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**Chandra Mukerji: Impossible Engineering**

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# chapter 1

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## *Impossible Engineering*

When the Canal du Midi was first navigated to the sea, a flotilla of dignitaries crossed the waterless valleys of eastern Languedoc. The sight was uncanny. The strange apparition of boats in the continental interior seemed to turn the order of nature upside down, making palpable the powers of governmental administration. The royal canal to connect the two seas was mute, obdurate, and superhuman. For witnesses of this first crossing, it was something to see.

Originally named the Canal Royale des Deux Mers, the waterway linked the Mediterranean to the Atlantic through the Garonne River, crossing southwestern France just north of the Pyrenees. The canal extended across

Figure 1.1

Map of Languedoc, Nicolas de Fer, 1700. Courtesy of the University of California.



Languedoc for nearly 240 kilometers (150 miles), and at the divide between the Atlantic and Mediterranean watersheds, reached 189 meters (620 feet) above sea level. The passage required a hundred locks to manage the substantial shifts in elevation.<sup>1</sup>

The canal, as a silent demonstration of disciplinary power over the earth, pointed obliquely toward techniques of governance that lay beyond the visible and familiar practices of domination—war, taxation, and court life.<sup>2</sup> In its mysterious materiality, it suggested that political authority could also lie in something both spiritual and worldly—dominion over the earth and its creatures. The Canal du Midi officially represented the power of Louis XIV, but more memorably testified to the power of stewardship over the earth, using the human intelligence given by God in the act of the Creation to allow people to manage the earth and its creatures. The apparent impossibility of running water through dry hills and valleys across a continent made the canal seem evidence of God's work, and not just the will of the king. Here lay the cultural power of political territoriality.<sup>3</sup>

What made the waterway so mysterious and haunting was its unaccountable intelligence. No one knew in the 1660s how to do the elevation studies or estimate the water supply needed for such a canal. In the mid-seventeenth century, Jean Picard at the Académie Royale des Sciences was refining survey techniques, and Philippe de La Hire was working on elevations. Still, their methods were not adequate for determining precisely how to route a navigational canal through the complex topography of Languedoc. Picard's techniques were hard to use on uneven terrain because compensating for shifts in elevation could be tricky. Some academic geographers in the 1660s even believed Jodocus Hondius that continental divides were always high mountains, and doubted that there were passes low enough in Languedoc for a navigational canal. For all these reasons, respected geographers were ill prepared and not inclined to help build a canal in Languedoc.<sup>4</sup>

There were also elements of hydraulics that were not well understood by the learned men who dominated geography and engineering. For example, no one knew precisely how much water a navigational canal with so many locks would use. There were no reliable calculations for estimating water losses due to splashing, evaporation, or seepage into sandy soils. The Canal du Midi also needed reservoirs or holding tanks to assure an adequate supply during the long, dry summers of southwestern France. But how big would the reserves have to be? Where could they be located? How would they be filled? Currents could be a problem too, and depended on the inclines that directed water downhill toward the seas, filling locks as they emptied. Floods were a potential problem as well. The waterway was made mainly with pounded dirt and clay reinforced with timber, so storms could easily do damage to the walls of the structure both from the inside and out. In sum, there were myriad problems of engineering to address in constructing the canal that no one had quite realized or could properly appreciate when the project was initiated.

Hydraulics existed in the 1660s, but most of the literature addressed problems of mining and the design of pumps. Canals were used for irrigation and drainage projects as well as navigation, but the literature on them was scarce. Military engineers wrote on hydraulics after the Dutch flooded low-lying areas around their cities with seawater during sieges, drowning their attackers.<sup>5</sup> Still, vernacular knowledge of hydraulics was broader than what existed in written form in the 1660s. Cutting a navigational canal across southwestern France seemed feasible, but actually taking it over uneven terrain with multiple locks was not an enterprise that was obvious to achieve with the engineering expertise of the times.

