

THE STROKE OF MIDNIGHT AND THE SPIRIT OF ENTREPRENEURSHIP

A History of the Computer in India

A vital question which comes before any organization, before planning a computer installation, is—why go in for a computer?

—Charanjit Chanana, 1973

“I never realized that I had it running in my veins,” read the first line of an e-mail that popped into my inbox in 2012. “Yes, the spirit of entrepreneurship,” the e-mail from Adi continued. Adi had decided to launch his own start-up, a business based on an idea for a software product that was untested. The e-mail’s subject line read “At the Stroke of Midnight!” After getting his master of computer science degree from the Technical University in Berlin, Adi married London-born Maya, whom he met through friends from Delhi University, where he had gone to college. Adi and Maya, in their early thirties, were a little bit older than most other programmers they knew. They had a two-year-old son, Krishna, and often talked about where it would be best to raise him—in England, in Germany, or in India. Because of Adi’s degree from a prestigious university, their ties to England, and Adi’s family network that included prosperous business professionals, Adi was better positioned than most to move out of the limited coding jobs available under the German green card. His e-mail was the first step in a series of messages that would ask family and friends to contribute funding to his venture. The remainder of the message said:

My parents have been quite versatile with their ambitions as they went about establishing a Textile Mill, a School, a Brokerage and Stationery shop, and finally a Financial Services firm. This fact was registered somewhere in my unconscious mind but I didn't realize it even as I went about serving the entrepreneur community as a volunteer.

Sareeta, at the stroke of the midnight, I will take a step—a step outside my comfort zone, a step into unchartered waters, a step into the unknown. It is a step that is taken with passion, with confidence, with humility, and with energy. It will be an adventurous journey but it is also risky. And today, I just seek your wishes.

—E-mail received January 2011, subject line: At the Stroke of Midnight!

I spoke to Adi a few weeks later by phone and told him that I found his “stroke of midnight” language evocative. I asked if he had in mind Nehru’s “Tryst with Destiny” speech on the eve of India’s independence. In this speech, made to the Indian Constituent Assembly on August 14, 1947, shortly before midnight, Nehru began:

Long years ago we made a tryst with destiny, and now the time comes when we shall redeem our pledge, not wholly or in full measure, but very substantially. At the stroke of the midnight hour, when the world sleeps, India will awake to life and freedom. A moment comes, which comes but rarely in history, when we step out from the old to the new, when an age ends, and when the soul of a nation, long suppressed, finds utterance. . . .

The achievement we celebrate today is but a step, an opening of opportunity, to the greater triumphs and achievements that await us. Are we brave enough and wise enough to grasp this opportunity and accept the challenge of the future?¹

Adi confirmed that he had meant to reference the speech, saying, “The speech is about birth and a moment of change. Like that, this is the birth of something new for me.” And almost immediately after drawing the link between the birth of a nation and the birth of an enterprise, Adi added, “The e-mails should do something to affect you. They are making an emotional argument to get you interested in the well-being of something. Like in the stages of the growth of a child.” Nehru’s language suggests the dawning of independent India is “but one step” on a path toward further de-

velopment and, at the same time, positioned the independence of India as a “tryst with destiny,” a culmination of a process started long ago and in some way inevitable. These two ways of framing an event, as progress over time and as a return to destiny, resurface in the way that Indian programmers in the diaspora narrate their relationship to the Indian nation.

Over the following weeks and months, Adi’s e-mails, all with the same “stroke of midnight” tagline, outlined for friends and family the stages of his company as a child’s growth. From the infancy phase to first steps, at each stage the child needed emotional investment from friends and family to nourish it and keep it growing. Adi was surprised at how well this strategy was working. “Only one person,” he told me, “complained that you are asking me for money but not even telling me what the project is about. All others are willing to give even without knowing what I’m building.” Asking him why he thought they gave so freely, he answered that for some of the older generation who had already made their fortune, it was a chance for them “to relive the excitement of the early days, to share in a dream.” Perhaps Adi had tapped into a deep reservoir of feeling in his citation of Nehru’s speech, which framed Indian prosperity as both something to be achieved through conscious effort and something bound to happen. In Adi’s e-mails, he aligned the excitement of India’s “birth” and with the birth of his company. He used the affect of Nehru’s speech, including the rhetoric of new opportunity and the “challenge for the future” and combined it with his own spirit of entrepreneurship to open the purses of e-mail recipients.² Adi’s gambit was a success. He was able to get enough support through these e-mails without ever revealing their purpose. Adi felt he needed to keep his plans secret because the idea was what was really driving the project; otherwise, someone else could take the idea before he got enough capital together for his start-up.³ By using these well-known nationalist tropes along with the image of the company as needy child, Adi brought corporate technological change within the ambit of the developmentalist time of the postcolonial nation.

At an earlier moment during fieldwork, everyone was sitting in Meenakshi’s front room drinking hot milky tea out of flimsy plastic cups. The conversation had started as a comparison of universities in the United States, Europe, and India. The contours of this conversation suggested that the West was clearly ahead technologically but that it was only ahead for

now and that perhaps it was even stagnating. To illustrate this point, Bipin made a slicing movement through the air with his hands. The brain drain, he said, is a problem now, but it will not be an issue in the future. “Things are moving closer together. A global village.” He moved his hands clockwise, intoning, “Things move in a circle. Now, Germany and Europe are at the top of the circle that India is so desperately trying to reach, and they are already moving toward that other place.” He let his hands drop downward toward the bottom of the imaginary circle he had just arced out in the space in front of him. “India’s high point was with Ashoka, and at that time in Europe there were only barbarians.”

