

Chapter 7

CONCLUSIONS

Inauguration, Engineering, and the Politics of Infrastructural Form

Our study of Peruvian roads began in response to the challenge of how to work ethnographically on the state. Roads offered us a particular way into thinking about state presence. As material infrastructures that are planned, executed, and owned by the state, roads also demonstrably bring that state into being, creating and recreating its territorial form and enacting its paradigms of ownership and control. At the same time, as we have shown, roads also exceed the state as they become part of the mundane material fabric of people's lives, producing possibilities and limitations that go beyond any specific plan for integration, connectivity, or even abandonment. In previous chapters we have traced the material politics of road construction with respect to two highways. The histories and contemporary ethnographies of these roads have offered a perspective on some of the ways in which the modern Peruvian state emerged, in practice, through uneven flows of people, knowledges, materials, money, and other less tangible cultural resources such as hopes and fears, beliefs, and memories. We also found the "state" to have been a somewhat discontinuous presence in most people's lives, confirming our sense of

the problematic nature of the state as a starting point for an ethnographic account of political life in Peru. Our focus on the roads, however, has allowed us to rethink the political from the more grounded, experiential, and immediate space of infrastructural formation. As we tracked the ways in which these roads were made, and attended to what they were made of, we were also able to follow the social forms that roads brought into being—the territories and displacements, the diverse forms of expertise and analytical attention, the movements and blockages, the social orderings and the transgressions.

While approaching roads as important sites of politics, we have explicitly attempted to go beyond those accounts of road politics that privilege the role that roads play in political struggles between state forces and protestors. The capacity of roads to channel and focus political confrontation is important, and both of our roads have been used for this purpose on many occasions. However, this book has been more concerned to extend the reach of the political beyond the established understanding of liberal politics—whereby the political refers to the negotiations or struggles between subjects, or between state and citizen. Our focus on roads has been a deliberate attempt to extend the space of the political to include both nonhuman subjects (forces, materials) and the refusals of impossible publics whose actions tend to be illegible to those who limit the political to particular modes of struggle and contestation.¹ The political in our usage has referred to the relationships in and through which heterogeneous forms of social difference are enacted. At times such differences emerge through conflict, argument, negotiation, or settlement. At other times they remain as implicit, unsettling forces. The tracing of how difference is articulated has thus lain at the heart of our project.

By way of a conclusion, we move our attention from the making of a road to the means by which road projects are brought to a close. Following the making of a road taught us a great deal about the ways in which road construction projects effect a politics of differentiation, particularly through the interplay between devices of standardization and unruly or unpredictable environments. We have paid attention to the ways in which road construction projects deploy and consolidate an image of a singular, abstract national territory or state space² and appeal to the standards and universals that underpin the authority of expert knowledge.³ At the same time we found a constant engagement with the awareness of such spaces and knowledges as inherently open, mutating, and responsive to the dynamic environment of which

they form a part. Nonetheless, from the perspective of the construction companies roads *are* eventually completed. In the registering of their completion there is a shift of perspective from the road as a living, growing relational entity to the road as an altogether more singular thing, a material form that engineers might perhaps take credit for. Indeed, many engineers talked of their hope and expectation that their works will have some kind of monumental future, standing as testimony to their achievements in stabilizing recalcitrant environments.

Inaugurations

An important moment in the enactment of this closure is the inauguration ceremony, a ritual in which politicians forge visible associations with new infrastructural systems, delivering the valuable electoral currency of public works to the media and, through them, to the electorate. Unfortunately, we never directly witnessed any of the many inaugural events that took place at various times on our two roads. They always seemed to happen suddenly, when nobody was really expecting them. We were certainly not the only ones to wonder why we never knew when these ceremonies were going to take place. Indeed, one of the most striking things about such ceremonies was their seeming capacity to exacerbate a sense of differentiation between a local population and a distant and external centralized state.