Still, there were technical precedents to follow.<sup>6</sup> The Italians and Dutch both used locks; the Italians had built a number of canals on the plain of Lombardy, and also used locks to control rivers and flooding. The Dutch designed locks, too, to raise and lower ships as they moved between harbors and the sea where the countryside was below sea level. They also had locks on inland waterways where there were small shifts in elevation.<sup>7</sup> But the Canal du Midi was not and could not be built exactly on the same principles, because it was much larger and longer, needed many more locks, required

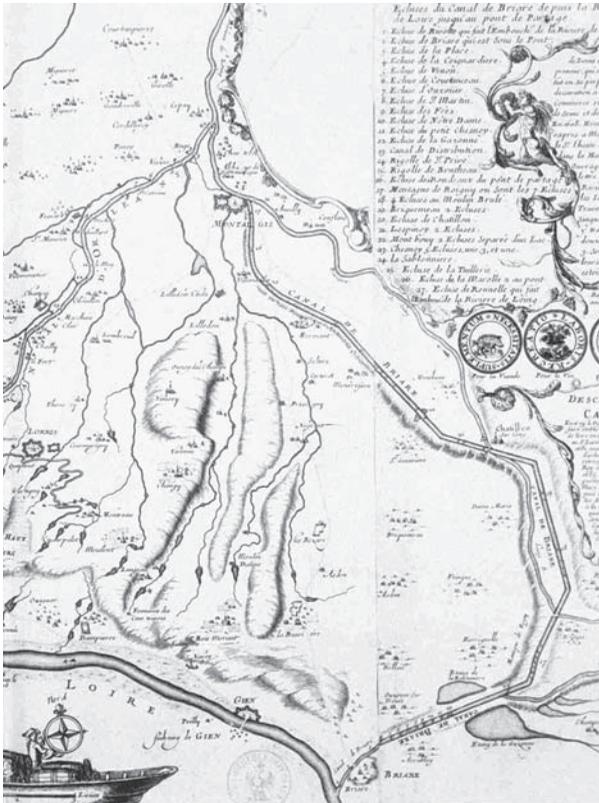


Figure 1.2  
Canal de Briare,  
Nicolas de Fer.  
Courtesy of the  
University of  
California.

an extensive water supply, crossed drier and rockier land, and changed much greater elevations. So it remained a cultural enigma even though it appeared to be a technical possibility.

Entrepreneurs and political leaders had thought for a long time about cutting a canal across Languedoc, and their ingeniousness made this particular project seem more credible. France was relatively narrow in the region, so it was an obvious place to try to link the Atlantic to the Mediterranean. In addition, Languedoc was relatively wealthy and proudly independent from the Crown, so there were political motives for state intervention there. For many reasons and over many years, then, engineers and entrepreneurs made studies and plans for a canal in Languedoc during the sixteenth and seventeenth centuries, helping define the problems that had to be addressed and designing templates for their solution.<sup>8</sup>

There was also a convincing French technical precedent to follow: a working navigational canal near Paris completed in 1642. It was called the Canal de Briare, and with both a water supply and locks, was successfully carrying cargo from the Loire to the Seine.<sup>9</sup> The Canal du Midi was certainly a more ambitious and complex project, spanning a broader region and rising

Figure 1.3  
Portrait of Pierre-  
Paul Riquet.  
Toulouse, Musée  
Paul-Dupuy.



higher above sea level, but there was reason to think that the lessons learned from Briare would prove useful. The problem with the proposal for the Canal du Midi was less a matter of apparent feasibility than credibility.

It was easier to conceive of plans for cutting a canal across Languedoc than to engender public trust in Pierre-Paul Riquet. He was a tax farmer, not an engineer. He took contracts with the state to collect taxes on salt in Languedoc, guaranteeing a specified income to the treasury and profiting from additional revenues.<sup>10</sup> Although he would be hailed as a genius in future centuries, in his lifetime he was not treated so generously. At Versailles, Riquet was considered a provincial naïf without the authority to speak on matters of royal interest and without the mathematical skills to construct anything of consequence.<sup>11</sup> He was rich, but in the period, financiers of his sort remained something of a suspect lot. They could take on powerful roles in local politics, yet they were still socially disdained by members of the nobility. Noble opponents, who had no desire to have their lands or hegemony in the region disturbed by the project—particularly if this entailed transferring assets to a financier for a risky enterprise—were happy to cast doubt on the tax farmer’s ability to do the work. No matter that Riquet had successfully collected revenue in a historically recalcitrant tax region, and had even made an additional fortune supplying the army with meat when France was fighting in Roussillon.<sup>12</sup> Neither enterprise could endow him with social dignity or make his word credible. He was no gentleman and was easy to paint as an opportunist seeking new ways to enrich himself. So constructing the Canal du Midi across the southwest of France required not only technical knowledge but also political and epistemological work to make the project legitimate.<sup>13</sup>