On this day, Bipin suggested that the IT revolution was like the coming of a new age of Ashoka, the third-century B.C.E. king who is most famous for his Buddhist edicts, carved on rocks and stone pillars spread throughout the Indian subcontinent. For Bipin, India was already rising, and the problems of the present and the past were destined to diminish with its ascension. The programming classes, according to his story, simultaneously should advance the cause of India rising and would ride on the wings of its historical inevitability.

These two stories encapsulate a continuous and changing relationship between the entrepreneurial subject and the nation-state, a relationship that has too often been assumed to have been sundered irrevocably with the coming of economic liberalization and globalization marked by “footloose” capital. In other words, while many scholars have stressed the ongoing importance of the nation-state, the way that the continued presence of the nation-state impresses itself on the new subjects of capital remains to be worked out. In India, the relationship between middle-class programmers and the nation-state emerges out of the intertwining of technologies, middle-class experts, and state power. This chapter follows the relationship between middle-class programmers and the Indian nation-state by showing how technologies of state enrolled elite Indians as their representatives in the construction of national sovereignty. Technologies like big dams and supercomputers produced an Indian middle class by mobilizing experts in a milieu where possessing a scientific temperament was a requirement for nation-building.⁴

Bipin’s and Adi’s narrative strategies confirm that development discourses do not disappear in postliberal India.⁵ The liberalization of the Indian economy, normally told as a story of rupture dating to 1991, is more accu-

rately parsed as an ongoing process, in which stories of national development and market liberalization participate.⁶ Adi extracts a teleology of development and weds it to a narrative of entrepreneurial self-fashioning. Bipin sutures a circular discourse on time to the inevitable rise of India. These methods position programmers as drivers and recipients of national development.⁷

Resisting the “before” and “after” logic through which the story of the software industry in India is told can illuminate how this very history is taken up in everyday life as a means of self-making and class-making. In other words, by tracing the continuities and contradictions in the story of the computer in India across the dateline of economic liberalization (1991), I try to make sense of one important location for the formation of the “new” Indian middle class—the intersection of technical expertise, state power, and subjectivity. In what follows, I bring together several histories of the computer revolution in India and read them in relation to Bipin’s and Adi’s story of national development as sociotechnical entrepreneurship. While technical expertise remained central to national development from the anticolonial period to the present day, the attitude of experts toward the state shifted from working on behalf of the state to working to reform and even bypass the state on behalf of the nation. The continued reliance on the idea of technical expertise as an essential tool of governance allowed those who possessed these skills to pivot away from direct state service and toward the private sector. This is one meaning of what Bipin was expressing with his assertion that India is rising. Programmers’ fates will rise with the inevitable rise of the nation, and at the same time, diasporic programmers also produce the conditions for this rise. Inevitability and agency are linked, the present is folded into the certain horizon of the future, and the conditions of present labor are understood as part of the inheritance of the “flexible and mobile performance of contingent identities.”⁸

Technology and the Indian National Imaginary

A persistent concern of this book is self-fashioning on the constantly shifting terrain of contemporary capitalism. The longer history of linkages among science and technology and the Indian state can help tell the story of how Indian programmers come to inhabit the paradigm of a flexible and cheap worker even as they try to divert their futures toward more fulfilling roles. Beginning with Nehru’s postindependence calls for educated technologists

who would lead the nation in its game of catch-up to the West, Indian scientists have been the recipients of national support (especially through education), have held leading positions within government, and have played the symbolic role of leaders on the national stage. Technologically educated Indian elites built on government support throughout the decades after independence (particularly in the 1980s and 1990s) to tighten the relationship between technology as a good of and for the nation and their personal, familial, and class- and caste-based investment in technological knowledge.

The success of outsourcing and software services rewrote the globally savvy coder as a middle-class paragon of Indian citizenship. The moment in which the tie between nation and technology could be expanded to Indians overseas marked a significant reversal of the relationship between diasporic Indians and the nation. This signaled a turn to technoentrepreneurialism as a means of further developing Indian national imaginaries.

In other words, the Indian software and outsourcing revolution mirrored the emergence of an India organized around the rise of a new middle class that turned toward private sector employment as a source of new wealth and symbolic power. Information technology sector titans, such as Nandan Nilekani, Aziz Premji, and Vinod Khosla, were examples of this new kind of entrepreneurialism, embodying in their stories the switch in emphasis from manufacturing to services, from government employment to private companies, from India-oriented to world-oriented.⁹

Within India's outsourcing industry, programmers are asked to perform a globally accepted Indian difference that maintains the allure of brand "India" to outside investors at the same time that it satisfies a national imaginary of Indianness.¹⁰ At the time of this writing and according to my informants, the path to middle-class success for young Indians leads to computer programming jobs, which are favored even over disciplines such as medicine. Computer programming is thought to be more lucrative and is more attractive because it is associated with the "opening" of the Indian economy to privatization. The programming sector is also aspirational for lower classes, with some researchers reporting that computer science is now favored in village education over English.¹¹

Programmers link themselves with the rhetorical power of a national imaginary such that the development of the nation and the development

of the self align. These practices of inhabiting technological know-how emerge from the extended involvement of the Indian state with technocratic knowledge. Programmers are inheritors of the technocratic imaginary of the Indian state yet find it wanting; they employ multiple repertoires of expertise that express “a further way to look” and can be understood as continuing a relationship, mediated by objects, between the expert and the state, “provid[ing] for the continuation of the structure of wanting.”¹² Adi’s “At the Stroke of Midnight” tagline betrays a structure of wanting that links the desire for India to move forward with personal desire of technological objects. The Nehruvian ideal of freedom at midnight remains a strong argument but one that moves audiences toward private initiatives that are to stand in for public goods.

