Dikes and Dams, Thick with Politics
Author(s): Wiebe E. Bijker
Reviewed work(s):
Source: *Isis*, Vol. 98, No. 1 (March 2007), pp. 109-123
Published by: The University of Chicago Press on behalf of The History of Science Society
Stable URL: http://www.jstor.org/stable/10.1086/512835
Accessed: 25/09/2012 21:43

# Dikes and Dams, Thick with Politics

By *Wiebe E. Bijker**

**ABSTRACT**

Things are thick with politics. This essay illustrates the point by focusing on a variety of technologies that help to manage water: anicuts and tanks in India, dikes and a storm surge barrier in the Netherlands, and levees in New Orleans. Technologies are not only shaped by political forces; they also exert political force themselves: on social stratification in Indian villages or on government stability in the Netherlands. We should recognize, then, that the functioning of technologies and the functioning of societies are intricately linked. The essay traces this interlinking by using the concept of “technological culture.” It argues that the different styles of coastal engineering in the United States and in the Netherlands can be explained by differences in their technological cultures, particularly the different styles of risk handling. This conclusion is then applied to the Indian case and to issues of development, democracy, and innovation.

DIKES AND DAMS, levees and anicuts, storm surge barriers and tanks—these are thick things. Most of them are thick in size, such as the dikes—hundreds of kilometers long—that keep seawater out of the Netherlands. (Some things of this sort have not been thick enough, however—such as the levees that failed to keep the water inside the banks of the Mississippi River and the New Orleans canals in 2005. And some things—such as the Narmada Dams in India—are too thick for me to deal with in an essay like this.[1]) All of them are thick in connections and linkages, like the anicuts that form crucial starting points for networks of irrigation canals and tanks in south India. All of them are thick with values, such as the Oosterschelde storm surge barrier that is hailed as a celebration of modern environmental democracy in the Netherlands. All of them are thick with power, such as the tank systems for irrigation that reflect the power relations in rural India. And, surely, all of them are thick with politics.

---

* Faculty of Arts and Social Sciences, Maastricht University, Postbox 616, 6200 MD Maastricht, The Netherlands.

I am grateful to Esha Shah, Shambu Prasad, Chitra Krishnan, Himanshu Thakkar, and Anna Wesselink for their helpful comments on an earlier draft of this essay.

[1] The Narmada Dam system in northwest India deserves an essay, an article, a book, a library of its own. For an eloquent and fiery indictment see Arundhati Roy, “The Greater Common Good,” in *The Algebra of Infinite Justice*, ed. Roy (Delhi: Penguin, 1999). For the other side’s view see the Web site on the Sardar Sarovar, the largest dam of this system, which is currently being completed in the midst of legal fights, hunger strikes, and technical controversies: http://www.sardarsarovardam.org/. To follow these fights see http://www.narmada.org/ and the publications of the South Asia Network on Dams, River, and People: http://www.sandrp.in/.

*Isis*, 2007, 98:109–123

0021-1753/2007/9801-0007$10.00

This essay is meant to support the claim that studying artifacts—how they are socially constructed as well as how they shape society—yields crucial insights into the history and development of science and into the history and development of societies. More specifically, I want to argue that a focus on the "things" of water management can help us to understand the cultural and democratic makeup of societies and at the same time is important for addressing questions about the further sociotechnical development of those societies. While moving my empirical focus between rural India, the United States of America, and the Netherlands, I want to make the additional point that the normative labels "modern" and "traditional" are not very helpful in designing technology policies for development. I also want to argue that "development" can be fruitfully used as a more symmetrical concept than the word's appearance in phrases like "development aid" or "underdeveloped countries" would suggest: when analyzing things and tracing how they are socially shaped and how they help to constitute society, comparative studies about cases in "the north" and "the south" can benefit all nations in their development.

## ANICUTS

Wherever water is flowing, silting is a problem. Tidal flows, for example, transport sand along coasts; it ends up silting harbors. Canals that divert water from rivers to irrigate areas of agricultural land often silt quickly because of the sediments transported downstream. To desilt irrigation canals by dredging is extremely expensive and thus effectively impossible in many settings. The alternative is to use things: cleverly positioned dams to steer the sand away from the harbor or cleverly shaped anicuts to influence the distribution of sediments between the main river and the diverting irrigation canal.[2]

Two problems must be addressed when designing irrigation systems: how to get water to dry places, and how to prevent excess water from making those places too wet. To divert water from a river to an agricultural area that is to be irrigated, an outlet from the river into a canal is constructed. Often an anicut or weir is used to control the water level and flow at that point: a dam across the river, just beyond the canal exit.[3] The anicut keeps the water level high enough to feed the canal even in dry seasons, while excess water is allowed to spill over and continue downstream (see Figure 1). Here the problem of silting arises: when any sediment-carrying flow divides, the ratio in which the sediment is divided is different from the ratio in which the water is divided. One branch—generally the canal—receives a disproportionate amount of sediment. That sediment—too much to be carried by the water—will then be deposited and a vicious cycle begins: the canal will become shallower, it will carry less water, and then even more sediment is deposited.

How is it possible that some of the irrigation systems in southern India have been

---

[2] My discussion of the anicut technology in India is based on Chitra Krishnan, "Tank and Anicut Irrigation Systems: An Engineering Analysis" (Ph.D. diss., Indian Institute of Technology, 2003). See also Krishnan and C. Shambu Prasad, "Technological and Policy Implications of Tank Systems: Reflections from Tank Irrigation in Kolar District, Karnataka," paper presented at the National Workshop on Rejuvenating Tanks for Sustainable Livelihoods: Emerging Trends, Patancheru, 2006; and Krishnan and Srinivas V. Veeravalli, "Tanks and Anicuts of South India: Examples of an Alternative Science of Engineering," paper presented at the Compas Asian Regional Workshop on Traditional Knowledge Systems and Their Current Relevance and Applications, Bangalore, 3–5 July 2006.

[3] The word "weir" is typically used for a straight dam across a river, perpendicular to the banks. Such weirs can be used, e.g., to create millponds feeding a side channel to power a watermill. The word "anicut" derives from the Tamil "*anaikattu*" and is typically reserved for longer dams that do cross the river but may have more complicated shapes.