Don Emilio, one of the Nauta pioneers referred to in chapter 1, told us of how he missed the inauguration of the Iquitos-Nauta road. Emilio was among those men who had first worked to open a path through the dense forest that lay between Nauta and Iquitos. He, along with fellow workers from that time, had been informed of President Toledo's visit by officials of the regional government. This was exciting news indeed. Over the years these men had seen the road grow from an extremely local project to the public work (*obra*) that had been realized through extensive networks of collaboration that had brought international finance capital, engineering expertise, and political controversy to the small town of Nauta. The pioneers were proud of the crucial role they had played in the initiation of this project, and they, more than anyone, were aware of how difficult it had been to elicit the support of the central state. It was a local politician, the mayor of Nauta, who had originally contracted the pioneers to find the route that would connect them to the road

that already existed between Iquitos and the Army camp at kilometer twenty-one. In their understanding of the process, the road had emerged thanks to local commitment and energy. It was local people, the local politicians and the pioneers, who had brought this road into being. They had opened the route. They had risked their lives, the dangers from snakebites, the deprivation that they endured for twenty-two days with only minimal food and water. It was their scout who had found the route, their *trochero* who had opened the original path with his machete, making it possible for the rest of the team to follow. The original expedition had included a technical expert who had brought a theodolite to survey the land. But, in Emilio's account, this technician was not, in any stretch of the imagination, in charge of the project. On the contrary, he succumbed to exhaustion and was utterly dependent on the pioneers for simply getting back alive. The pioneers were never paid for the work they did, and there was some resentment that despite their fundamental contribution they had received neither pension nor recognition. In fact, Emilio was at pains to point out that "things get done around here because there is no support from the authorities. They don't help you, so you do things for yourself."

Despite these decades of struggle and disappointment the men were excited by the possibility that there was finally some hope of public recognition in the form of an inauguration ceremony. They saw this event as an opportunity for the state to finally recognize the important part they had played in producing the road. For them, the road was testimony to their strength and resilience. They had never given up, but had managed to coax this stretch of asphalt into being despite the long history of abandonment and the intermittent attempts by state authorities to plunder resources and engage in flagrant acts of theft and corruption. The current head of state, President Toledo, had not been implicated in this murky history, and thus he offered a new opportunity for the pioneers to forge a productive relationship with the central state. The state might deliver on the promises of care and social provision that all politicians make in their election campaigns, where public works feature strongly as the best way to encapsulate the desire to meet local needs while responding to wider national and international aspirations for economic growth.

Unfortunately, things did not turn out well. Toledo was due to arrive at kilometer five, and the pioneers had been instructed to wait in Nauta for somebody to come and collect them. They had assumed that they were to be treated

as honored guests, but when nobody appeared they finally decided to take the initiative and hired a mototaxi to take them to the ceremony. When they got there, they were not allowed through the security cordons. By the time that word had got through to those who could have afforded them some visibility in the proceedings, Toledo was no longer there. He had arrived and left in a helicopter, as presidents do. The gap between these men and their president gaped before them. Even when in the vicinity, drawn there by the precious road in which so much hope had been invested, the connection between local aspiration and central state preoccupations had once again failed to materialize.

Our absence from the event prevents us from even beginning to imagine an ethnographic description of the kind that Max Gluckman produced in his famous analysis of the inauguration of the bridge in late 1930s Zululand (Gluckman 1940). Gluckman's engagement of the "social situation" established the importance of such events for the analysis of rituals as moments of potentiality, as encounters when social and political differences are produced and reproduced as much in the erasures of others as in their affirmation.⁴ The ways in which Emilio was forgotten, his inability to cross the security cordon, and his ongoing sense of both hope and disillusionment were, on this occasion, familiar but unexpected emergent effects. Just as in Gluckman's example, structural inequalities were enacted and embedded in the routine dynamics of the ceremony. Standing at kilometer five on the Iquitos-Nauta road, President Toledo could celebrate the new connectivity that the road stood for, while also reproducing the finely differentiated social space that distinguished those who were there from those who were not, and that shaped how they were there, how they arrived, and how they left. The disappointment at the heart of Emilio's story brings home how the inauguration of these infrastructural spaces routinely launches new futures that are from the outset highly problematic in local terms. In the first place, they are enacted and imagined at a scale at which local interest is irrelevant, superseded, or transcended by the force of the *obra*, which may be located but is no longer local. If the president has come to open a road, he has come in the name of a national project, and most usually to celebrate new or enhanced international connectivity.