For Adi, Bipin, and other programmers I spoke with, their approach to national development withdraws support from a state they see as inefficient even while it reaffirms support for the Indian nation. When I asked him what he thought the government’s role should be in helping poor communities in India, Mayur, who worked in Bangalore before applying for a German green card, told me that it was up to businesspeople and professionals like himself to grow the Indian economy, which would produce more opportunity for other people. The state, he told me, “should set up the basic rules, like establishing the laws of physics. And then get out of the way.”¹³

Adi’s idea for his start-up was a business-to-business (B2B) venture that he called BSure, which he pitched as a software program plus online and phone support that would function as a saved log of personal connections. According to his business plan, employees of a firm would fill in a simple form after each call or e-mail interaction they had with a client, listing both personal details (such as birthdays, interests, or hobbies) and business concerns. This would go into a database, so that the next employee who would contact that firm could pull up this information. For an additional fee, Adi’s company would keep track of clients’ interests and send them appropriate gifts, tips, and suggestions that would correspond to their personal interests. With the start-up funds that Adi was able to garner through his e-mail campaign, he was able to move to London. His next step, he told me, was Silicon Valley, where he plans to pitch the idea to venture capitalists. Adi is a success story within Indian programming economies. From his start as a student at Berlin’s Technical University, he was able to stay in Germany

long enough to find a few programming jobs and then, through this campaign and the money he had saved, to move to London, where Maya had family. He may be on the cusp of vaulting himself out of the middle-class precarity that I describe in this book. Yet, his story exemplifies how Indian coders inhabit a middle-class identity that coheres around a changed relationship to the Indian state and around a long-standing relationship to technology as definitive of elite-led national development.

Narratives about the past both craft a story about what happened and a relationship between that story and the present moment. What is more, such narratives, far from only being the creation of professional historians, are the stuff of everyday life, where “we are all amateur historians with various degrees of awareness about our production.”¹⁴ Moments of “retrospective significance” occur when actors try to compose a narrative that looks back from the perspective of the present to craft a story of how that present came to be—such as when Adi and Bipin relate a historical relationship presaging rising India. Understanding these moments as part of “the processes and conditions of production” of history produces an account of the power of these narratives and of fissures and silences within them.¹⁵ By tracing the palimpsest of these moments, history of the socio-technical present emerges that recognizes multiple technical worlds in the making and how those worlds are linked, here, with the question of class.¹⁶

State Projects and the Emergence of a Scientific Elite

The history of software in India is often treated shallowly. The watershed moment of 1991 when India liberalized its economy marks in this narrative the beginning of the IT revolution in India. Liberalization reduced barriers to foreign investment, eliminated certain bureaucratic hurdles of arcane licenses and prohibitions that were the legacy of both colonial and early national legal regimes, and opened Indian markets to foreign trade and consumer goods. Complicating this story is a more recent body of evidence emphasizing that as much as a nascent industry was able to grow as a result of liberalization, the sponsorship and even protection of software services by the Indian state before 1991 and the long-term investment in science and technology higher education by the Indian state were also major causes of the rise of Indian IT.¹⁷ These recent findings suggest that the development of India’s IT industry can be understood as part of the developing idea of the state itself.

The early history of the computer in India shows how computers were integrated in national development projects while also helping solidify an ideology of national elites as leaders of the nation. While this association between technology, the state, and elite culture shifts after 1991 toward a new definition of both the state and the national elite that relies on private accomplishment to fund development projects, it nevertheless leaves technological expertise at its center.

A triangulation of technology, elite culture, and the state emerged in India's late colonial period as middle-class intellectuals began to shape anticolonial arguments through national identity. Middle-class Indian nationalists formulated an Indian nation whose positive attributes were both unrecognized and exploited by the colonial state. The elaboration of the scientific truths found in the Vedas and other scriptural texts became one pillar in an evolving riposte against assumed Western superiority. Bengali scholars such as Brajendranath Seal and Prafulla Chandra Ray codified notions of Hindu scientific progress that had been circulating in journals and pamphlets since the late nineteenth century. Seal's "The Positive Sciences of the Ancient Hindus" (1915) "identified a body of scientific knowledge and practices developed by the Hindus in the investigation of physical phenomenon," while Ray's two-volume *History of Hindu Chemistry from the Earliest Times to the Middle of the Sixteenth Century A.D.* (1902–9) read Sanskrit texts to "assess the achievements of Hindu alchemy from the point of view of modern experiments in observation."¹⁸ Such works opened up a terrain of negotiation on which native intellectuals could press claims for membership in universal domains of knowledge and practice.¹⁹