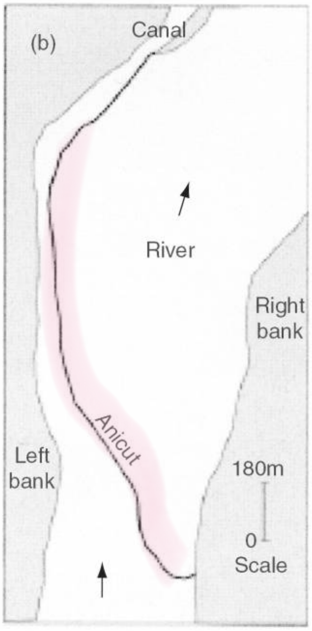

*Figure 1.* *Irregularly shaped traditional anicut (scale in meters).*

functioning for more than a thousand years, without being clogged by sediments and without actively being dredged? Would it be possible, Chitra Krishnan wondered, to understand this technology and adapt it so as to help solve current irrigation problems in India and other dry regions of the world?

One of the anicuts Krishnan studied is the Grand Anicut, or Kallanai, in the Kaveri (English: Cauvery) River in Tamil Nadu, the southeastern state of India. The Grand Anicut is the most ancient surviving irrigation work in the Kaveri River delta. Attributed to the Chola king Karikaal, who is believed to have built it in the second century, this anicut is thought to be the oldest water-diversion structure in the world that is still in use. The Kaveri River flows past the historic rock of Tiruchirapalli and then breaks at the island of Srirangam into two streams, which enclose between them the delta of Thanjavur, the granary of South India (see Figure 2). The northern branch is called the Kollidam, the other continues as the Kaveri. They flow into the Bay of Bengal a few hundred miles south of Chennai (formerly Madras; see Figure 3).

The Kallanai is an anicut of unhewn stone that stands in the Kaveri parallel to the riverbank; it is more than 300 meters long, 20 meters wide, and 4.5 meters high. The purpose of the dam was to divert the waters of the Kaveri across the fertile Thanjavur delta region for irrigation via canals. Since the English arrived in the eighteenth century, the Kallanai has been tampered with and other hydraulic structures have been added nearby. It is therefore difficult to extrapolate from the current situation into the past to understand the workings of the anicut. In her pioneering study, Krishnan combined historical studies of old descriptions of the anicut from a variety of archives with archaeological and anthropological field surveys and original hydraulic research. This enabled her to piece to-

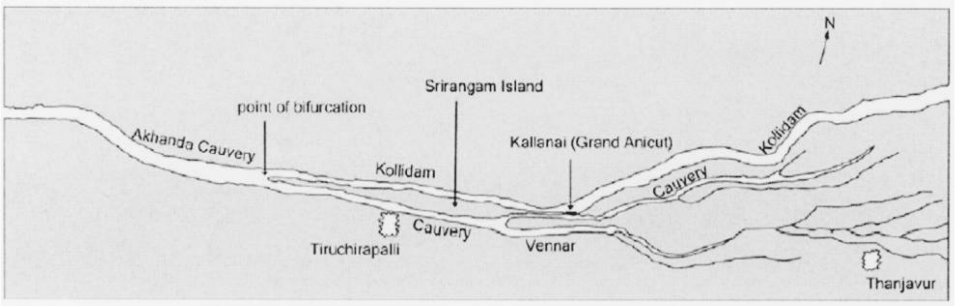

*Figure 2.* *Map of a small section of the Kaveri as it was in 1854 A.D. The section includes the beginning of the delta (i.e., the point of bifurcation) and the Grand Anicut, 28 kilometers downstream. It also includes the towns of Tiruchirapalli and Thanjavur. Courtesy of Chitra Krishnan, "Tank and Anicut Irrigation Systems: An Engineering Analysis" (Ph.D. diss., Indian Institute of Technology, 2003).*

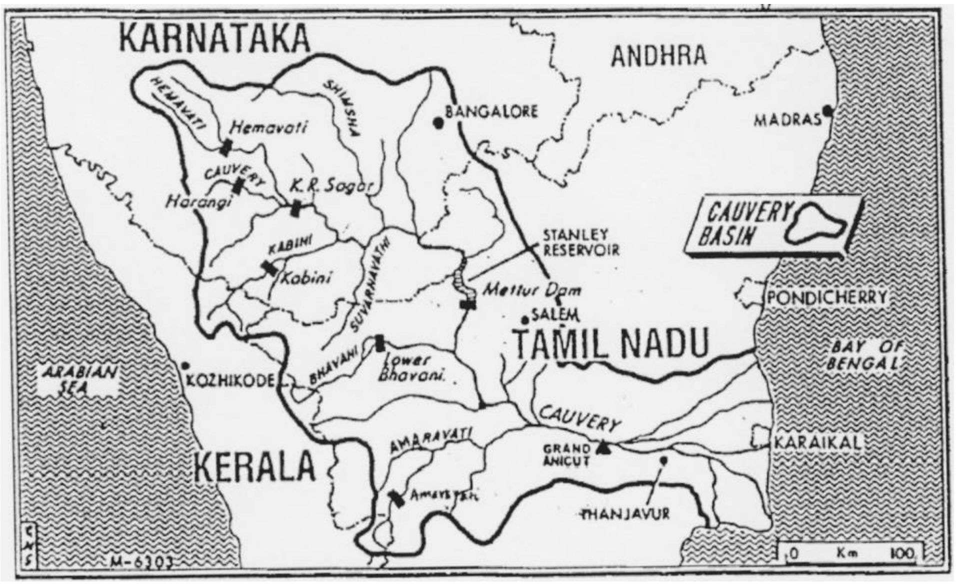

*Figure 3.* *Map of southern India.*

gether a picture of the Kallanai that would explain how it could have functioned so effectively for so many centuries.

She reconstructed the river reach around Kallanai as it probably was before 1800 (see Figure 4). As the illustration indicates, Kollidam was the wider (also the steeper, straighter, and hence faster) of the two branches, and, as its name implies (*Koll-idam*: region of spill), the flood carrier. It was barely used for irrigation. Almost all of the 600,000 acres irrigated by the river in 1800 were delta lands south of the Kaveri branch. So the Kaveri branch was the lifeline for delta farmers, while the Kollidam was of little consequence for them.