On the one hand, then, the inauguration ceremony was a moment in which local residents sensed the gulf that existed between themselves and a centralized state. At the same time the reverse was true. Not only did the ceremonies enact the centralized state as distant and uncaring from the perspective

of local people, they also produced the local population as a challenge for the state itself. The ceremonials that surround an inaugural event do not simply mark the road as a state space, but also suggest that it is a space gifted to local people. Local people, now in receipt of this gift, are obligated to make something of it: to use it appropriately, to conjure prosperity from it. In the act of inauguration local people are thus handed the responsibility of improving their lives. This obligation or sense of implicit debt to the state is interesting to observe as an effect of the politics of decentralization, and of neo-liberal economic policies more generally, and reminds us of the continuing centrality of transcendent power to regimes that otherwise revolve around a sense of distributed force. Somewhat surprisingly, this sense of obligation is reminiscent of the huge public ceremonies that the Inka rulers would orchestrate to inaugurate the growing season. In these ceremonies the Inka asserted that all productive capacity emanated from their gifting to their subjects, of land, water, and ultimately life itself. The ceremonies were huge theatrical enactments of subjection orchestrated by an imperial power with an overwhelming capacity for material and symbolic control of its territories. Of course, the compulsion to participate is orchestrated differently in contemporary times, and yet the continued power of the state to define the public good, and to act in the name of this abstraction, continues to confound possibilities for local people. Furthermore, the state's capacity to invoke the public good at a scale with which specific people struggle to identify further condemns such people to marginal spaces of poverty and anger, in which they are increasingly either ignored or criminalized should they orchestrate dissent.

Following Gluckman, then, we can see that the inauguration of contemporary infrastructure projects performs a similar politics of structural differentiation to the one he so memorably described. Inauguration ceremonies enact a differentiation of the local from the national, of the state from the citizen, and of the politician from the public. However, although Gluckman's account provides a rich description of an inauguration ceremony not dissimilar to those taking place along our two roads, it misses a further form of differentiation that we have been at pains to explore in this book: the differentiation between Politics with a big "P" and the politics of technical relations.

Inaugural ceremonies are not only moments for indexing the relationship between politicians and publics; they are also taken as important opportunities to reclaim the roads from the space of technical expertise in which they have become embedded in the course of their construction. Public works are

always more likely to produce enduring associations with the politicians who secured the funding than they are to elicit tributes from, or even the memories of, the engineers or the workforce who constructed them. Both of the roads that we have described were inaugurated by presidents who sensed the electoral (or legacy) advantage of a close association with these promissory spaces. Although we tend to think of inaugurations as occurring at the end of a construction project, we were struck by how often an inauguration would be announced during the middle of a project, to coincide with political events. Just before the 2006 general election, for example, President Toledo opened the first kilometer of the Interoceanic Highway—a tiny stretch of road that was completed and inaugurated before the rest of the road even had a full engineering profile. He and his ministers had worked to get the Interoceanic project off the ground, and they wanted recognition for this achievement in the electoral campaign. Toledo's successor, President Alan Garcia, was on hand to take credit for the subsequent construction. In the final weeks of his presidency, Garcia inaugurated the Billingham Bridge in Puerto Maldonado before it was actually completed.

These inauguration ceremonies thus appear to have little to do with the completion of the technical process of constructing a road. Indeed, the inaugural moment effectively puts *process* aside to celebrate the product.⁵ Recalcitrant materials, disputed hierarchies, and unstable alliances are not discussed, nor are the negotiations over relative expertise, spheres of jurisdiction, mutual responsibility, and the ethics of environmental engagement. More unlikely still is there any reference to the multiple, and incompatible, aspirations for future transformation. After all, inauguration ceremonies are not the place where you would expect to find discussion or debate around the nuanced configuration of the public that is enacted in public works.