At the same time that Indian middle classes were formulating an idea of Indian science that connected indigenous knowledge with national identity and elite cultures, the *raison d'état* of the British Raj was shifting toward managing India's resources. Partially in response to accusations of mismanagement from social reformers who linked famine, women's rights, and poverty to the failures of British statecraft, the late nineteenth-century colonial government refocused scientific enterprise away from what was called "systematic research" and toward utilitarian investigations. Science and technology were to find solutions to immediate and pressing problems, especially in agriculture and land management. Beginning in 1902, the newly created Board of Scientific Advice (BSA) shifted focus

to the economic improvement of agricultural land and the development of industry. The instrumentalization of technology in service of the state sought out technical solutions to problems of productivity and socioeconomic organization: “By the beginning of the 20th century, colonial power was no longer about bringing the light of Western reason and Christian truths to the dark corners of the globe, but about the scientific and technological reconfiguration of these dark corners. As an incarnation and instrument of the technological will, the colonial state became inseparable from the configuration it had brought into existence. Not surprisingly, it also emerged as the site for the definition and determination of India and Indian interests.”²⁰

The establishment of a postindependence technoscientific apparatus for the sake of benefiting the citizens of India was centrally important in the years leading up to and in the decades after 1947. Problem solving through technical means created a kind of contract between the citizenry and the state, whereby what Srirupa Roy calls the “needy nation” and needy citizens were invoked by the Nehruvian government as a means of reinforcing state power. The sovereign certainties of colonial science gave way to the postcolonial management of development through technology, which “presented the task of nation building as perilous, uncertain, and above all incomplete without the willing partnership and active participation of the people.”²¹

In the decades after independence, the nation and its citizens were constructed as having problems that science could solve, while the state was constructed as needing its citizens’ expertise and “scientific temperament” to succeed.²² Both the state and its citizens were defined as lacking the knowledge that scientific expertise could provide. Out of these citizens a small cadre of elite scientists would be trained to lead the nation at the same time that all citizens needed to develop an attitude of openness to rational inquiry that went beyond the expertise of scientists themselves.²³ While the ideological rhetoric of the nation shifted from colonial to postcolonial regimes, the need for a strong technoscientific state apparatus remained unquestioned.

From the 1950s through the 1980s, computer technologies fit into this overall framework of technoscientific management in two critical ways. First, machines were prestige objects that signaled the state’s internationalism. Second, they were technical apparatuses to be used within a general

framework of problem solving. Crucially, Indian elites participated in both projects by brokering the provision of computers to India from abroad and by integrating machines into already existing scientific enterprises.

The drive to computerizing existing research programs was led by Homi Bhabha in Bombay and Prasantas Chandra Mahalanobis in Calcutta, both well known as leaders of India's technoscientific establishment. Mahalanobis founded the Indian Statistical Institute (ISI) in 1932 in order to "increase the efficiency of human efforts in the widest sense."²⁴ While employed by the Raj, Mahalanobis used his statistical methods largely to study cash crops such as jute and to compute food yields as related to famine, such as rice. After independence, the ISI produced yearly statistical data on the economy, agriculture, and population health of the country to govern national planning.²⁵ Bhabha used computers in his nuclear research programs at the Tata Institute of Fundamental Research (TIFR) in Bombay, which he founded in 1945. They were integrated in nuclear reactor electronics and control systems. The machines at TIFR were time shared and used by scientists from government labs, educational institutions, and private organizations. During the late 1950s, a battle for computer resources began between Bhabha and Mahalanobis. Each wanted to establish a national computer center in order to have increased access to the computing power the government of India could provide through imports from the United States and the USSR. Bhabha effectively won this battle by negotiating independently with American suppliers, especially IBM and CDC (Control Data Corporation), to supply machines for TIFR.²⁶ These early uses of computers in India set a pattern: limited governmental resources, reliance on importing machines from the United States, the USSR, and elsewhere, and the integration of computer technologies across a wide range of national-developmental programs, from economic data collection to nuclear experimentation. At the same time, throughout the 1960s and 1970s, considerable emphasis was put on the development of Indian machines and especially on developing programming skills. Much of the training in programming at this early stage was developed in conjunction with overseas research institutes, especially the University of Illinois in the United States, a pattern that would yield the transnational connections important to the expansion of Indian software services in the late 1990s.

The history of computing in India from the 1950s through the 1980s was dominated by the investment of government in technologies as a means

of statecraft, the cross-border connections of the scientific elite and the corresponding ideology of development that they and the government promoted, and the evolution of improvisation and ad hoc construction by individual technicians in the face of resource shortages. Early efforts by researchers to build computers often involved a great deal of improvisation as necessary parts were frequently bought from markets selling post-World War II remainders in Chandni Chowk in Delhi and Mohammed Ali Road in Mumbai. In India, this tradition of improvising machines from local parts bazaars is a major part of the way digital cultures work in South Asia. Although this topic is ancillary to my book, traditions of bricolage no doubt hold important insights for understanding computer cultures in India.²⁷ In this discussion of relations between elite transnational coders and the history of science and technology, I want to emphasize the way certain contradictions in the way computer technologies were integrated into the state's technoscientific enterprises were themselves subject to improvisation, as middle classes fashioned themselves first as technocrats in the service of the state, and then as entrepreneurs in service to the nation.