Kallanai ensured that during floods, when the water level in the river rose above its crest, a significant part of the water was diverted into the Kollidam; from there it could

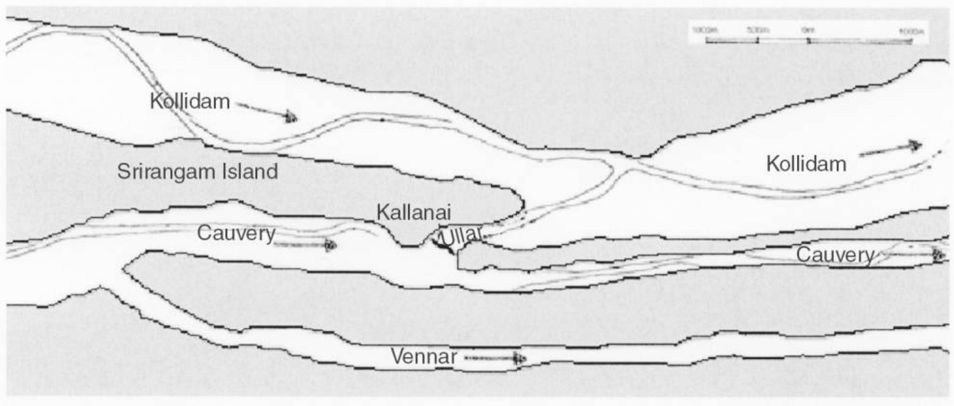

*Figure 4.* *Reconstructed map of the Kaveri River around the Kallanai anicut, before 1800. Courtesy of Chitra Krishnan, "Tank and Anicut Irrigation Systems: An Engineering Analysis" (Ph.D. diss., Indian Institute of Technology, 2003).*

flow directly to the sea, causing minimal damage to agriculture. Kallanai's role, therefore, was to prevent floods in the Kaveri from entering and damaging the irrigated delta by diverting a large part of the water into the Kollidam via a short connecting stream. In the eighteenth century, lack of maintenance probably weakened the Kallanai and diminished its functioning. Krishnan conjectures that the distribution of the sediment carried over Kallanai (with diverted floodwater) was adversely affected by the first British modifications, made after they began ruling the area in 1801. They did recognize the problem, but since they probably did not understand the underlying hydraulic mechanisms of the anicut their modifications only worsened the sedimentation problem. Krishnan's reconstruction suggests that the original Kallanai had some very peculiar design features: the curved shape of the masonry section, a sloping crest, and an irregular descent from front to rear (see Figure 5).

Krishnan tested some of the ideas incorporated in her reconstruction in hydraulic scale models and by mathematical analysis. The results supported her hypotheses about the beneficial effects of the curvatures in traditional anicuts, as compared to straight weirs, in mitigating flood flows and diminishing silting. Further hydraulic research, possibly with computer rather than physical models, could detail the fundamental hydraulic principles that made traditional irrigation techniques in some respects so effective.

Let me pause here to draw some intermediate conclusions. First, it is fascinating to see how a detailed study of this thing, the Kallanai anicut, opens up a view of more than a thousand years of irrigation and flood management practices. And Krishnan's investigations really did place the thing at the center: by combining such varied sources as a farmer's family archive, letters from British engineers, her own field measurements, and scale-model research, she succeeded in reconstructing this artifact that then tells stories about Indian agricultural history as well as hydraulic innovations. The second intermediate lesson is that a distinction between "traditional" and "modern" technologies is not really helpful here. We might call the Kallanai a traditional thing because it was built almost two thousand years ago. But, on the other hand, it does seem to incorporate quite advanced hydraulic science and engineering—at least in the sense that we need the science in order to under-

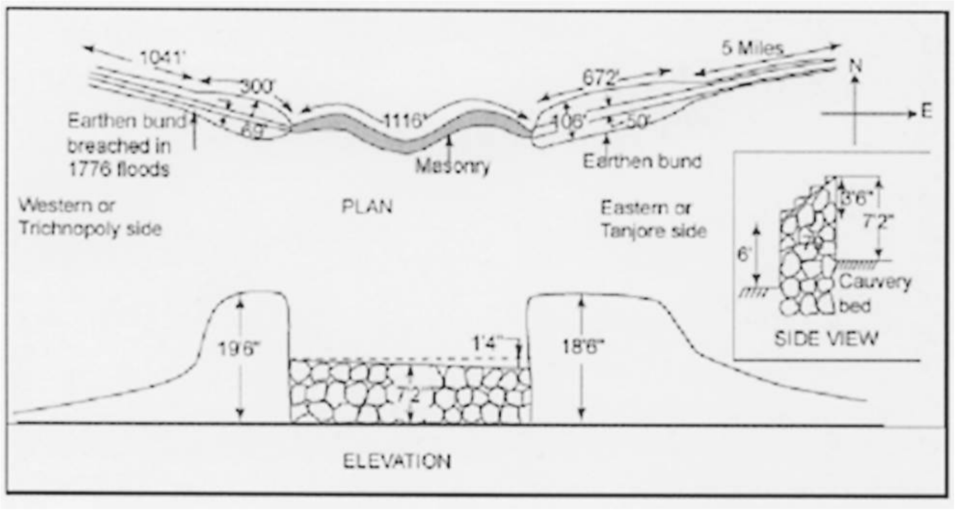

***Figure 5.*** *Plan and elevation of the Kallanai, as reconstructed by Krishnan from descriptions of around 1777. Courtesy of Chitra Krishnan, "Tank and Anicut Irrigation Systems: An Engineering Analysis" (Ph.D. diss., Indian Institute of Technology, 2003).*

stand why the Kallanai has functioned so well. Krishnan's analysis not only explains the functioning of the Kallanai but also distills some design principles that can be useful in restoring, upgrading, or redesigning anicuts from the same period. This makes the Kallanai a starting point for a set of scientific design principles that could prompt innovative flood management and irrigation practices today. So, rather than establishing the traditional and the modern as incommensurable categories, this case demonstrates a continuum and even a complementarity between these types of knowledge.