The power of inauguration ceremonies to enact big “P” Politics, while erasing the politics of technical relations, is suggestive of a more pervasive doubling within the politics of contemporary infrastructure projects. Take, for instance, a very dramatic instance of infrastructural politics that was brewing at the time of the final inauguration of the Interoceanic Highway. The central government, anxious to continue its collaborations with Brazilian capital and to further its initial steps to find new inroads into Brazilian markets, had begun to draw up plans for the construction of several large reservoirs. The idea was to sell both water and electricity to Brazil. What was shocking was that the reservoirs were to be built at Inambari, across the very area

through which the new Interoceanic Highway now passes, destroying the road in the process. Beyond the possibility that the road might create a more integrated national territory, or facilitate flows of goods and persons—extending the networked integration of Peru with Brazil, and even creating the alluring promise of a gateway to eastern markets—the road construction project had opened up new possibilities and new relations, and a new future in which the road itself was really not that important. From the perspective of the political performances enacted at inauguration ceremonies, this calculation seemed absurd—why destroy a thing that held such political promise? However, from the perspective of our analysis—one that has attempted to recover a more complex terrain of social and technical relations at play in infrastructure projects—the plan for the reservoir is less surprising. Simultaneous to the performative inaugurations of this construction project, the government had begun to focus on how the reservoir project might be more lucrative and secure better relations with other countries. Like any infrastructure project in its early incarnation, the reservoir was shrouded in uncertainty. Indeed, the project had been suspended when we left the field, although not canceled, but this did not mean it was without its social effects. With the announcement of the reservoir, the plans and calculations of state officials had caused Inambari to become a site of considerable social conflict that involved alliances and tensions between local residents, engineers, and concerned environmentalists. People of course adapt—as they always have—but such adaptation frames the struggles of everyday life as the new opportunity threatens in small or overwhelming ways to destabilize previous adaptations and precarious livelihoods. Our work suggests that those who wish and need to understand the dynamics of such conflict and processes of adaptation would be well advised to approach the field with an awareness of the wider infrastructural politics already in play.

In these contexts of uncertainty, when roads become reservoirs, and when infrastructures turn out to be capital assets,⁶ and not routes for terrestrial integration through the flow of goods and people, inaugurations index a very particular kind of political “promise.” This is not a promise of infrastructural provision, for the inauguration requires that the work of construction is assumed to have already been done by the multiple actors who have effectively brought the material infrastructure to a point of (provisional) completion. Inaugurations instead gesture to a potential future that still requires work but holds promise and allure in relation to particular (but underspecified)

future imaginaries: greater wealth, greater health, greater connectivity.⁷ Inaugural ceremonies render technical work invisible, at the same time as they register the uncertainty of the social and acknowledge that more is needed for the infrastructure to deliver that which is expected of it. Inaugural ceremonies mark new beginnings under good omens and seek to render the works auspicious. But auguries also mark uncertainty, and there is a tacit acknowledgement that while the project might be successful, it might also fail. The handing over is the passing on of this responsibility, and a gesture that also points to the dark side of the promise of a better future, with the reminder that this future comes without guarantee (not even, as we have seen, the guarantee that the state will continue to back the infrastructure after its inauguration). As Keck and Lakoff (2013) have pointed out, the augury is above all a “figure of warning.” When an infrastructure (or a single kilometer of tarmac surface) is handed over, the quality of an uncertain future hangs in the air.

The Emergent Politics of Engineering Practice

Having demonstrated that inauguration ceremonies are not primarily rituals that mark the completion of an infrastructure, but rather political punctuations in a longer trajectory of infrastructural emergence, we now turn our attention to the way in which the technical work of engineering a road enacts the closure of a project and the requisite transfer of responsibility from engineer to politicians and ultimately to the public. As we discussed in section 1, both our roads had their origins in the 1930s in Peru’s first wave of national road construction. Both have taken many decades to complete, and such completion is constantly deferred as bits of road collapse and require repair. We have illustrated how the stories of their emergence as more or less stable surfaces are ongoing stories of material drama that lack a clear point of origin or a single moment of completion. A sense of an ongoing process of material flows and blockages is echoed by the histories and accounts of the social dramas played out on the roads as they have been routinely engaged as spaces of protest and negotiation in the political life of the country. We have also traced how over the years these roads have been mobilized to channel commerce and economic potential, and how their future prospects

are now threatened by new infrastructural imaginaries regarding how best to generate new national economic interests.