The state's investment in computer technology consisted of brokering deals to get supplies of computers from overseas and in using international collaborations to build training institutes, including the Indian IITs. Histories of the Indian Institutes of Technology suggest that in addition to institutional support from the United States at IIT Kanpur and Kharagpur, the USSR at IIT Bombay, and Germany at IIT Madras, the establishment of the IITs depended on the circulation of Indian national elites who had been trained overseas and then helped broker agreements and staffed the institutes in India. Devesh Kapur has argued that the emigration of elites to the United States and elsewhere acted as a release valve in the political arena, allowing other groups to enter political society at the same time that for the old Brahmin-dominated elites it "changed the locus of privilege from political power in the state to economic power in the private sector and outside of India."²⁸ This suggests that there was a transnational character to Indian professional technologies (such as medicine and engineering) long before the liberalization movements of the early 1990s. It also confirms the domination of computer science in India by upper-caste Hindus. After 1991, overseas elites were folded into a narrative of state as its ambassadors and representatives in a global economy in which increasingly private institutions and actors furthered state power.

The IITs: Embodying Postindependence Contradictions and Establishing a Technoscientific Middle Class

Authors trying to explain the success of Indian programmers often turn to the Indian Institutions of Technology, the IITs, which have justifiably become famous for graduating several leaders of tech companies in the United States and in India. Yet it is also very much the case that most programmers working in India and overseas have not graduated from one of the IITs.²⁹ Programmers attend regional institutes and colleges and also supplement training in engineering and related fields with certificates in programming languages from private institutions. The IITs might be better understood from within the longer history of the computer in India that I have been tracing as embodying the sometimes contradictory framings of technological elites, the work of the nation, transnationalism, and citizenship.

According to reviews of the history of IITs conducted by Ross Bassett, Patrick Kim Sebaly, and Stuart Leslie and Robert Kargon, the institutes were set up with the cooperation of the governments of the United States, the USSR, and Germany and financed largely by the government of India.³⁰ The internationalism pursued in the grounding of IITs was in fact similar in nature to that pursued in other areas of technological development, including building the country's nuclear technology and provisioning TIFR and the ISI with computers. In all of these cases, supplies of materials, knowledge, and outside expertise were to be secured from as many sources as possible, in keeping with the official policy of nonalignment during the Cold War. Competition among foreign powers, especially the United States and the USSR would help assure that Indian needs would be well met. The American impetus for investment, for instance, fit squarely into a post-World War II development paradigm. Of the MIT experts who were engaged in founding IIT Kanpur, Leslie and Kargon remark that their agenda was "to train the future engineers and engineer-administrators capable of leading developing nations to modernization. Having spent a decade perfecting engineering at home, they welcomed the opportunities afforded by the Department of State, by the Ford Foundation, and by businessmen and political leaders in developing countries to share their success abroad."³¹ Similarly, Soviet assistance at IIT Bombay and German assistance at IIT Madras were governed at least in part by the desire to export Soviet and German educational models to the developing

world. The result of German consultation at IIT Madras produced training that integrated practical workshops and hands-on experience while Soviet experts developed specialized courses of study on the graduate level at IIT Bombay.³² On the whole, the IITs were based largely on an American model of education, which would move the Indian technical education system away from the training of technicians and toward the creation of general, conceptual knowledge and collective problem-solving skills. This would be accomplished through a curriculum stressing basic sciences, along with humanities and social science studies, and the latest and most up-to-date technologies, including computers. The first director of IIT Kanpur, P. K. Kelkar, believed that “a scientific foundation could provide the basis by which teams of diverse experts could collaborate to solve complex problems.” He believed “the American reforms were based on anticipating a ‘complex and challenging future’ and the need to prepare for it,” which was also the case for India.”³³

The founding charter of the IITs was the 1946 “Development of Higher Technical Institutions in India Report,” also known as the Sarkar Committee Report. It is an interesting document, not least because it displays so clearly the ambivalences around what a technical education for Indians would look like. The mandate of the commission was to establish the best possible method for training engineers and other technologists for postwar and, soon, independent India. The first lines of the report capture the burgeoning sentiment of urgency in the pursuit of development for India and the conviction that these projects would have to be led by the nation and its citizens and not by outside forces: “In view of the certainty of an appreciable increase in the demand for higher specialists in Industry,” wrote the committee, “a rapid expansion in the facilities of Higher Technical Education is a pressing necessity. It is evident that apart from any other considerations, the calls of reconstruction in Europe and elsewhere, and the enormous industrial and Governmental undertakings completed in Europe and America to provide full employment, will make it difficult, if not impossible, to secure from abroad, the services of the right type of engineers, architects, technologists and planners etc. to carry out India’s postwar projects.”³⁴ Framing the choice as one between setting up one main institution with several branches “possibly on the lines of the Massachusetts Institute of Technology” or several regional institutions, the committee ultimately recommends establishing “not less than four” institutions, in each

of the cardinal directions.³⁵ They superimposed thereby onto the physical and cosmological topography of India a technological map of state. In the very plan of the IRTs, the geography of India and the technological imaginary of the Indian state mutually reinforced each other.

