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Roberta J. Magnusson, *Water Technology in the Middle Ages: Cities, Monasteries, and Waterworks after the Roman Empire*. Johns Hopkins Studies in the History of Technology. Baltimore and London: The Johns Hopkins University Press, 2001. xiv + 238 pp. Diagrams, figures, notes, and index. \$38.00 U.S. (cl). ISBN 080186626X.

Review by William H. TeBrake, University of Maine.

In a slim, well-written, and well-organized volume, Roberta J. Magnusson closely examines the relationships between people and "complex, gravity-flow water systems" during the high and late Middle Ages. Consisting of "collection basins, long-distance conduits, and distribution points," these systems supplied water to portions of, or entire, towns, to a whole range of secular and ecclesiastical buildings or building complexes, and to "at least one enterprising village" (p. viii). Though she is interested in all such systems, the author makes clear at the outset that her focus, reflected in the volume's subtitle, is primarily on urban and monastic water systems. She also makes clear that she came to the study of the middle ages by way of archaeology, and this is indicated by her obvious competence in including archaeological material alongside documentary information throughout this study.

Magnusson begins by looking at the continuity of hydraulic works in areas once part of the Roman Empire. A number of popes, for example, kept portions of Rome's water supply system functioning into the ninth century, and other officials, both secular and ecclesiastical, oversaw repairs to keep some additional water works functioning. A few new works were even built during the early middle ages. Despite such scattered indications of continuity, the author maintains that "the thread of technological continuity had become seriously frayed," if not completely broken by the late ninth and tenth centuries (p. 5), with only a very small handful of water works continuing to operate through the period. Beginning during the eleventh century, however, complex water systems began to make an appearance in a number of places throughout Europe, becoming increasingly widespread in the two centuries that followed, even in areas that never had been incorporated into the Roman Empire. To all intents and purposes, these new hydraulic works should be considered innovations, according to Magnusson, even though they had many similarities in design and function to Roman water works.

In chapter two, Magnusson examines the fundamental prerequisite to the construction of any complex water system: resource acquisition, which she breaks down into the source of water itself and a strip of land between the water's source and its destination. Both could be met by acquiring ownership through outright purchase, through donation or appropriation, through easements, or through some combination of these. She goes on to present numerous examples of how these requirements were met and also analyses a number of disputes that stemmed from resource acquisition.

The longest, a third of the text, and by far the most detailed chapter in this study is chapter three, in which Magnusson examines the design and construction of medieval water supply systems. Here her background in archaeology becomes very visible as she augments the meager documentary record with numerous archaeological reports to sketch a detailed picture of what went into a medieval water supply

system. An entire system would consist of three subsystems that "collected the water at the natural source," "conveyed it to the desired destination," and "distributed it to users" (p. 55). She further breaks these subsystems down into their component parts. Collection of water at the natural source could be done through the use of conduit-heads or seepage tunnels that characteristically channeled water into some sort of holding tank or cistern from which water was conveyed to the rest of the system. Conveyance was achieved by the use of lead, earthenware, or wooden pipes as well as open channels, while distribution to users was accomplished by means of dipping places, fountains, or taps and stopcocks.

Magnusson examines the financing and administration of water systems in chapter four. Because of the high costs involved in designing and constructing a complex water system, no project could be successful without a serious commitment from the community to be served "to bear its costs, whether through increased levels of taxation and expenditures or through the generosity of private individuals" (p. 132). And, once constructed, water systems would require constant maintenance and oversight, always costly in time and materiel. The entire system could come to a halt if sediment and calcium deposits were not regularly removed from channels and pipes, and hard frosts could lead to frozen and broken conduits.

In the final chapter, Magnusson looks at how people used the complex water systems of the middle ages. In general, users in Britain were presented with tanks or cisterns that were outfitted with taps or spigots. Such a closed design made the pollution of water by users highly unlikely but restricted usage to the filling of containers. On the continent, water was characteristically distributed by means of fountains, which included open basins of water, that could be used not only for filling vessels but also for watering livestock, bathing, laundering, and performing industrial activities. Because most such activities ended up rendering the water remaining in the basin unfit for human consumption, overseers of water systems had to expend considerable time and effort to limit such activities. In the end, according to Magnusson, the "informal development of new behavioral norms and unofficial resolutions of disputes among users themselves were probably as important as official interventions in the establishment of appropriate patterns of usage" (p. 134).

In a brief epilogue, Magnusson looks at the fate of medieval water systems during the early modern period. In general, she maintains, there was a tendency for publicly or commonly owned water systems to be replaced by systems that were privately owned and operated. The latter delivered water directly to the houses of individuals who were willing to pay for the service. Consequently, as those better off increasingly paid for water delivery to their houses, their support dwindled for water systems that delivered water to a few public access points.

There is much more to this little volume than has been presented here. Along the way, Magnusson also looks at what medieval people thought of water as a beverage, at the kinds of conflicts that grew up around water usage (including charges that some wasted the precious resource), at the effects that changing habits of personal hygiene had on water use, and at industrial uses of water. Throughout, her documentation is careful and substantial, and she does a fine job of placing the history of water technology securely within its economic, social, and political context. It will be instructive not only to historians of technology but also to anyone interested in resource use during the middle ages.

The major limitation with this study is its geographical focus. Despite her expressed interest in studying medieval water systems throughout Europe, Magnusson's focus, at least in the most detailed sections, where she looks at the construction and financing of complex water systems, is limited primarily to Britain and secondarily to Italy; the material concerning Britain in chapter three can be considered comprehensive, while that on Italy is more selective—a handful of urban systems, with most attention paid to Sienna. These choices make it a less than ideal volume for readers interested primarily in France. The author never explains why she adopted such an odd geographical limitation, though it

likely stems from the focus of the dissertation that preceded the book. Despite this limitation, however, this volume can be read with profit by H-France subscribers: some French examples are included, and, presumably, the design, construction, and use of complex water systems would have been much the same in France.

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