Yet although roads are clearly ongoing processes, what was key for the engineers with whom we worked was to find ways of delimiting their engagement with the road in order that they could demarcate the temporal and spatial boundaries of their own infrastructure project, as well as the present and future issues and relations for which they should and should not be held responsible. To do this, they deployed a range of devices and techniques that enabled them to act in anticipation of a future where they would at some point hand over the road to the nation. As we have shown, an adherence to reason, abstraction, and normative procedure appeared to offer engineers a way forward in this work, shaping the knowledge practices that have come to define their particular mode of expertise. So how might we specify the politics dynamics of such interventions?

In section 2 we have described the instruments and practices that engineers deploy to both control and keep their distance. In particular, we looked at the laboratories where soil samples are tested and manipulated; at the articulation and imposition of codes of conduct directed at the regulation of working practices; and at the transparency measures designed to combat the endemic corruption associated with public works. Each of these fields of practice mobilizes the familiar instruments of engineering practice—the standards and norms of professional codes and legal provision; the reliance on metrics, algorithms, and computer models to convert concrete measures into projected trends; and the use of technological devices to extend and standardize human perception and analytical capacity. There is no doubt that civil engineering practice enacts the framings of modern disciplinary knowledge.⁸ And yet our ethnographic observations also suggest that this is a story of limited control in which the engineers' disciplinary moves are ultimately only ever going to be provisional attempts to suppress the proliferation of alternative framings. It is at this point that we find that ethnographic understandings of engineering expertise begin to reconfigure our understandings of the political.

Both Foucault (1969, 1971, 2007) and Mitchell (2002) have provided fascinating diagnostic accounts of political economy, but to do so they have had to step back from the messiness of practice. Their accounts of disciplinary power enact a scalar shift, or a move away from the complexity of the particular to

the strong general account of epistemes, epochs, and regimes. As ethnographers we appreciate the clarity that such distance affords, but at the same time we remain intrigued by the politics of the specific and interested in how the space of the political might be understood from this perspective. When we attend to what civil engineers are actually doing on a day-by-day basis, we are faced with the inherently pragmatic and flexible nature of these practices. Thus, for example, we find that while standardizing metrics and the universals of mathematics are central to engineering practice, the measurements these techniques afford are never assumed to be stable. The calculations of optimum material interventions are made under laboratory conditions where materials are approached as if conditions inside and outside the laboratory were continuous—but in the knowledge that such continuity is only approximate, and that good solutions aim to be satisfactory rather than correct in any absolute sense. Both measurement and experimentation are ongoing; while experience guides the expert engineer, they know there are no ready-made solutions for the material challenges they face. Similarly, in the field of health and safety we found that stringent rules and regulations were drawn up, communicated, and enforced in the sure knowledge that most people were sidestepping and bending the rules most of the time—and that in many ways such flexibility was necessary to safe working. The regulations thus refer to a utopian world where the application of logic and the adherence to rules assumes stability and ensures that things will go according to plan. But in practice, of course, things go wrong all the time, the rules frequently contradict common-sense understandings, and the aspirations to certainty and stability run counter to the basic need for everyone to be attentive to the dynamics of the relations in which they are immersed, ready to deal with the unexpected. Finally, with respect to corruption, the regulatory instruments and legal structures designed to ensure transparency do little to assuage the sense that opaque and undisclosed relations and arrangements guide the core decisions in construction projects. Public information can always conceal the details of private negotiation.

Our interest in the specifics of how boundary-making devices are deployed in practice thus leads us to a very different, and we would argue more nuanced, understanding of the political that recovers and repositions the figure of the engineer. James Scott's critique of high modernism in *Seeing Like a State* exemplifies the broad political framing that traces the destructive failures of specific attempts at social engineering to the hubris of planners and

engineers (Scott 1998). The image of the engineer as a detached, autonomous, rationalist planner is habitually produced, perhaps particularly in social anthropology, in contradistinction to alternatives, often celebrated for their more, emergent, or processual engagement with the world. Lévi-Strauss (1966) defines the engineer as the prototypical modern thinker, in contrast with the *bricoleur*, his nonmodern counterpart. In a similar vein, via a very different philosophical route, Ingold (2011) evokes the rigidity of the engineer setting out to get from point A to point B, in contrast to the “dwelling” or “way-faring” modes of engagement that he favors as more authentic ways of living. Our argument is that while these differentiated modes of practice are indeed significant to the world of civil engineers and their capacity to produce an infrastructure project as having internal coherence and an identifiable endpoint, it is in their combination that technical knowledge gains its efficacy. Engineering projects enact their ordering power in relation to emergent environmental and social processes without embracing a dwelling perspective (Ingold 2000); they address material emergence and vibrancy without embracing animism; they engage contingency, repetition, and uncertainty without discarding a commitment to linearity, progress, and change.