Reading through the report, however, some of the contradictions in this imaginary of India come to the surface. The dissenting opinions of committee members Dr. Nazir Ahmad, Office of the Indian Tariff Board, on the one hand, and Brigadier R. D. T. Woolfe, controller general of inspection, MGO Branch GHQ New Delhi, on the other, make for particularly compelling reading. The committee found that “the existing facilities of higher technical education in India are inadequate . . . to satisfy India’s post-war needs for high grade technologists.” Foregoing a “normal” process of investigation and survey due to this pressing concern, the committee wrote that “the needs of the present situation are so apparent and urgent that a solution cannot be deferred pending such a survey.”³⁶ The sense of expedience carried the committee past considering what these needs might be and why they would be best addressed by four new institutions. In his dissent, Ahmad, for instance, suggested that there was little attempt made to assess existing facilities and how they could be developed. He further pointed out that creating four new institutions would leave a gap between the number of “trained men” and the requirements—estimated to be several thousand—of the country. Rather than creating institutions *ex nihilo*, Ahmad suggested developing what already existed, a method “which has already been followed in Europe and America.” He further warned that “if this process is not followed, the existing institutions would stagnate and decay while the newer institutions will work in an atmosphere of isolation.”³⁷ Ahmad went on to suggest bolstering the resources of historical institutions of higher learning, especially because he felt that the proposed IRTs located in only four places and for the most part in urban centers would remain beyond the reach of most Indians.

If Ahmad was concerned with the education of rural Indians and the development of existing programs, Brigadier Woolfe’s dissent proceeded along entirely different lines. He complained in a letter to Dr. Jon Sargent, educational advisor to the government of India, regarding technical education in India, “There can be no doubt that the scientist members of the committee steered the discussions very ably into channels with which they were familiar.”³⁸ The result of the scientists’ influence was a plan, according

to Woolfe, to train chemists and engineers in “the very industries which come into conflict with overseas competition already developed on much more efficient lines than India can ever hope to achieve.”³⁹ No doubt he had in mind the British and other European industries that had been able to produce in the colonies markets for their finished goods and intellectual commodities. The letter goes on to suggest a better application of resources would be to train technicians (as opposed to general practitioners) for the specific industries of jute, cotton, silk, lumber, fuel, mining, and pharmaceuticals. Woolfe was envisioning in the main a continuation of the British practice of training specialized executors to produce the raw goods and materials of Empire, and he certainly had one eye on preventing competition for European knowledge from possible colonial upstarts.

The findings of the Sarkar Committee and these dissents collectively embody the ambivalences around technologies of state that would characterize the postindependence period and after. This period witnessed negotiations over what the technical enterprises of state should be and what kind of contribution the technological elites being trained in India would make to the newly formed nation. Finally, the internationalist aspects of technological projects embodied both the objectives of large-scale development projects and the equally broadly imagined paradigms of a sovereign post-colonial state.

Itty Abraham has argued with regard to India’s nuclear projects that the keen interest and energy devoted to developing nuclear energy has to be understood as part of a postcolonial desire to claim national sovereignty on an international stage, creating of nuclear technologies a visible sign of the power of the state itself. Dams, steel mills, and nuclear tests are some of the most visible fetishes of state power.⁴⁰ Yet, a similar argument could be made for investment in the IRTs and in computer technologies. The urgency expressed in the first few lines of the report represent in this sense a riposte to Woolfe’s more tepid claims for India. In the immediate postindependence period, the state and its leaders were set on countering, in numerous fields, the *idée fixe* that India would remain hopelessly stuck behind areas of the world that had taken full advantage of a very long colonial engagement.⁴¹

It was also clear that those trained in the new technical institutes were to play leading roles in these transformations; they were to be incorporated as experts into the technical apparatus of state.⁴² But it remained under-

determined exactly how they were to fulfill this role, as Ahmad's dissent points out so clearly.

Elite technological institutes were given the simultaneous mandates of producing cutting edge research for an international audience and of developing local talent and local resources. Nehru's vision as expressed in numerous speeches from the late 1940s through the late 1960s often stressed the latter, envisioning a cadre of graduates who would bring a technical, modernist mind-set to all of India.⁴³ It fell to India's scientific establishment to create, as he urged the graduates of Administrative Staff College in Hyderabad in 1958, out of the agricultural laborer, "a technical worker, even in the field."⁴⁴ In this vision for India, the scientist-technician brought together knowledge and morality in an idealized fashion. "The scientist," Nehru exclaimed in a speech at the inauguration of the forty-third session of the India Science Congress on January 2, 1956, in Agra, called "Scientists and an Integrated View of Life," has to deal with the problem of "the betterment of the Indian people, raising their standards, increasing their wealth, removing inequality, and so on and so forth; planning, if you like, in its widest sense to help in that process." Given the scientist's duty toward development, Nehru asserted that "the scientist ought to have, and I believe has, a somewhat greater freedom of functioning and of directing people's thoughts, because the politician is suspect."⁴⁵ The presentist framework of Nehruvian moral development made all historical inheritances amenable to intervention. "To put the point perhaps overstarkly," writes Uday Mehta, "the challenge of caste injustice becomes analogous to that of building industry or large dams. They are all challenges in which the state draws and leans on the guiding primacy of science and social science."⁴⁶

The dual mandate of achievement and development for elite classes did not always fit neatly together. As Ahmad predicted, the graduates of elite institutions such as the IITs often found their closest interlocutors and colleagues among other technoelite groups who were frequently working in high-tech positions overseas.⁴⁷ Despite, or perhaps because of, the lack of clarity about how nation, citizen, and technology were to be woven together, consensus moved instead toward promoting the needs of state through technical solutions. While in the 1950s and 1960s these solutions took the form of large-scale investments in big development projects, beginning in the late 1970s and 80s, the state additionally turned to privatized industries and transnational networks of technoelite power.

