-powered); he points out that most ancient water-mill sites are rural, but repeats the old (and completely groundless) statement that the Collegium pistorum "may have worked actively against the introduction of water-mills in Rome".

In the chapter on 'Machine efficiency' (78–80), the author summarizes the results of his studies of nine ancient mill sites – the most striking fact being the small variations in efficiency between the three mill types:

- Three mills with bucket-wheels had an efficiency of 36–43.8%.
- Two impulse-driven, overshot mills had an efficiency of 34–42.6%.
- Four impulse-driven, undershot mills had an efficiency of 27.5–42%.

But the author wisely saves the most thought-provoking part of his book to its very end: "The natural phenomena which tend to accelerate technological evolution" (80–83), and "Theories of evolution" (84–90). The "natural phenomena" are summarized as follows (82):

(1) That a small impulse-driven wheel can deliver the same power as a larger one with the same water-flow and velocity, but at a higher speed of rotation.

(2) If the flow rate is held constant and the velocity is doubled, the power generated is quadrupled.

The consequence of these phenomena is that the best method of increasing the productivity would be to adopt smaller, vertical impulse-wheels and accelerate the head-races. A survey of Imperial mill sites convinces the author that the Romans eventually became aware of this fact.

This argumentation leads Spain to a novel conception of the invention of the horizontal-wheeled mill. This type remained rare in Antiquity, but recent finds have added five such mills in Gaul and two in Britain, dated from the 1st to the 7th century AD (85). As he rightly points out, history of technology shows that the development does not always proceed from simpler to more complex solutions, but occasionally the other way around. Smaller, faster water-wheels give lower gear ratios and, eventually, smaller gears: "there would come a time when the velocity of the accelerated head-race could drive a wheel at a rotational speed similar to that required by the millstones for satisfactory grinding. Thus, a gearless direct drive was possible, simply by changing the axis of the water-wheel from horizontal to vertical" (86).

Spain finds Michael Lewis's early date for the horizontal wheel "persuasive" (85), but in no way impeding for his own theory. The horizontal-wheeled mill may well have been invented in the mid-3rd century BC (Lewis), but been displaced by the vertical-wheeled mill and later reinvented (Spain).

Robert Spain's book is an important and welcome contribution to the slowly growing number of monographs on ancient water-mills. It constitutes the first basically trustworthy hydro-mechanical analysis of these mills, and it offers ample material and suggestions for further studies.

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Thomas F. Tartaron, *Maritime networks in the Mycenaean world*. Cambridge: Cambridge University Press 2013. ISBN 978-1-107-00298-2.

The aim of the author of this volume is to present a more balanced picture of Late Bronze Age maritime interactions in the Mycenaean world. In doing so, Thomas Tartaron analyses and reassesses the maritime networks by emphasizing the importance of small- and medium-scale voyages in the Mycenaean period. He concentrates on the coastal networks where small- and medium-sized vessels were used, especially in the Saronic Gulf—an area he knows well from earlier research. He argues convincingly that such local networks are much more representative of the Mycenaean communities than the long-distance connections which previously have received so much attention.

In the introductory chapter (1–11) Tartaron treats 'The problems of the Mycenaean world' i.a. and discusses the issue of terminology: several terms which are commonly used, such as ship, boat, vessel, craft, anchorage harbour, port, and port town give rise to many problems for the identification of the available evidence and material when seen as uncomplicated; consequently, if used without deeper consideration, these terms make further analyses of maritime interconnections problematic. Instead, he argues, they need to be defined within the context of Bronze Age Greece (3–5). He also notes the complexities inherent in a discussion of the coastscape, caused by natural factors such as geomorphological change and global sea-rise, and refers to the challenge of defining the Mycenaean coastal world (7–10). In this analysis, together with the discussion of Mycenaeans and the sea in Chapter 2, 'Mycenaeans and the world' (12–47), Tartaron thus directs attention to the methodological and logical problems within discussions of Mycenaean maritime activity and sets the scene for the next chapters. He also considers the ethnographic material in this discussion. The use of ethnographic parallels is always tricky (as the author recognizes), but here and elsewhere in the book they are handled sensibly and in a balanced way.

Chapter 3 concerns the archaeological finds and depictions of ships and boats dated to the Aegean Bronze Age (48–89). Tartaron provides a critical analysis of previous research on Bronze Age ship technology; he attempts to identify various types of ships and boats and concludes that only the galley is widely enough attested to allow for a reasonable understanding of it. As he points out, various smaller vessels may also have been used, but these are more difficult to identify with any certainty (88–89).

The vessels and their crews navigated in the Aegean Sea, and this is the focus of the next chapter (90–138). Here, the maritime environment is examined, while Tartaron takes into account not only local but also global-scale network systems.