

### III. PRODUCTION AND DISTRIBUTION

## TIBER VALLEY PROJECT: WATER MANAGEMENT

*Andrew Wilson*

### 1. Research objectives

Examination of the ways in which the drainage basin of the River Tiber has been managed in antiquity is clearly a key issue in any attempt to relate ancient settlement patterns to their geographical and landscape settings. But besides the obvious significance of the study of water management in the history of the Tiber Valley as a whole, it can also be used as a lens to examine two larger themes:

- Rome's political relationship with other settlements in the Tiber Valley with regard to control over water resources, especially through attempts to control the flooding of the Tiber;
- Economic factors affecting settlement patterns in the Tiber Valley, by analysis of drainage, irrigation and land improvement schemes.

### 2. Data collection and analysis

Very little analytical work exists on water management efforts in the Tiber Valley, although there are many scattered data on hydraulic structures. Literary sources for the floods of the Tiber have been collected, but a brief article by M. Belati (1999) is the only really analytical synthesis of flood control schemes, and even this does not fully examine the wider technological and political contexts.

For water-related features in the rural landscape, data from the Tiber Valley Project database was extracted and, for cisterns, capacity measurements tabulated where possible and correlated to other indications of site type, to see whether the rural cisterns appear to be more suited for irrigation or alimentary supply.

### 3. Results and conclusions

#### *i. Flood control:*

Analysis of attempts to control Tiber flooding suggests an evolution of technical solutions, becoming progressively more ambitious over time and moving from treatments of the symptoms to attempts to tackle the problem at source. Ammerman's corings in the Forum and the Velabrum (Ammerman 1998; 1990) show that in the sixth century B.C. the ground level in these areas was artificially raised by between 1 and 4 m. Impressive and labour-intensive as these landscape transformations were, their effect was only to raise certain areas above the levels of many, but not all floods: the problem was alleviated, but not solved. Later expansion of Rome's population into other low-lying areas (Campus Martius, Trastevere) brought further problems, leading to Augustus' appointment of magistrates responsible for dredging the channel and canalising the banks of the Tiber. This contained some of the lesser floods, but still did not remove the problem.

Fundamentally different are efforts to tackle the cause of the problem, seen for the first time in a scheme considered by Caesar, but never put into effect. This was the construction of a relief channel round the back of the Janiculum. Serious flooding recurred almost annually, and throughout the course of the first century A.D. increasingly ambitious attempts started to deal with the root of the problem, rather than simply to contain the symptoms. Claudius' works on the new harbour at Portus included the digging of relief channels to link the Tiber to the sea, above the sharp bend by Ostia that acted as a bottleneck and caused the waters to back up. This scheme shows that Claudius' engineers evidently understood the systemic nature of flood control, and that it might be necessary to effect works many miles distant from the point at which one desired to control the floods. An additional effect of Claudius' works must also have been to reduce the extent to which Ostia was exposed to regular and severe flooding.

However, Claudius' works did not prevent the severe floods of A.D. 69 recorded by Tacitus (*Hist.* I, 86,2). In response, a scheme was proposed to divert the Chianti, one of the Tiber's tributaries on the right bank upstream from Rome, into the Arno, to reduce the amount of water flowing through Rome. This provoked a senatorial debate and the scheme was successfully opposed by the local communities who would have been affected by this move.

Trajan constructed further exit channels from the Tiber to the sea near Ostia and Portus. There is some uncertainty over which channels belong to the Claudian and which to the Trajanic flood relief schemes; possibly the ongoing work at Portus may be able to clarify this. Post-Trajanic measures seem to have been limited largely to repairs to the Tiber banks and dredging of its channel.

The larger flood relief schemes of the first and early second centuries A.D. imply a recognition that effective solutions to the problem of the Tiber floods required a landscape-wide solution that addressed the whole catchment area of the river valley and its estuary. However, political considerations prevented the most ambitious schemes (Caesar's relief channel and the Chianti diversion), which were also the most likely to have provided an effective longer-term solution, from being put into action.

## ***ii. Irrigation, settlement and the rural economy:***

The South Etruria survey results indicated a much denser concentration of settlement in the southern part of the survey area, closer to Rome. It seems clear that the proximity of Rome encouraged settlement here, and it is frequently assumed that farms and villas in this area were engaged in growing fruit and vegetables to serve the markets of Rome (Potter 1979; Morley 1996). However likely this is, until now it has remained largely an assumption, supported in part by literary sources, which relate more to the south and east of Rome (Tibur etc.) than to the Tiber Valley to the north, and by theoretical models.

There is however a mass of data in the Tiber Valley survey archives and in published material (*Forma Italiae* etc.) which can be used to ground this analysis in the archaeology. Irrigation and drainage schemes demonstrate investment in land improvement for some form of agriculture, and one class of structures provides a clue as to the kinds of products grown. A number of rural sites possess large cisterns (200-700 m<sup>3</sup>) far exceeding the water-supply needs of a farm or villa, and in many cases these are not associated with villa baths. Such cisterns are most plausibly interpreted as being for irrigation: a study carried out on similar hydraulic features to the east of Rome (Thomas and Wilson 1994), using software to estimate irrigation

needs for different crops in various kinds of soils, suggested that the capacity of such cisterns was insufficient for irrigating significant areas of wheat or vines, but would have suited the irrigation needs of vegetable gardens or fruit orchards. The scant epigraphic evidence seems also to support the use of cisterns of this type for irrigated horticulture. We have here a suggestive indicator to support the hypothesis of settlement in the immediate vicinity of Rome being geared to growing perishable crops that could not be transported too far to market, and indications of substantial investment in hydraulic infrastructure to support this irrigated horticulture.

#### 4. Publications

It is intended to publish the research as an article for the Papers of the British School at Rome; much of the text currently exists in draft, but needs additions.

#### 5. Future directions

More work is needed on the rural cisterns thought to be for irrigation, and on their systems of supply (especially the possibility that some were fed by rural aqueduct networks perhaps serving several farms). This work will be facilitated by the recent acquisition of digitised relief and hydrographic data for the Tiber Valley; it should now be possible to use GIS watershed analysis to see which cisterns might have been fed from what sources, and what land they might have irrigated.

There is unresolved debate over the date of the underground drainage tunnels known as *cuniculi*, which are common in South Etruria. Some are clearly Etruscan, and it has been proposed that all are; some scholars, however, have pointed out that *cuniculi* could have been dug well into the Republican period. Given the difficulties of dating such rock-cut features, one way forward might be to examine the spatial distribution of *cuniculi* in relation to settlement distribution in different periods, to look for significant correlations.

#### 6. References

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