Computers as Development: Expertise as International Connection

During the 1960s and 1970s, Indian computing depended on the training of experts in institutions such as the IITs, the implementation of computer technologies in government-backed development projects, and the importation of computers and computer components from overseas suppliers. The ISI, for instance, initially rented machines for its statistical work at a rate of approximately eight to nine lakhs per year (\$114,250–\$128,570 according to the 1970 conversion rate). In 1961 to break this cycle of spending, Nehru asked IBM to manufacture the model called 1401 and to train computer operators in India.⁴⁸ The manufacturing and sales methods used by IBM would prove controversial, leading to the company's eventual ousting from India in 1977. In *The Long Revolution*, Dinesh Sharma provides the following summary of the company's standard operating procedure: "The operation ran something like this: old or discarded machines were brought in from the US and other markets; they were stripped to the base; all parts were tested, whatever was not reusable was thrown away, whatever was reasonably good and repairable was repaired, and the machine was rebuilt from almost the component level."⁴⁹

These refurbished machines, often already obsolete in the United States and Europe, were then to be leased with maintenance and service packages that would be paid monthly. This practice, widely accepted in the global computer industry through the 1960s, came under increasing scrutiny in the first half of the 1970s. A report compiled by the Electronics Commission of India in 1975 found that when 1401s were being installed in India, minicomputers with the same capacity could be had elsewhere for one-quarter of the cost, and a slightly more powerful computer could be purchased for \$1,200 while IBM was charging \$20,000 in annual rental for a single computer.⁵⁰

The political maneuvers between the government of India and foreign multinationals during the early part of the 1970s deserve their own treatment, and indeed, assessments of this era of protectionism have been anything but sparse.⁵¹ A reading of this literature as regards the computer industry suggests that both the high-profit business practices of companies such as IBM and protests against the automation of work by banking and railway unions led to a reassessment of IBM's business practices in India.

Notably, the newly modified Foreign Exchange Relations Act (FERA) of 1974, which rewrote provisions originally set down before independence, limited foreign ownership of Indian corporations to 40 percent.⁵² IBM was given two years to comply with the provisions of FERA. In the meantime, the government's Public Accounting Commission Report made the argument for protectionist policies more acute by concluding that "the import entitlements facility given to IBM . . . enabled it to dump in India what was largely junk, that is, machinery and gadgets which had hardly any market elsewhere in the world, yet to earn excessively high profits without making any or significant contributions towards India's attainment of self-reliance in critical areas of computers."⁵³

The ensuing history of IBM (and also Coca-Cola) pulling out of the Indian market is often related along free market versus socialist interventions or in terms of uneven development as a continuation of colonialist strategies. While the era of import substitution can certainly legitimately be read as a case in the study of nationalist economics, it is also the case that polemical arguments about whether protectionism or open markets lead to more development remain ahistorical, generalizing from a very particular context to an ideal type that cannot hold across place or case.

What is clear in the history of the computer in India is that the 1977 departure of IBM from India in no way extended to a questioning of computing or technology in general.⁵⁴ Throughout the 1950s–1970s, it was a shifting mix of nationalism and internationalism, global expertise, and national development initiatives that consolidated the position of the elite technical classes as a model and agent of the technologies—from steel plants and mining to finance and computing—of human development.

During the 1970s and 1980s, the mandate for technological development in India began to move in two opposing directions. While technologies of state were still meant to better the people of India, the locus of development during this period moved uneasily between two Indias, rural and urban, indigenous and cosmopolitan. Often glossed as the distinction between *Bharat* and India, these two Indias were largely interlinked in practice but increasingly distant in the rhetoric of statehood as powerful farmer's unions and wealthy landholders mobilized political support around the countryside in opposition to the cities. Indira Gandhi's political career was in many senses sustained by appealing to a popular imaginary of the countryside as *Bharat*, dividing the political sphere and its citizenry

into a Manichean duality that could be recursively applied across the populace.⁵⁵ Within this framework, the computer was called on, as in the 1950s and 1960s, to aid in carrying out calculations and developing new solutions for already existing research, the building of utilities, and industrial projects. Indeed, many of the developments that are commonly associated with postliberalization India, such as software technology parks (STPs), have a much longer history. It was under Indira Gandhi's third term as prime minister that STPs first garnered governmental support, with the idea that they would produce software exports for which investment in special export processing zones and satellite technology could be justified.⁵⁶

To this mandate was added another, the goal of developing an internationally networked system of machines that would link together the “developed” and “underdeveloped” worlds. As the UN Development Decade Report for 1970–80 had it, “As international computer networks and computer reporting become established during the next decade, developing countries will find computers necessary as a ticket of admission.”⁵⁷ In the Indian context, the dual mandate of using computer technologies to better the lives of the poor and of staying abreast of the latest technological development with an eye toward maintaining that necessary “ticket of admission” on the international stage led to several only partially acknowledged contradictions. While government policies continued to pursue technologies from abroad, for instance, workers in the banking and railway sectors went on strike to oppose their replacement by machines. And, although the stated aim of computer research continued to be framed in terms of service to the nation, the practices of India's technolite continued to look toward the United States for training and employment. Indeed, it was in the 1970s and 1980s that Indian computer engineers began to set up the international networks that would become the outsourcing industry two decades later. Companies with founders who had been trained in the United States were able to create business that relied on labor arbitrage, taking advantage of the cheaper cost of technical labor in India, throughout the 1980s.⁵⁸