The engineers we worked with were not in a position to ignore the details of local engagement. They were required to attend to other knowledges, practices, and possibilities on a daily basis. And their projects rarely simply fail or succeed, for they always carry multiple intentions and possibilities, and they always change things in unexpected ways. Contrary to the stereotype, we found that engineers know perfectly well that the data they work with is provisional, and they know that they can only transform the environment by working with what is already there. In this sense we want to suggest that engineers only partially enact the ordering paradigm of approaching the environment as an external world of nature to be grasped and controlled, despite the fact their expertise has commonly been described in this way.

The argument that we make, and which we outline in more detail in the following section, is that the professional expertise of road construction engineers lies in their ability to produce resilient structures out of the dynamic relational properties of the material and social worlds in which they find themselves. To achieve this they concentrate their effort on coordinating material relations in full awareness that these relations are realized in dynamic engagement with social worlds. Aware of environmental relations and of the productivity of difference, of systemic interconnection and oscillating

variation, they attend to the possibilities of framing, of provisional decontextualization that allows relations to be stabilized long enough for decisions to be taken and actions performed. Indeed, the central aspect of their work is the capacity to frame their own expertise as a particular quality of knowledge that enables controlled and ordered material transformation as a primary responsibility undertaken, secondarily, with regard to the social implications of their work. This ability to carve out a specified domain of expertise is key, we suggest, to appreciating both how social responsibility appears as a problematic issue for modernist projects of transformation and how it is that the same expertise offers the best means available for responding to such problems. The point that we want to stress here is that the determination to identify and produce such framings is not founded in the distance of the person who fails to notice what is happening on the ground, but in the distance taken by the person who is all too aware that local complexity has somehow to be managed if planned transformations are to be embarked on. And it is in this respect that we began to think about engineers as both engineer and *bricoleur* in Lévi-Strauss's terms, as "recombinant scientists" working with what comes to hand to resolve the specific and localized problems that any infrastructural project produces in its articulation of the diverse encounters that constitute the grand plan or overall scheme.

Engineering the Social via Acts of Framing

How then do the civil engineers make space to act? How do they relate their space of action to the past and future manifestations of the infrastructures with which they are working? And how do they create and deploy framing devices in these complex spaces in which multiple knowledges and understandings compete for attention? Our approach here has been to follow the relational dynamics of the knowledge forms that engineers produce in the course of their work. Engineering projects generate all kinds of documents, plans, and analytical forms, each representing particular kinds of abstraction, each enacting a particular framing. These documents are themselves social forms, relational devices that are produced to serve a particular purpose. One such purpose is the enactment of engineering expertise. Engineers, in common with the scientists that Latour and Woolgar (1979) famously

described in *Laboratory Life*, produce inscriptions. In some respects these detailed specifications are understood to be the central product of engineering expertise. The civil engineers that we have worked with, in both Peru and in the United Kingdom, have stressed to us over the years that engineering and construction are two quite different things. "Engineering" is the production of the technical solution, design, or prototype that is subsequently realized in the practice of construction or manufacture. In this respect, the crucial engineering work is carried out prior to the construction phase of a project. However, even if we stick for the moment with the idea that engineering involves the production of a design, we find in practice that such designs are produced in a variety of social framings that subtly shift the referent of the design. A feasibility study for projects such as those we studied in Peru will include all kinds of technical details and specifications concerning the road surface, its foundations, its materials, its form, its routing, and its potential costs and benefits, including the calculated risks with respect to environmental and social impact. These studies are highly technical, but they serve a particular purpose. They sort out and set out the relations between funders, politicians (or representatives of diverse public constituencies, or both), and the construction company. The engineering in this framing combines social and technical knowledges in a specific way. The studies have to address questions such as what kind of road do we want and expect this to be? And will this project be related to other concerns and policies with respect to public investment? The studies are ultimately consolidated in the contractual agreements that are drawn up to allow a project to start through the release of funds.