## TANKS

Let me move on to tanks.[4] Anicuts by themselves are not enough to create irrigation systems: they allow for flood management, and they help to steer a relatively small stream of water into an irrigation canal—but then what? Indian farmers in some regions use a system of tanks, often linked in long series and networks, to control on a micro scale how the water from these canals irrigates their farmland (see Figure 6). Tanks are reservoirs for water, often created by building a dam or embankment in a valley or lower part of the terrain. These tank embankments are usually semicircular or irregularly shaped (see Figure 7). They can be a few hundred meters to several kilometers long. An average sized tank in south India has an embankment 2 kilometers long, is 5 to 7 meters deep at its deepest point, and may irrigate around 300–350 hectares of land. Tanks usually are located close to villages and share their names. Typically, the water is used for household purposes as well as for irrigation.

These tanks are just as thick with hydraulic ideas and principles as the anicuts, but now

---

[4] In this section I will draw on the work of another Indian engineer-historian-sociologist: Esha Shah, *Social Designs: Tank Irrigation Technology and Agrarian Transformation in Karnataka, South India* (Wageningen University Water Resources Series, 4) (New Delhi: Orient Longman, 2003).

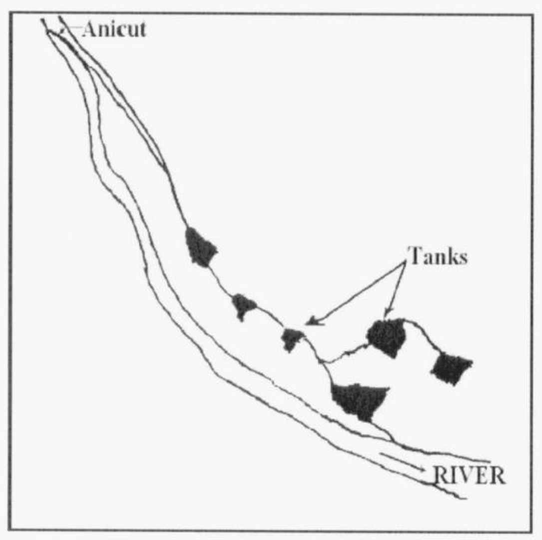

***Figure 6.*** *Anicut feeding a tank system. Courtesy of Chitra Krishnan, "Tank and Anicut Irrigation Systems: An Engineering Analysis" (Ph.D. diss., Indian Institute of Technology, 2003).*

I want to turn to another aspect of things. As I have argued elsewhere, things can be understood only within their social context: they are socially constructed, and they shape social relations.[5] They are, for example, thick with power relations and politics.[6] In a pathbreaking historical sociological study of tanks in Karnataka, India, Esha Shah has sought to understand how social relations of power in particular historical contexts shape tank technology and how technology in turn shapes resource utilization practices in society. Her starting point is the claim, often expressed in academic and policy circles, that local communities are better equipped than distant state agencies to manage natural resources. This view may find support both from the leftist "direct democracy" angle and from the "state hands-off" liberal economics corner. Recognizing that Indian society, both historically and today, is hierarchically organized and "anything but egalitarian," Shah was intrigued by the questions of how tanks are used to distribute water resources and how this process may be used to enhance local democracy.[7]

In a careful and detailed analysis that draws on her sociological and engineering skills, Shah identifies some of the design principles that govern the shape of tanks and shows how these principles reflect and reproduce aspects of the local social order. Many south Indian tanks have relatively long embankments—much longer than modern engineering principles would favor. These long embankments, Shah conjectures, were positioned at

---

[5] Wiebe E. Bijker, *Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change* (Inside Technology) (Cambridge, Mass.: MIT Press, 1995).

[6] This point was first made, within the context of the philosophy of technology, in Langdon Winner, "Do Artifacts Have Politics?" *Daedalus*, 1980, *109*:121–136. See also Wiebe E. Bijker, "Why and How Technology Matters," in *Oxford Handbook of Contextual Political Analysis*, ed. Robert E. Goodin and Charles Tilly (Oxford: Oxford Univ. Press, 2006), pp. 681–706.

[7] Shah, *Social Designs* (cit. n. 4), p. 5, quoting David Ludden, *Peasant History in South India* (Princeton, N.J.: Princeton Univ. Press, 1985), p. 89.