In spite of strong local opposition and the limits in knowledge of hydraulics, a navigational waterway of unprecedented proportions was indeed cut through Languedoc. Riquet did not have to become an engineer to make it work. The Canal du Midi was a product of a collective intelligence—the work of groups with both formal and vernacular expertise in land measurement, construction, and hydraulics. The minister of the treasury overseeing the work, Jean-Baptiste Colbert, sent experts from the north, and Riquet found skilled men and women in Languedoc who somehow worked together to realize this giant undertaking.<sup>14</sup>

The result was a modern “miracle” with surprising political ramifications. The canal demonstrated the efficacy of a new kind of power, engineering the land as a form of government. It was a model of impersonal rule, exercising a power over Languedoc distinct from that of local nobles and even the king. It was legitimated by stewardship principles, carrying the sanction of God’s will. Those who excavated the channel and filled it with water, endlessly inventing their way around obstacles, produced more than new engineering knowledge or a piece of French infrastructure. They helped elaborate a modern logic of territorial administration based on “works” rather than “words.”<sup>15</sup>

Their work was meant to be grand, but not as transforming as it became. Building a great infrastructure was supposed to make France more like the Roman Empire—a conservative, nostalgic vision of the future. Classical technical ingenuity used in pursuit of military power was the model of how to improve France.<sup>16</sup>

The military Genius of the Romans made them trouble very little about Commerce, because all the Nations they had conquered traded to the profit of the Conquerors, who thus enjoyed every Thing useful and agreeable that the World produced; yet [the empire] produced a great number of magnificent Works [to uphold] its Advantage; how many Ports did they improve on all the Coasts of the Empire? On the other hand, the grand Bridges they made were not less designed for Commerce than for the Passage of the Armies and warlike Stores; nor did they only make those great Roads for the Communication of all Parts of their vast Empire, but also rendered most of the Rivers navigable, and joined them by Canals.<sup>17</sup>

France would seek power as the Romans had done, engineering an infrastructure for strategic advantage. This diachronic isomorphism was designed to align France with the classical tradition.<sup>18</sup> Change was a matter of restoration—of the glory and powers of Rome.

French literati of the period divided themselves into the ancients and the moderns, arguing whether the works of genius of the classical period could ever be matched or bettered by present or future generations.<sup>19</sup> The Canal du Midi did not fit the dreams of the literati.<sup>20</sup> Yet it was surely a modern effort—a claim about what was possible by combining new knowledge of nature with classical engineering. The ancients provided models of greatness, building ports, roads, bridges, and some canals. Now the French would design the locks needed to carry waterways across entire continents. The canal in Languedoc was a product of modern intelligence in the Roman tradition, and a monument to the capacity of the ancien régime to use and transcend the intellectual powers of the ancients.<sup>21</sup>

This vision of the “New Rome” had potent cultural purchase, but also disquieting political implications. The canal through Languedoc did not emerge from or serve the patron-client ties that dominated local political life; it succeeded in spite of the efforts of local elites to use social connections to defeat it. More than tactical skill, it depended on technical finesse that was not distributed according to rank.

A project like the Canal du Midi could allow a bourgeois entrepreneur like Riquet to reach above his station simply by mobilizing intellectual resources to further political territoriality. He could employ those with local knowledge of the land along with educated engineers to help make this part of the kingdom a visible part of the French state. In so doing, he turned himself into a new social type—a nascent technocrat—a man without station

but with the capacity to exercise powers of government through the deployment of skills.<sup>22</sup>

The result was revolutionary. The waterway demonstrated the political efficacy of impersonal control, the stuff of modern state administration and technocratic government. Riquet recognized the importance of what he was doing, and to his credit and downfall, too, started to write to Colbert with naive enthusiasm about his contributions to the regime. The entrepreneur also started attributing his newfound abilities to God's will, not monarchical authority—a form of hubris at odds with the divine right of kings that made him seem a dangerous man.<sup>23</sup>