Quite different knowledges are assembled in the laboratories of the construction companies once the work is under way. Here, the key relations to set out and sort out are those between the available materials and the environmental forces that they expect to confront. The engineers measure and model the relational capacities of the materials with respect to things like their relative resistance to weight, plasticity, or porosity; they gauge the relative value of natural over man-made materials; and they work to find the best fit between what they have to work with and the agreed specification of their final product. These are still activities that move toward the production of an engineering design. The temporality has shifted, however. The design is still prior to the subsequent act of construction, but it is also recursive (Kelty 2005).

The problems and challenges the construction process produces are continually referred back to the laboratory for modification and subsequent design refinement.

The notion that engineering work is always prior to and separate from construction is thus itself a somewhat abstract or ideal account of how construction proceeds in practice. Engineering design informs the construction process and signals what it is that has to be built and how, but the design remains open to modification. The technical studies direct the proceedings, but they do not in the end determine how to proceed. The realization of the design is something that is worked out on the ground in the interactions between engineers (contractors and supervisors), foremen, laborers, materials, and machines. The importance of the technical specifications lies in their capacity to clear the way for action by setting out the parameters of the material transformations that are to be undertaken. However, we suggest that they also serve another, equally important function in the ways that they simultaneously delimit the relational domain for which the engineers are responsible. In this respect, the framings entailed in the drawing up of a technical specification are not predicated on the failure to address local conditions. They can perhaps be seen as attempts precisely to localize the space of intervention, to articulate its specificity, and to limit responsibility for all that will, inevitably, overflow this space at some unspecified future date. In this respect, technical knowledge works by closing down alternatives.

This formulation would, we imagine, be contested by many engineers, who often articulated their point of departure as the specification of alternatives. These alternatives should always be explored at the stage of the feasibility study to allow those in a position to decide what solution best addresses what problem. But this is not our point. There are many ways to build a road, but to the extent that any of these ways need to pass through the devices of the feasibility study, the engineering specification, the laboratory analysis, and so on, they are subject to framings that create a meaningful distance between a sphere of expert practice and the everyday worlds of the surface dramas described earlier.

These acts of framing produce social problems, in fact “frame” the social as a problem. They do so not primarily because they distance the expert from local relations, nor because they cast the expert as governing subject able to impose a particular (erroneous) truth about reality, but because their particular way of engaging the local generates a space of externality that appears,

in retrospect, as problematic precisely because it is discontinuous and nonintegrated (Callon 1998). In the concern that technical projects should integrate the social, the “social” appears, by default, as that which the technical has failed to carry forward, a relational space that is disengaged and left behind. It is in this way that expert knowledge practices produce knowledge gaps, and in contexts where development and progress have widespread purchase as idioms of social improvement, such gaps signal both temporal and moral lag.

One of the paradoxes that engineers are constantly battling with is their awareness that the same people who campaigned tirelessly to secure investment from governments for roads, which they believe will deliver them better lives, are also working against the realization of this dream, even when the road is under construction and requires only their cooperation for successful completion. Such dilemmas were vividly communicated to us by one of the engineers who had worked on the Iquitos-Nauta road. He told us, admittedly with a marked note of irony in his voice, that the road workers and people living along the road that he was trying to complete were total savages. He explained that this project was the very first in Peru to use a cutting-edge synthetic webbing that had been found to be highly effective in strengthening the road surface in sites (such as the Brazilian Amazon) where there was no stone. He and his colleagues had built a shelter to keep the webbing dry and had posted a guard to keep it safe, but the guard fell asleep and the webbing was stolen. The next thing he knew, the webbing started appearing as lining for the pens in the chicken farms along the road. To make matters worse, when he finally started to use the webbing for the job it was intended for, his workers had managed to destroy it. A special machine had been brought in from Brazil to help lay the webbing on the ground, but the driver had not realized that the grooved wheels, which facilitated the laying of the material in forward drive, would destroy it in reverse. The engineer’s complaint focused on how local people did not appreciate the value of the webbing, nor did they seem to appreciate that they were damaging the very thing that they were supposed to be creating together. These failures to integrate people into a common project, as framed by the civil engineers, are widely seen as the kinds of “social” issues that the specialized social relations departments of engineering companies are charged with handling.