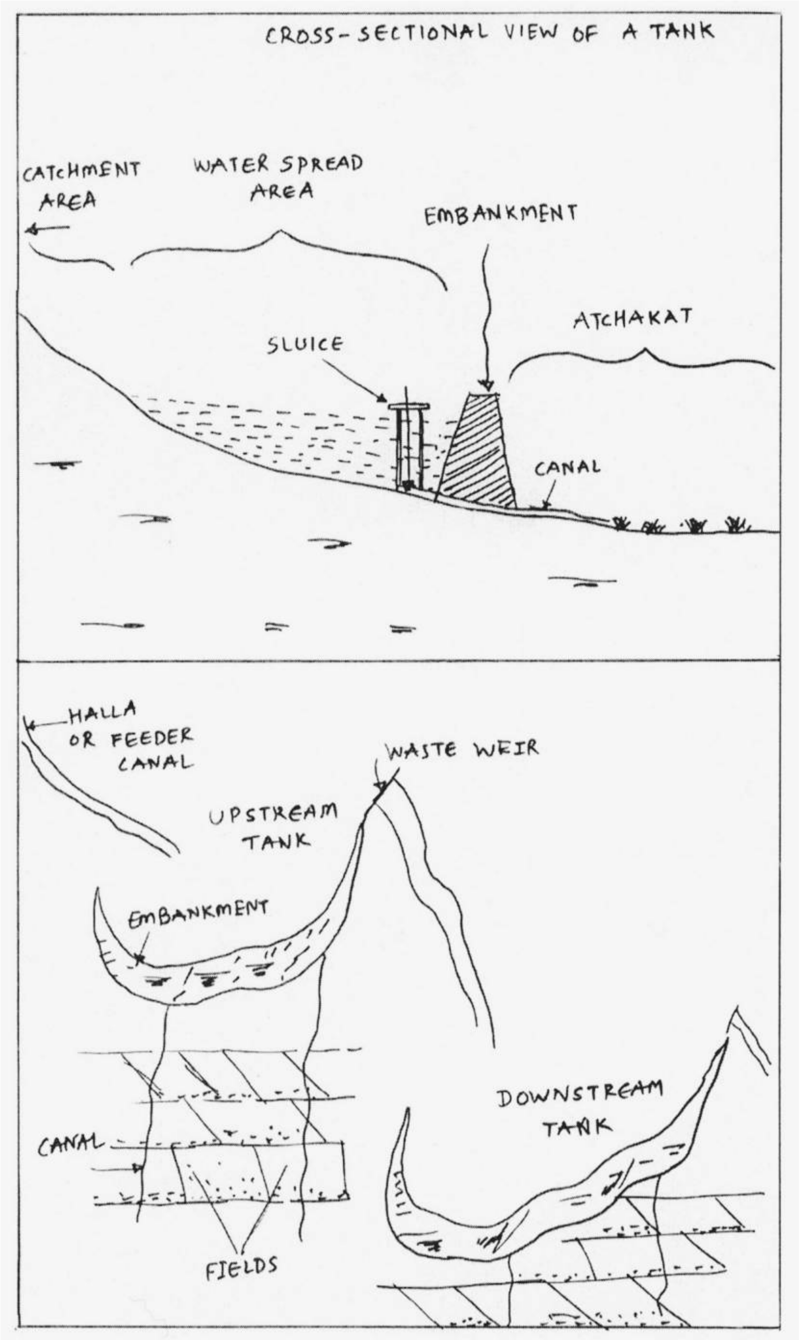

***Figure 7.*** *Layout of an Indian tank, with feeder canal, embankment, wastewater weir, and farm fields. Top: cross-section; bottom: map. Courtesy Esha Shah,* Social Designs: Tank Irrigation Technology and Agrarian Transformation in Karnataka, South India *(Wageningen University Water Resources Series, 4) (New Delhi: Orient Longman, 2003), p. 2.*

places that favored the elites of the Hoysala and later Vijayanagara empires that ruled Karnataka between the eleventh and the sixteenth centuries: “the site selected for tank construction was primarily a function of political will to invest in that locality and the topographical features of the site played a secondary role.” A majority of the surviving tanks in Karnataka were constructed between the ninth and the sixteenth centuries. These ruling elites could afford to implement design principles that required the costly construction of long embankments because they commanded and controlled much of the labor force of the lower castes. The ruling elite’s control over lower-caste labor substantially reduced the cost of constructing long embankments. Another design principle pertains to the irrigation method. In a “field-to-field” irrigation system, fields located in the head reach would take water first. *Neerganti*, or watermen, then helped to distribute the water to successive fields, down the slope. This sociotechnical arrangement (which encompassed the technology of the tank, the specific layout of the irrigated fields, and the social function of the *neerganti*) reproduces the social order: “historically and economically privileged groups of farmers own much of the head reach land, [while] lower caste and service caste farmers occupy the [least favorable plots of land at] the tail-end.”[8]

Though the social order is thus reproduced and solidified in things, it is not cast in concrete. Shah describes a fascinating case in which tail-end Muslim farmers successfully used their newly acquired economic might to reverse the social and irrigation order vis-à-vis the historically privileged caste group of Jainas at the head reach by using hydraulic arguments:

> Their challenge to the norm is based on an uncommon interpretation of the way earthen canals function. In their tank, there is heavy seepage from the main canals due to encroachments of canal walls and burrowing actions of rodents. Hence, “if canals irrigate four hectares, they waste water for four hectares.” Tail end farmers argue that water should be supplied to the tail end because when canals supply water to the tail end, the head and middle reach are automatically irrigated due to heavy seepage.[9]

But the struggle goes on: in other cases, powerful head-reach farmers have consolidated their social power by removing irrigation canals that would allow tail-end irrigation in addition to the field-to-field distribution of water.

Shah pointedly observes that “advocates of indigenous or traditional knowledge rarely mention the grave inequity of traditional India while romanticizing the nature and culture of pre-modern science and technology.”[10] When tanks, hailed as traditional technology, are approached from such a romantic perspective, their power in reproducing the social order may go unnoticed. When adapting and innovating tank systems for contemporary water management, the use of advanced hydraulic research thus is not enough: input from sophisticated research in science, technology, and society (STS) studies is equally crucial for translating water management technologies into effective and socially embedded solutions to societal problems. But with such additional insights, these tank and anicut sys-

---

[8] Shah, *Social Designs*, pp. 38, 269.

[9] *Ibid.*, pp. 270–271. I am not sure how to assess the difference in effect between the hydraulic arguments and the newly acquired economic power of these farmers; a possible interpretation is that the local style of democracy values (scientific) arguments over sheer economic power, although their new economic standing must have helped the farmers get listened to in the first place.

[10] *Ibid.*, p. 5.

tems do seem feasible and democratic alternatives to the "temples of modernity" that are so thick with suppressive power.[11]

The third intermediate lesson, then, builds on the second: not only is the distinction between traditional and modern technologies difficult to make; it may also blind us to the values and social orders that things help to maintain. The distinction between the "traditional" and the "modern" may thus be counterproductive when adapting these technologies to address current water management problems.

## COASTAL ENGINEERING STYLES IN THE UNITED STATES AND THE NETHERLANDS

The preceding sections may invite an erroneous conclusion: that we have a value-neutral hydraulic science and engineering, on the one hand, and the sociological-historical research that deals with power relations, on the other. Numerous STS studies over more than three decades, on a broad range of topics, have effectively shown that such a distinction cannot be upheld: science and engineering are not value free; and power relations typically are technologically and scientifically reproduced. I do not want to review that rich body of literature here; instead, I will stay close to my subject matter of water things and use the example of the levees and dikes of New Orleans and the Netherlands to demonstrate how vastly different values may be embedded in seemingly similar things.[12]

How is it possible that American levees failed to keep New Orleans dry, when behind Dutch dikes large parts of the Netherlands can exist below sea level?[13] Americans too have asked this question, and a flock of American expeditions traveled to the Netherlands in the aftermath of the flooding of New Orleans by hurricanes Katrina and Rita in 2005. The big U.S. television networks, specialty channels such as National Geographic, and political delegations—including the governor of Louisiana and members of the U.S. Congress—visited the Netherlands within a few months after the flooding, and all parties returned with spirited reports of how the Americans could learn from the Dutch. Does this suggest that the Dutch dikes are simply better than the American levees or that the U.S. Army Corps of Engineers is less able than the Rijkswaterstaat engineers in the Netherlands? I will show that something else is going on.