The improved countryside in Languedoc was hegemonically treated as a manifestation of Louis XIV's greatness, but the waterway remained impossible to reduce to the king's will. Excavating and routing the channel was dirty and delicate work that represented the monarch's authority, but also lay beyond it. It was an act of anonymous power that confronted normal politics in an oblique way, setting up the contrast between depersonalized administrative activity and patrimonial powers.<sup>24</sup>

Territoriality, as an administrative strategy and political culture, started being nurtured in the beginning of Louis XIV's reign by Colbert, the minister of the treasury and navy. It was based on *mesnagement* politics, an administrative and political philosophy developed early in the century under Henri IV. According to *mesnagement* thinking, the state was a great estate; its lands should be developed for the well-being of its people through the rational assessment of its virtues and vices, and the proper allocation of activities to appropriate sites around the countryside. Infrastructure was central to this approach. An estate needed roads and waterways to link diversified properties and the estate to marketplaces. It needed to have mills and other commercial ventures, too, and the water to feed them. To Colbert, this kind of land stewardship made sense as a program of state administration, and Riquet's canal seemed appropriate to it.<sup>25</sup>

But this logic of improvement flew in the face of entrenched political interests. Projects for improving the kingdom required lands, and their indemnification worked against the smooth flow of favors and information among nobles that cemented patron-client relations. Stewardship was a cultural tool of political change whose potency was greater than hoped and whose powers were more difficult to control than expected.<sup>26</sup>

The Canal du Midi became a peaceful eye in a contentious political storm, where patronage politics confronted territorial stewardship.<sup>27</sup> Land was requisitioned against the desires of local nobles, and the navigational waterway was excavated from the countryside in spite of hostility that only increased in passion from the 1660s to the 1680s. Nonetheless, the channel was cut; the canal's water supply worked; and boats started passing through the dry and rocky landscape of western Languedoc where no one had been able to navigate before.

Figure 1.4  
Detail of a portrait  
of Jean-Baptiste  
Colbert. Réunion  
des Musées  
Nationaux.



Why did Colbert, normally a cautious man, ever agree to such an outlandish plan that was sure to stir up local ire? The simple answer was the potential value of heroic engineering to the king's plans for empire. A navigational canal connecting the Atlantic Ocean to the Mediterranean Sea would allow French ships to avoid Gibraltar. The original plan was to make the canal wide enough for naval vessels, and Colbert was minister of the navy as well as the treasury.<sup>28</sup> The military dream had to be abandoned as the canal had to be narrowed in the mountains, but the waterway still joined the Atlantic to the Mediterranean and furthered the propaganda program of building a New Rome. The canal positioned France as a land of moderns—a triumphant possibility in the *ancien régime*.

The success of the Canal du Midi has traditionally been attributed to Riquet's naive genius—a thesis questioned in this book. The canonical view, first crafted in the eighteenth century and blown to larger proportions in the nineteenth century, fit nicely with the entrepreneur's own assessment of the situation.<sup>29</sup> Riquet claimed sole authorship of the canal, including some technical details whose uses were commonplace.<sup>30</sup> He spoke in words that served the myth of his isolated and beleaguered genius—a narrative he probably believed unquestionably—but his view was not correct by historical standards. His claim to sole authorship of the canal belied the diversity of techniques needed for the waterway, and the surprising story of collaborative engineering that made the Canal du Midi a work of technical art and political transformation.

Still, Riquet's status as a local hero was not misplaced. He believed in what local people could do, even as he took credit for it. He was an advocate of Languedoc, and liked to imagine how to improve the province with canals, roads, water supplies, and a permanent Mediterranean port, recognizing in regional peasants, artisans, artists, and engineers the capacity for this work. Colbert insisted that he consult with experts to assure his honesty and the canal's efficacy, and Riquet learned from them, but he sought his own counsel from indigenous experts in hydraulics and construction who lived in Languedoc. In this historical moment, no educated engineer could say for sure how to carve a navigational canal through Languedoc, but a group could do the work. For including regional peasants and artisans in the collaborative work, Riquet became the personal instantiation of their collective achievement—the intelligence of the region.<sup>31</sup>

