Book Review
Vadose Zone Journal

The Public Fountains of the City of Dijon

H. Darcy. Translated by P. Bobeck. Kendall/Hunt Publishers, Dubuque, IA. 2004. Hardcover, 554 pp. $239.95.
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A MODERN READER would grasp the nature of this work more readily if its title, which to the uninitiated might suggest a coffee-table book full of beautiful color pictures, were instead something like "Draft Final Interim Report on the Rosoir-Spring Remedy for Public Water Supply of Dijon: Hydrologic, Engineering, Financial, Legal, and Political Challenges and Impacts." It is big, having 526 large pages that include preface, main text, and eight appendixes, plus 27 double-size fold-out pages of detailed illustrations. Darcy's sights were set well beyond immediate and local issues: in laying out all the design considerations for the Dijon water supply, his intent was to supply a paradigm for similar systems elsewhere. Of course, another unique feature is that four pages in the middle of Appendix D present the investigation that established the foundation of subsurface hydrology for the next 150 years and beyond.

Bobeck has translated *Les Fontaines publiques de la ville de Dijon*, which Darcy wrote in 1856, into 21st-century American diction, although it retains some old-fashioned stylistic features such as erratic paragraphing and excessive wordiness of a very different flavor from what is common today. Thanks to the modern vocabulary and occasional footnotes explaining textual anomalies, this book is easier to read than 19th-century scientific writings that were originally written in English.

Darcy's goal was to engineer a complete system, including political, economic, sociological, and psychological components. Part I contains mainly background material, including an account of several centuries of hydrologic investigations and proposals concerning public water supply to Dijon. Darcy shows previously existing hydrologic knowledge to be primitive and fraught with error, although with occasionally accurate insight. Darcy sifts the various accounts and historical records with incisive skepticism, reasoning soundly about what is true and useful. Part II gives the main details of Darcy's aqueduct and supply system. He includes a highly detailed description of plumbing accoutrements and how best to utilize them, including manholes, valves, pipes, and all their fittings, which would be incredibly useful if only it were about the devices commonly used in laboratory and field experiments 150 years later. Part III, the objective of which is "to verify the exactness of the laws that are generally accepted today" (p. 289), presents experimental investigations on the conveyance of water and the effects of conduit geometry, enclosed air, upslope segments, and multiple reservoirs. Darcy puts much value on direct scientific measurement and visual observation. He summarizes his investigations in the form of general principles and formulas, to serve as a basic reference for engineers. Part IV, on the legal and political issues arising from Dijon's new water system, contains extended quotations from official documents that implemented Darcy's plan and resolved disputes. Linking these is Darcy's own rather triumphalist and often self-congratulatory narrative, which consistently demonstrates his deep understanding of the economic, social, and psychological issues that arise from the sensitive matter of water. One cannot help but be impressed at how the fundamental matters of competing self-interests and human psychology are the same as today, even though particular problems and solutions differ. It is fascinating to see how Darcy's thoroughgoing engineering approach confronted political and legal problems. For example, he details a specific plan for public meetings and then notes that after meetings performed this way, "it generally happens that greedy emotions are neutralized" (p. 377). Darcy's personal philosophy is also abundantly on display. In a letter to the mayor of Dijon, he favors an abundance of public fountains (where water was dispensed for free at numerous locations throughout the city) and only a small number of concessions (which for a price conveyed water to an individual dwelling or business). He seems imbued with egalitarianism as well as the unchallenged concept that natural resources are inherently limitless. In the main, these show him to be of his own place and time (a few decades after the French Revolution, a century before the first Earth Day), although with a strong vision for what the world could and should become.

In all topics, there is much emphasis on economics, even down to pieces of hardware costing a fraction of a franc—avoidance of unnecessary cost was a constant concern to Darcy. He maintains balance, however, keeping the physical and political

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details in mind at the same time as the economic. For example, he presents a typically detailed description of slotted iron and copper plates having specially designed orifices to allow the precise extraction of 1/25, 1/141, and 1/37 of the total flow for the use of three villages along the route of the aqueduct. Darcy as a matter of course notes what design features must be incorporated to ensure that the fractioning of the water supply will retain the designated proportions after inevitable corrosion and wear have taken place. He also explains that these water diversions were negotiated with the villages (we learn later, with Darcy's own instigation and participation) in the course of securing rights for the aqueduct to cross their land. Moreover, he explains that sharing the benefits of the water system with these villages is necessary to motivate their citizens to prevent damage and vandalism to the aqueduct.

The book is replete with tedious engineering data, not just in tables but in extended prose passages; for example, "first secondary branch follows Rue Victor Dumay; it is 96.80 m long and 0.108 m in diameter. At the point where it crosses Rue Sainte-Anne, it connects to a sub-branch that follows Rue Sainte-Anne. This branch is 167.30 m long and 0.081m" (p. 192). While intensely subdivided (the four parts are divided into chapters, which in turn are divided into sections, within which there are further divisions), the organization of material is flawed at every level. For example, instructions on the insertion of tarred rope into pipe joints before the addition of molten lead are in a long passage detailing fabrication costs. This defect is unlikely to disturb the modern reader whose interest is more historical than practical. Likewise, the level of detail (one can get the impression the book reveals the cost and dimensions of every piece of water pipe in the city of Dijon), while vital to the character of the work, is easy to perceive while thumbing quickly through many of the pages.

Not a committee product, this book is flavored throughout by Darcy's own take on life beyond the realm of hydraulic engineering. His humanitarian concern, implicit in the purpose of the book as a whole, appears also while he describes specific installations throughout the city, where mention of a hospital or orphanage typically comes with a footnote giving a sentence or two about the institution, its history, and purpose. Another personal element is Darcy's fascination with the decorative and esthetic aspects of water and hydraulic systems. Just three sentences into the main text, he declares, "Water can also be an embellishment for public squares and promenades, to energize them with new life by spraying forth from monumental fountains, in smaller water sprays or cascading as waterfalls" (p. 1). He routinely gives elaborate descriptions and drawings of architectural adornments, such as the classic Roman–Greek–Renaissance building built atop a reservoir at the city's edge.

The highlight for modern readers, naturally, is the subsection of Appendix D headed "Determination of the Laws of Water Flow through Sand." In this appendix on practical techniques for filtering water, in a book that is a monumental case study of how to supply water to a city, are Darcy's celebrated experiments and conclusion that "the volume discharged is proportional to the head and inversely proportional to the thickness" (p. 456). We already know the result and import, but to closely examine Darcy's own writing can fascinate, inspire, and in some ways, enlighten. For vadose zone specialists, Darcy's presentation sheds light on our recent decades' ongoing debate over how firmly to attach Darcy's name to the flux/force proportionality in unsaturated flow theory. Although Darcy states that he is writing to show what is important from an engineering rather than a theoretical standpoint, he is clearly aware of the uniqueness and importance of his famous experiments and their generalization: "[T]o my knowledge at least, no one has experimentally demonstrated the laws of water flow through sand" (p. xxv).

What's the value for a scientist of the 21st century? The same in the celebrated Appendix D subsection as in the rest of the book: insights into the genius and humanity of a brilliant hydrologic pioneer.