A detailed analysis of two internalist histories of coastal engineering in the two countries reveals, I will argue, that Dutch dikes and American levees incorporate very different sets of values—values about land and people, about vulnerability, about dealing with risk and uncertainty. These different value systems are at the core of coastal engineering science and practice. In 1996 the twenty-fifth meeting of the International Conference on Coastal

---

[11] My point is not that tanks are inherently iniquitous and nonegalitarian but, rather, that a proper analysis of tanks should also investigate such issues as power relations and not be blinded by romanticized views of the past. Such an analysis could even include a wider social system and ecosystem than I have discussed here: e.g., conflicts between farmers and fishermen might play a role as well. Regarding the "temples of modernity" see the sources cited in note 1, above.

[12] For more details see my research note: Wiebe E. Bijker, "American and Dutch Coastal Engineering: Differences in Risk Conception and Differences in Technological Culture," *Social Studies of Science*, 2007, *37*:143–152.

[13] I use the words "dike" and "levee" interchangeably. Both refer to elevated structures (mostly human-made, but sometimes natural) of sand, clay, and/or stone that are positioned along river or sea sides or around polders. "Levee" probably derives from the French "*levee*," "raised" (*Chambers Twentieth Century Dictionary* [Edinburgh: Chambers, 1983]). "Dike" (or "dyke," "dik") is similar to the Dutch "*dijk*," which is thought to derive from the Latin "*figere*," "cut and then connect"; it thus seems related to "digging in." The use of "levee" rather than "dike" in English may also be spurred by an offensive slang meaning of "dike" (or, more often, the homonym "dyke"): "lesbian."

Engineering was celebrated with a “Silver Conference”—ICCE96—in Orlando, Florida. The proceedings of this conference document the history of coastal engineering in the fifteen countries that have hosted the ICCE since its first meeting in 1950, in Long Beach, California. I will compare the American and Dutch articles.[14]

Though both articles are intended primarily to provide internal histories of coastal engineering, a few nonengineers figure in the narratives. And already these different nonengineering characters seem to shed a telling light on the relations between the dikes and the people. In the American chapter, they are the “beach users,” “visitors on holiday, who had little knowledge of what occurred during hurricanes or winter storms (such as ‘northeasters’), and little interest in funding studies and works.” The article on the Netherlands begins by quoting the Roman historian Plinius, who describes the Dutch as “a miserable people [who] live on high hills, or better on man-made mounds, just above the highest water level known by experience.” It goes on to discuss the landowners who collectively maintained and managed the dikes and sluices. To this end, the so-called water boards—said to be the oldest democratic institutions in the Netherlands—were created. A ruling by Count Floris V in 1280 is cited to illustrate the claim that these boards exemplified “the real democratic attitude in the Netherlands at that time.” His ruling stated that everybody had to pay for the maintenance of the dikes: “the monastery, the knight, the priest, the common man, everybody alike.”[15]

Another striking difference is in the way each history describes the early days of the field. A large part of the early history in the American article is devoted to beach and sand transportation studies. The emphasis is on scientific research, publications, and laboratory facilities. A key role is played by the Beach Erosion Board of the U.S. Army Corps of Engineers (USACE), which was established in 1930. In contrast, the Dutch article gives research a prominent place only when describing the postwar period. The beginning of coastal engineering in the Netherlands is marked by an unfinished manuscript by Andries Vierlingh (1507–1579). Vierlingh was a well-educated patrician and a gentleman farmer who also served in high-level public offices. He was, for example, a *dijkgraaf*: the highest officer serving the elected water boards. Making Vierlingh’s work central in the early history of coastal engineering in the Netherlands gives the key role to a certain style of engineering *practice*, rather than to scientific *research*. This style of practice is captured by Vierlingh’s adage “Niet met fortsigheit maar met soetigheit”: “Not with force, but with sweetness.” As the translation offered in the Dutch coastal engineering article puts it: “Don’t fight the sea with brute force but with soft persuasion.”[16] The author observes that this approach “actually is still characteristic for the coastal defence policy in the Nether-

---

[14] My proposal about the different sets of values incorporated by American levees and Dutch dikes is akin to the analysis of different national styles for technological systems of electricity distribution in Thomas P. Hughes’s seminal volume *Networks of Power: Electrification in Western Society, 1880–1930* (Baltimore/London: Johns Hopkins Univ. Press, 1983). The articles I will analyze are Eco W. Bijker, “History and Heritage in Coastal Engineering in the Netherlands,” in *History and Heritage of Coastal Engineering*, ed. Nicholas C. Kraus (New York: American Society of Civil Engineers, 1996), pp. 390–412; and Robert L. Wiegel and Thorndike Saville, “History of Coastal Engineering in the USA,” *ibid.*, pp. 513–600. Eco W. Bijker is Wiebe E. Bijker’s father.

[15] Wiegel and Saville, “History of Coastal Engineering in the USA,” p. 519; and E. Bijker, “History and Heritage in Coastal Engineering in the Netherlands,” pp. 391, 392. For a more comprehensive account of the early history of the water boards see Arne Kaijser, “System Building from Below: Institutional Change in Dutch Water Control Systems,” *Technology and Culture*, 2002, *43*:521–548.

[16] E. Bijker, “History and Heritage in Coastal Engineering in the Netherlands,” p. 395. For Vierlingh’s 1579 manuscript see Andries Vierlingh, *Tractaet Van Dyckagie* (Nijhoff, 1920; ’s-Gravenhage/Rotterdam: Nederlandse Vereniging Kust- en Oeverwerken, 1973).

lands." He refers, for example, to the strategy of sand suppletion. The sand dunes along the Dutch coast are maintained by people joining hands with nature: engineers supply extra sand at strategic locations along the coast, and the tidal currents distribute it where it is needed and thus broaden and strengthen the beach and dunes.[17]

A common element in the American and Dutch coastal engineering histories is the central role played by natural disasters. Disasters figure prominently in the thinking of American coastal engineers: "It is important to collect information on natural disasters shortly after their occurrence, to document events and effects." Moreover, they recognize that a boost in public awareness and in coastal engineering and research "often is the case after a natural disaster occurs which affects adversely lives and property of many people."[18] Central in the article on the history of Dutch coastal engineering—as in the consciousness of the general public—is the 1953 storm surge disaster, generally known in the Netherlands as "De Ramp"—"the disaster." In the early morning of 1 February the dikes in Zeeland, at the southern end of the Dutch coast, broke: the sea reached the top of the dikes; waves started to nibble at the back slope of the dikes, which are not armored by stones, undermining their structure from the rear; and eventually the sea pushed through. The seawater rushing into the polders several meters below sea level quickly scoured the breaches wide open. In one week, 1,835 people drowned, more than 750,000 inhabitants were affected, and 400,000 acres of land were inundated. The effects were traumatic—at the individual level, for the Netherlands as a country, and for the coastal engineering profession.[19]

Though Dutch and American coastal engineering have both been shaped by the experience of natural disasters, they are strikingly different. The American practice focuses on predicting disasters and mediating the effects once they have happened—in brief, on "flood hazard mitigation." Dutch practice is primarily aimed at keeping the water out.