How are we to understand a work of “genius” in this context? Do we dismiss genius as simply a romantic notion that was particularly appealing to local advocates in nineteenth-century Languedoc? Riquet's status was certainly elevated in that time (along with fitting statues of him). We could simply argue they exaggerated the importance of the canal and its “author” in those heady days of French nationalism, and deny that the canal was a great accomplishment at all. But there *was* a kind of genius behind the Canal du Midi, a transcending of individual limits through collaborative work. It was a work of superhuman intelligence because it was the product of both formal expertise and a region's collective abilities, not just the mind of a gifted individual. And this gave the Canal du Midi its uncanny presence and power, too.<sup>32</sup> It instantiated an impersonal form of knowing that had surprising potency.

This explanation of the success of the Canal du Midi bears and veils its own mysteries. Drawing skilled people to work for the local tax farmer to build a canal across two hundred and forty kilometers of the province was not a sure thing, and getting them on-site did not in itself assure a good outcome. Riquet was not a credible engineer, so the project had no clear leadership and could have been a disaster. With the historical record littered with failed collective enterprises, why did this one work?

The question is all the more pressing because the collaboration in Languedoc required groups with differences in language, gender, education, and rank, which created social chasms among them. The people of Languedoc spoke Occitan, or the langue d'Oc, while experts from Paris spoke French; educated gentlemen who were sent by Colbert had courtly manners and other marks of social rank distinguishing them from bourgeois financiers and regional tax farmers like Riquet; and military engineers from noble families lived in social worlds far from those of Pyrenean peasants and artisans from the valleys of Languedoc. Gender played a role, too. Many laborers recruited to work on the canal were women. Why anyone in the period paid attention to their ideas is a mystery in itself. The brilliance of the Canal du Midi, then, lay not just in the success of the hydraulic engineering

but also the social engineering. It was perhaps Riquet's greatest contribution to the canal and the political heritage it left behind.<sup>33</sup>

The power of collective intelligence as a political asset and the effectiveness of collaboration as a problem-solving strategy can be understood better from Ed Hutchins's theory of distributed cognition.<sup>34</sup> Hutchins contends that much of what we consider cognition or thought takes place not in individual minds but rather in conversations among individuals trying to accomplish a joint task. He uses the example of a large naval vessel coming into port to illustrate the multiple calculations and observations that can be linked to accomplish difficult activities. Some sailors check depth readings, others look for landmarks, and still others regulate the speed and direction of the ship. In a complex division of cognitive labor, they make separate calculations, but they get the ship to harbor by coordinating their activities around a naval chart. They relate their readings to these standard measures of the harbor, and make decisions based on the results. Their work constitutes a form of social intelligence organized for practical ends.<sup>35</sup>

Hutchins argues that much of thought *can* be deeply and complexly social, because it is physically distributed both in artifacts like charts and plans (with their memory and measurement systems) as well as among people with different roles in the problem-solving process. The cognitive result of these interactions, Hutchins claims, may not usually be called cognition because of its social nature, but it should be. Where calculations do not take place inside an individual's head but emerge from social interaction, they are not any less a form of cognitive activity. To navigate or engineer a canal clearly requires thought, although it is not mental activity in the usual sense (secluded in the mind of an individual thinker). It is an ongoing, learning process—a pattern of socially distributed cognition.<sup>36</sup>

The Canal du Midi was clearly a product of such distributed reasoning, yielding both an impersonal intellectual power and a new culture of engineering. To cut the canal across southwestern France, diverse participants organized themselves around the plans and specifications for the canal that functioned like Hutchins's naval chart. The parameters for the work did not determine how to build the waterway but instead provided a common focus for the collaboration. Rather than inhibiting the success of the venture, the social differences among those working on the Canal du Midi actually increased the range of problem-solving strategies available for the work. Gentlemen, artisans, surveyors, military engineers, and women peasants all had different ways of reasoning, so when one engineering strategy proved unsuccessful, they were able to find others to try until they figured out what would work. They provided a rich cultural repertoire of modes of reasoning.