The social relations officers are sent out to clear the way for the construction process, negotiating the minute details of routing, the sourcing of local

materials, and the negotiation of compensation and work opportunities. In the process they find themselves engaged in discussions of incommensurable values and habits that are hard to reduce to the frames of developmentalist thinking, whereas infrastructural provision assumes smooth flow and prioritizes connectivity as the precondition for effective social aggregation. But the dilemmas that the social relations officers face disrupt these assumptions. How, for example, do you compensate a family for a precarious, illegal roadside shack that is their only shelter and source of livelihood? How do you negotiate the value of land that has been painstakingly tended over many decades despite its poor productivity? How do you relocate a powerful shrine that indexes forces of regeneration and future possibility for those who attend to the powers of miraculous Christian saints? How indeed do you convince people that your inadequately guarded and clearly valuable material should not be taken and used to meet a spontaneous or pressing need? Again, the social problems emerge as quite external to the technical framings, and they are associated with a nontechnical, recalcitrant, or ignorant people who do not understand how their actions impede the progress they have campaigned for. The possibility that such people might understand this perfectly and nevertheless choose to act otherwise tends not to be examined. Integrating the social in the final analysis is about getting people on board and signed up to a common project.

As others have pointed out with respect to the contemporary discussion of participatory methods in development projects (Green 2010), technical framings are thus not primarily knowledge claims; they are attempts to negotiate the ways in which a space of action (the construction project) is cut off from the everyday worlds of material and social flux and uncertainty. As we have seen, in the context of endless disputes about the origins, boundaries, and future trajectories of any infrastructural form, it is essential for engineers to produce precise framings as to what aspect of the infrastructure they are expected to be responsible for. Where the framings are put under pressure by competing agendas, alternative priorities and values emerge as social problems. The problems might be articulated as either a failure to embrace the values of progress or a failure to recognize risk. In either case education, or at least some kind of awareness raising, is nearly always produced as the answer, the means by which the integration of the social and the technical can be achieved or restored. In the process, social responsibility remains securely bracketed off from the activities of the technical expert.

It is perhaps for this reason that large-scale public works are widely thought (even by engineers themselves) to be steeped in corruption. With no secure identification of social responsibility, corruption stories flow freely around these projects. The nebulous force of interests, largely unspecified, is always thought to lie behind the decisions of who to employ, where to route a road, what materials to use, where to source them from, or where to dispose of them. Fears that the wrong kinds of integration are being effected are commonplace, and the question of who gets drawn into the projects and how occupies everybody's thoughts. Even spaces without roads can be configured in this paradigm as a space where a road might have been had somebody not run off with the money.

As we have argued throughout this book, the skills of the engineer do not simply lie in the capacity to produce abstractions from the messy details of real world material and social processes. They also have to produce abstractions that are generative of possibilities for subsequent intervention in and transformation of these material and social processes. Such is the specificity of engineering as opposed to the theoretical sciences. Engineering knows itself as science in action. The specificity of engineering practice is thus not about an incapacity or refusal to engage the oscillations and instabilities of the world. The engineers we worked with did, however, bring a particular orientation to this engagement, which is the specific analytic determination (supported by the instruments and institutions of modern science and technology) to separate things out and to detach themselves and their focus of attention from the ongoing relational currents in which we all live. In this respect, the knowledges that these engineers produce do have a particular quality, namely the capacity of the specific abstraction to manifest as generic (i.e., as nonspecific) and thus float free of the complex relationality of the social.⁹ We would suggest, furthermore, that all expert knowledges rest at some point on this ability to generate authoritative generalizations from an attentive analysis of specific relations. Our interest in infrastructural formations is an interest in how these movements between the general and the specific are enacted, registered, and authorized. The engineers we followed in the course of our ethnography have shown us how diverse modes of integration coexist, how scalar shifts occur, and how uncertainties are addressed. Most important, perhaps, they have shown us how a focus on material transformation opens up a world of tensions, negotiations, and contestations that extend our understanding of political life.