A long string of hurricanes in the United States in the 1950s gave rise to a major effort by both the USACE and the Weather Bureau to develop warning systems and protective measures. Several surge-prediction models were developed, with differences resulting in part from the different needs of the modelers: the USACE was concerned chiefly with protection, the Weather Service with warning, and the Federal Emergency Management Agency with insurance. The resulting "present day warning systems, and evacuation programs, . . . have largely prevented loss of life despite increasingly higher density population of coastal areas." In the 1970s and 1980s coastal regulations were established by some states and by the federal government; the National Flood Insurance Program (NFIP) is the centerpiece of the latter. The intent of NFIP is to "reduce future damage and provide owners with protection from financial losses through an insurance mechanism that allows a premium to be paid by those most in need of this protection. This program is based on the agreement that if a community will practice sound floodplain management, the Federal Government will make flood insurance available."[20]

---

[17] The analogy with Chitra Krishnan's analysis of anicut practice in India is striking: one of her conclusions is that the old anicuts worked so well because they sophisticatedly reshaped water currents and sedimentation processes, rather than trying to control all natural elements by force. (I have phrased this conclusion in my own words.)

[18] Wiegel and Saville, "History of Coastal Engineering in the USA" (cit. n. 14), pp. 550, 549.

[19] Of course, these casualties are minute in comparison to those caused by many flooding disasters elsewhere in the world. But for the Dutch, who were recovering from the war and rebuilding their nation, the effect was traumatic. For a more detailed account of the role of this disaster in the development of Dutch coastal defense and its relation to Dutch democracy see Wiebe E. Bijker, "The Politics of Water—the Oosterschelde Storm Surge Barrier: A Dutch Thing to Keep the Water Out or Not," in *Making Things Public: Atmospheres of Democracy*, ed. Bruno Latour and Peter Weibel (Cambridge, Mass.: MIT Press, 2005), pp. 512–529.

[20] Wiegel and Saville, "History of Coastal Engineering in the USA" (cit. n. 14), pp. 538, 555.

The key phrase in the United States is "flood hazard mitigation" and the key ideas in this discourse are "prediction" and "insurance"—all of which suggests that the fact of flooding is accepted. The risk criterion that is used in designing levees and other coastal defense structures in the United States is 1:100—that is, they are expected to withstand a "hundred year flood." This criterion is a technical norm, carrying important professional weight among coastal engineers, but it does not have any legal authority. Very different is the practice in the Netherlands, where the guiding idea is that the water should be kept out at all costs. In the Deltaplan law the risk criterion of 1:10,000 was specified—not merely as a technical norm, but as an obligation embedded in a law unanimously approved by parliament.

Thus our fourth intermediate lesson is that things such as dikes and levees may incorporate different styles of coastal engineering and different value systems. I would even propose that they incorporate different technological cultures in the way they handle vulnerability, risk, and uncertainty.[21]

## THE OOSTERSCHELDE STORM SURGE BARRIER

The specific way in which the Dutch deal with the vulnerability of their country, and the risk of flooding, can be understood only by reference to De Ramp. It provided an enormous boost to both the research and the practice of coastal engineering. It also spurred a rather drastic reaction in the form of the Deltaplan, which called for the almost complete closure of the tidal outlets of the Maas and Rijn rivers. This certainly was a more forceful strategy than Vierlingh's "soft persuasion." By the 1970s, however, other societal developments, related as much to increased environmental concerns as to a general decrease in respect for authorities, had begun to challenge both the stature of the coastal engineers and the authority of the national agency Rijkswaterstaat, which was responsible for the Deltaplan. A national controversy arose over whether to close the last remaining open outlet, Oosterschelde. The solution to that controversy was a storm surge barrier that remained open under normal circumstances but could be closed by means of sliding doors when a storm surge was forecast. This thing not only seemed to restore Vierlingh's principle of soft handling and *soetigheit*; it also represented a "sweet technology" in the sense that it proved a very challenging, advanced, and exciting piece of science and engineering. Once it was built, and the controversy left behind, the Dutch did not hesitate to advertise this structure as the "eighth wonder of the world."

The Oosterschelde storm surge barrier is not only promoted as a technological wonder; it was also hailed as a marvelously democratic thing. Mockingly—because of its literal compromise character as a thing that can be both open and closed—it can be said to represent the Dutch consensus style of politics. Moreover, the fact that even its technical details were discussed in parliament makes it almost a "democratically designed" thing.[22] Most important, its operating characteristics are not permanently cast in steel and concrete but can be modified and thus adapted to changing ideas about safety and ecology. Thus

---

[21] In addition to differences in technological culture, geographical differences also play a role: there are no hurricanes in the Netherlands.

[22] The design that was agreed upon in parliament, however, was deemed unworkable by the engineers, who then proceeded to design another open/closed dam. The engineers involved scorned the politicians and generally professed to be sick of politics; at the same time, however, they recognized (and continue to acknowledge) that all things are thick with politics.

some of the decentralized Dutch political style, which had been exemplified by the old water boards but seemed to have been demolished in the aftermath of the 1953 disaster, was restored. In 1991 a detailed study evaluating the functioning of the barrier and its effects on tidal ecology was published. This report was broadly discussed by civil society organizations and in the provincial government council. Detailed technical considerations—pertaining to civil engineering, hydraulics, ecology, and biology—were presented and discussed: when things really matter, Dutch politics delves into their technical details.