On the Canal du Midi, formal knowledge of hydraulics was not enough without local knowledge of the region along with its terrain, soils, weather, and the sea. And formal measures for designing artifacts were useless without artisans who could realize the plans with local materials. Engineers,

who could do mathematical calculations, had a limited range of relevant techniques and did not always know how to take advantage of the topographical detail they could measure. Military men who could design fortifications did not necessarily know how to build a water capture on a river. Reasoning from both principle and precedent, then, the men and women who worked on the Canal du Midi created an intellectual ability much greater than any one of them could achieve alone. They not only brought different knowledge and analytic ability to the problems but also learned from one another. The engineering became a product (in the mathematical sense) of different epistemic cultures—a learning system in which the participants acquired new capacities for reasoning from their interactions, making their accomplishments seem miraculous even to those who were involved.<sup>37</sup>

That a variety of social groups was needed to build the Canal du Midi can be demonstrated by using counterfactuals: recognizing what would *not* have been possible if any one of these groups had *not* participated.<sup>38</sup> Using this method, it is possible to see, first, that no single group of experts could have solved the engineering problems of the enterprise, and second, that a range of groups with different backgrounds were essential to completing the Canal du Midi.

The role of culture in social forms of cognition has been described in the psychology literature by Michael Cole and his colleagues.<sup>39</sup> They have argued that in school, individual learning is a group accomplishment that is deeply embedded in the culture. We may ask schoolchildren to take their tests as individuals, but mastery of subject matter is embedded in school systems, curricula, textbooks, teaching styles, and student participation—cultural forms. The thought of each student is a product of and serves to reproduce these sociocultural arrangements. They make schools carriers of intellectual cultures and bases of the intellectual “scaffolding” needed for effective learning.<sup>40</sup>

If learning depends on a base of common culture, this raises questions about the Canal du Midi. Given the social and cultural divides among the participants in the enterprise, how did they find common ground for learning from each other?<sup>41</sup> The answer is surprising. They shared remnants of the classical past; they all knew some elements of Roman engineering. Academics and military engineers studied literature written in ancient times, and scholarship derived from it. Locals, on the other hand, unknowingly reproduced elements of classical culture over generations, thereby making them taken-for-granted elements of daily life.

The Roman presence had been pervasive in the region. The city of Narbonne near the Mediterranean coast of Languedoc had been an important administrative center of ancient Gaul; Romans had also colonized the Pyrenees, building bath towns near hot springs with extensive waterworks and leaving behind a complex tradition of hydraulic engineering. The people of Languedoc did not see themselves as guardians of ancient knowledge but they also had not abandoned ancient techniques of building or hydraulics

just because Rome had fallen; they continued to use the skills pertinent to their lives, simply forgetting their provenance and treating them as common sense.<sup>42</sup>

Some Roman techniques were clearly maintained by the Visigoths, who drained swamps and irrigated dry lands in the former Narbonnaise. Peasants in the Pyrenees who built domestic water supplies and public laundries in former Roman bath towns also transformed Roman hydraulics into commonsense practices. And artisans in the building trades reproduced classical methods as well. Those who dismantled the ruins from ancient Gaul learned lessons in construction methods. When they tried to reuse stones from old buildings in new ones, it was easier to reproduce the classical forms for which they had been cut than to recut them, reproducing some ancient building techniques over time. So a variety of ancient skills became “commonsense” practices and were available for building the Canal du Midi—carried by peasants, artisans, and gentlemen engineers alike. Their common heritage allowed participants to engage in a generative creativity at the interstices between traditions of formal knowledge and everyday practice, taking advantage of the distributed quality of their knowledge as well as its common assumptions. Even where the participants found themselves at odds with one another, their differences permitted an intellectual reflexivity that itself was productive. This was only possible because the debates were grounded in a culture of classical thought that might have lost its provenance but not its ancient logic.

Distributed reasoning would not have become so important to the Canal du Midi if there had not been a vacuum of authority as well as a deficit of formal knowledge for the work. Riquet wanted to be in charge, but his word as a financier had no credibility with either engineering experts or men of rank. He was continually supervised, spied on, argued with, and vilified by enemies, so his leadership remained mitigated to the end. Still, no one else could displace him.<sup>43</sup> In the absence of both sure technical authority and firm leadership, those trying to build the canal turned to each other to realize the daunting task of cutting a navigational canal across southwestern France.