## INNOVATING THINGS

All the things discussed in this essay once were innovations; now they are standing practice. They have grown hard and obdurate, difficult to change. They may even stand in the way of innovation. When things stabilize and grow obdurate, stable ways of thinking and fixed patterns of interaction do emerge around them—I have called these "technological frames."[23] People with a high degree of inclusion in a technological frame will find it difficult to imagine other ways of dealing with the world, of using these things radically differently or even not using them at all. Things like anicuts, tanks, and dams, for example, have kept farmers and agricultural engineers caught in the frame where rice grown on inundated paddy fields is the norm.

A radically different way of growing rice is currently being developed: "keeping the soil moist but never continuously flooded during the plants' vegetative growth phase, up to the stage of flowering and grain production." This "System of Rice Intensification" (SRI) seems to offer an important innovation for growing rice with less water and fertilizer. It may help to mitigate some of the social conflicts over water, like the Kaveri water dispute between the rice-growing states of Karnataka and Tamil Nadu and the small-scale conflicts about irrigation that continuously happen everywhere. But not surprisingly—considering the long-standing practices of inundated paddy rice growing, bound to so many things—it proves quite difficult to convince mainstream agriculture of the potential value of SRI.[24]

Shambu Prasad, an engineer and STS scholar who teaches in a business school, calls for "creative dissent" within science to escape the constraints of obdurate things and mainstream thinking and thus to allow for innovation.[25] In particular, he advocates an openness to dissenting views so that nongovernmental organizations and other civil society groups may have a more positive influence on new scientific and technological developments and thus help them to find a better grounding within their social context. Current experiments

---

[23] W. Bijker, *Of Bicycles, Bakelites, and Bulbs* (cit. n. 5). For an analysis of various forms of socially constructed obduracy see A. M. Hommels, *Unbuilding Cities: Obduracy in Urban Sociotechnical Change* (Cambridge, Mass.: MIT Press, 2005).

[24] C. Shambu Prasad, "System of Rice Intensification in India: Implications for Promoting Pro-Poor Innovation: Report Submitted to United Nations University, Institute of New Technologies, under Dfid Project 'New Insights into Promoting Rural Innovation: Lessons from Civil Society'" (Maastricht: United Nations Univ., Inst. New Technologies, 2005), p. 4. See also Prasad, *System of Rice Intensification in India: Innovation History and Institutional Challenges* (Patancheru: ICRISAT, 2006); Prasad, Prajit K. Basu, and Andy Hall, "Assessing System of Rice Intensification as a Process: Evidence from India," paper presented at the Fourth Annual IWMI TATA Partners Meeting on "Bracing up for the Future," IRMA, Anand, 24–26 Feb. 2005; and Krishnan and Prasad, "Technological and Policy Implications of Tank Systems" (cit. n. 2). For an overview of the current state of the art in SRI see Norman Uphoff *et al.*, eds., *Assessments of the System of Rice Intensification (SRI)* (Ithaca, N.Y.: Cornell International Institute for Food, Agriculture, and Development, 2002).

[25] C. Shambu Prasad, "Dissent and Innovation: Science and Civil Society in India," paper presented at the International Symposium on the Culture of Innovation in Indian Science and Technology: Opportunities Seized and Opportunities Lost, Hyderabad, 2006.

in India to develop a "science policy for the people" aim at transcending the anti-science attitude that many civil society organizations have mistakenly been charged with. These experiments resonate with the active engagement with science and technology demonstrated by some patient groups in the United States and Europe.[26] In the case of SRI, such engagement opens up a broad range of innovations—as, for example, among the farmers in Mustikovila in Anantapur district: "SRI here was not about getting higher yields than a conventional plot, but more about allowing farmers to mitigate risk and re-establish control over resources. This benefited farmers who over the years had become increasingly dependent on and vulnerable to external agencies."[27]

SRI thus shows how thick with politics things—tanks, anicuts, canals, and dams—are. But SRI is equally thick with politics. Could it mean an increased use of chemicals to fight weeds that will no longer be drowned by the water on the paddy fields? Could it mean a loss of employment for women, since inundated paddy cultivation heralded a feminization of labor? Most tasks on inundated paddy fields, like transplantation and weeding, are carried out by women. SRI breeds weeds that cannot be uprooted as easily as weeds on inundated fields: they require a bit of force. Hence there have been some experiments with locally invented machines, such as the "rotary hoe," to provide that extra (male) force for weeding. SRI, like any other technique, touches the way labor is socially organized.

The bottom line of this essay, then, is that things are thick with politics. And I mean politics with a lowercase "p": not the politics of politicians, but a broad range of politics, from the micro to the macro scale, that is related as much to the power of humans as to the power of ideas and things. Recognizing that things are thick with politics also draws attention to the crucial relation of things to people, of things needing to be embedded in a culture if you want them to work. To explain the difference between American and Dutch coastal engineering, I have suggested elsewhere that the Dutch people generally know more about, and are more actively interested in, coastal engineering than American citizens.[28] That allows for other (by which I do not mean "better" or "more advanced") coastal engineering things in the Netherlands than in the United States. A similar conjecture can be made about Indian water management. It may be possible to work out new irrigation schemes that integrate existing tank systems with significantly altered river flow patterns into advanced, sustainable tank ecosystems. But this integration would need to build on local practices of water management and democracy—for example, by giving new roles to the *neerganti* and by training people in new irrigation techniques (as in the case of the Mustikovila farmers noted earlier). Could such schemes then be an alternative to the "river linking" projects that the national and state governments of India (and China) are currently planning and executing—which seem to be as enormously thick with politics as the notorious case of the Narmada Dam?[29]

---

[26] Regarding AIDS patients' involvement in scientific research see Steven Epstein, *Impure Science: AIDS, Activism, and the Politics of Knowledge* (Berkeley: Univ. California Press, 1996); on patients with muscular dystrophy see M. Callon and V. Rabeharisoa, "Research 'in the Wild' and the Shaping of New Social Identities," *Technology in Society*, 2003, *25*:193–204.

[27] Krishnan and Prasad, "Technological and Policy Implications of Tank Systems" (cit. n. 2), p. 17.

[28] W. Bijker, "American and Dutch Coastal Engineering" (cit. n. 12).

[29] Medha Patkar, ed., *River Linking: A Millennium Folly?* (Mumbai: National Alliance of People's Movements, 2004).