These efforts produced a new technical capacity on the ground, and in participants, a thrilling ability to change the world. Apparently intractable problems over time became possible to address; technical innovations suggested other improvements or experiments to try. Participants started thinking in ways that were novel to them, and found new powers in their own common sense. Even laborers continued to work on the project toward the end when Riquet was broke and they were slow to be paid. The excitement of doing the impossible was intoxicating—explicitly so to Riquet and the military engineer, Clerville, who were able to write about it:<sup>44</sup> To conjure up the powers of Roman engineering by mistake and put this knowledge to work successfully on a modern project must have been a powerful experience.

The Canal du Midi was attractive as a political experiment because it fit with the propaganda campaign to define France as the New Rome, the proper center of a new Catholic empire to rival the Hapsburg one.<sup>45</sup> The waterway was hailed as Roman in spirit, and designed to reference and resemble the classical past. Still, no one dreamed how Roman the canal would become. No one expected or knew what classical techniques artisans and laborers would bring on-site, giving the Canal du Midi its daunting anonymous intelligence. And no one anticipated how French the structure would be. The techniques used to fashion it were honed against the countryside itself—French valleys, forests, hills, rock formations, rivers, and riverbanks. The knowledge of artisans and peasants was situated in France itself, and that made all the difference.<sup>46</sup> State territoriality was not imposed on the land and its people with this canal but rather built by locals from the ground up with knowledge that only they could deploy.

Place matters to technical innovation, and so it did in Languedoc in the late seventeenth century.<sup>47</sup> The social and material inheritance from Rome, the movement of diverse groups into Languedoc, and the mixed character of the land itself gave a vitality to the region that was consequential. Social life is always dependent on the material possibilities of places and gives rise to forms of intellect that make sense there. The intelligence in Languedoc about land and its uses was both deep and broad, providing rich cultural resources for engineering a canal there.

In seventeenth-century Languedoc, where the towns dotted diverse landscapes from high mountain valleys to the Mediterranean coast, people found a variety of ways of life, and nurtured multiple forms of intelligence. Some groups in the fertile valleys north of the Pyrenees grew grapes, olives, wheat, and vegetables, irrigating the dry, rocky soil from the Montagne Noire to the sea. Others herded sheep, cattle, and goats in high mountain meadows, making cheese for sustenance in the winter and using the abundant water supplies of the mountains to run mills for tanning the hides from the animals they slaughtered. In mountain forests, people collected firewood, made charcoal, or produced glass. On the coasts, they fished the sea, the wide rivers, and shallow salt ponds toward the Mediterranean, and even found ways to do agriculture in almost pure sand. Along the pilgrimage routes to Compestella, villagers witnessed miracles, made monuments to them, and served the believers who stumbled through their towns. Others were migrant laborers or engaged in trade across the high passes into Spain. This complex region gave rise to multiple logics of social life.<sup>48</sup>

The peasants of Languedoc certainly seemed at the time an unlikely source of state power. They were (as a whole) famous for their unruliness—a stubbornness that sometimes served tradition, and at other times refused attempts at control. In this land so rich in its topography and so variable in its productivity, bandits and rebels against the king's men found a viable niche. Those who killed tax collectors could disappear into mountains that they knew better than any authorities and where sympathetic villagers sustained

them. They straddled a border region where authorities from both Spain and France had limited abilities to control the flow of people and things. Their knowledge of the landscape was a political asset as well as an economic resource, and one they both cultivated and used with agility.<sup>49</sup>

It was precisely this kind of local knowledge—the intelligence of bandits, fishermen, washerwomen, masons, charcoal makers, and women indigenous engineers—that made it possible to build a canal in Languedoc. These were the people who knew what you could do in this particular countryside, its topography, seasonal rainfall, rock formations, rivers, forests, and coastal sands. A navigational canal might have been long and wide, but it was not so different from the diversionary canals of the Pyrenees or the irrigation systems of valley estates. In some undefined way, it was an appropriate task for the people of this region, and Riquet knew it. He understood the stubborn and tenacious character demanded by the landscape, and recognized that the people who could make rocky hillsides or sand dunes yield a living, could realize his ambition to build a canal through Languedoc. What he and the other participants did not understand was that they were inventing a new kind of silent, insidious power.