The split between middle classes that looked toward major metropolitan areas, research centers, and networks of diasporic Indian elites in the West for self-development and the ongoing moral discourse of development through computer technology would only be resolved during the era of neoliberalism in India, when the moral authority of development was

folded into the practical advancement of the private individual. It was when moral governance began to be conceived of as a matter of care of the self as care of the nation, of good conduct as a means of conducting the development of the nation, that the elite technical classes of India could become vessels of national development by virtue of pursuing their own privatized advantage.⁵⁹

Software for the Indian Nation

In 1991 the high-water mark of market liberalization in India reformed industrial policy, abolishing industrial licensing for all projects except human health, the environment, and those considered strategically important (such as mining), and doing away with 40 percent foreign ownership rules. These measures rested firmly on the links made between the state, technocratic reason, and technical elites. Summarizing the layered history that led to India's IT boom, Ramachandra Guha writes:

Some of the credit is certainly due to the reforms of 1991, which opened up foreign markets for the first time. But some credit must also be taken by Rajiv Gandhi's government, which gave special emphasis to the then nascent electronic and telecommunication industries. Moving back a decade further, the Janata government's expulsion of IBM allowed the development of an indigenous computer manufacturing and maintenance industry. But perhaps the story should really begin with Jawaharlal Nehru's government, which had the foresight to set up a chain of high-quality engineering schools and the wisdom to retain English as the language of higher education and of interstate and international communication.⁶⁰

Indeed, several recent analyses have tried to contextualize the reforms of 1991 within a longer history of government support and intervention in the IT industry in order to argue that a mixed rather than free market economy is what ultimately produced India's IT boom. Murali Patibandla, Deepak Kapur, and Bent Peterson, for instance, argue that the high level of skill in software in particular came out of import substitution policies on hardware.⁶¹ Because imports of hardware were blocked except for the purpose of developing software for export, attention turned away from producing hardware for overseas markets and toward producing software that would run on locally produced machines, such as the IBM 1401, left behind after

1977, and new machines being produced overseas, for which government initiatives such as STPs were built. In other words, even in the industry said to most benefit from the turn toward privatization that the 1991 reforms supported, rumors of the demise of the power of the Indian state are highly exaggerated.

As I have been arguing, these debates on the advantages or disadvantages of free markets have tended to obscure what is an important but not unchanging problematic that extends across the history of the computer in India: the tight but ambivalent relationship between technolite classes and the development of state power. The narratives of Bipin and Mihir betray much of this ambivalence. Perhaps what has produced the most significant sense of change for this generation of technolites is the strategy for pursuing the goals of national development and the corresponding sense of the milieu in which they are to be pursued. If their parents' generation—the generation of Nehruvian scientists of state—was to provide be representatives of the state and teachers of the nation, this generation is meant to serve the nation and incorporate in themselves the qualities of a new, privatized state power—adaptability, growth, and openness to foreign investment. Commenting on the continued, if altered, significance of attachment to national development among IT professionals, Chris Fuller and HariPriya Narasimhan write:

Older people do not expect the younger generation, including their own children, to want to work for the state, rather than better-run and better-paying private companies. In itself though, this does not amount to a retreat from Nehruvian ideas of progress, let alone from any patriotic commitment. Many older informants, including those who worked for the government, tend to insist that the state has become corrupt and no longer serves the nation and people. Moreover, everyone who favors economic liberalizations and globalizations also argues that they are the best means to national development and prosperity, which the bureaucratic state and the old “permit raj” failed to deliver.⁶²

The salient point is that the institution of neoliberal forms of governance, which include privatizing industries and relying on nongovernmental entities to foster development, does not correlate with a decrease in state power as much as with a restructuring of how state power operates. And, similarly, those who most benefit from privatization of industry, including

IT professionals, have not retreated from the nation-state but have come to inhabit a new sort of relationship with state power. This relationship continues to be articulated through the medium of technology.

Of Partially Fulfilled Contracts: From Technoelites to Tech Entrepreneurs

In chapter 3, the code that programmers write was considered a means of exchange rather like the partial terms of extended contract that might be called “taking while giving,” of maintaining attachment to the code itself as a valuable object even while producing code in the service of one’s employers.⁶³ In the transactions around code as it is deployed in the workplace, the Indian programmer is simultaneously tasked with producing workable software solutions within the parameters of any given project and, through her very presence in firms, the speculative capital that marks a firm as adequately global. One strategy that coders pursue is to attach part of the value of code to themselves—to make code to some degree “inalienable” from themselves—even while they produce it as a product that can be alienated from their labor.

The creation of bits of code as inalienable wealth is a risky strategy that is encouraged by the politics of culture in the IT workplace. The IT industry tries to capitalize on the perceived value of the Indian coders. It is risky because it can all too easily lend itself to an overspecialization, turning what is a willingly mobile orientation to the world to an unwittingly fixed one. As Srinu explained, “Getting labeled as an expert in a particular area” prevents upward mobility. Though it is precisely this expertise that got him his job in the first place, if he does not show his versatility he will become stuck in one place and might eventually inherit a role that is about to be terminated as a project ends.

A similar set of constraints applies to the tie between technologies and national belonging. Though the assumption has been that diasporic Indian middle classes have decreasing attachments to the idea of India and have replaced Nehruvian allegiance to the state with an allegiance to their own bank accounts, this ethnography suggests this line of reasoning is unfounded. Rather than framing the question in terms of patriotism tout court, it is better to ask how newly emerging relationships between the state and its subjects reimagine the state itself and how national development can best be served.

Mayur, who believed the state should set rules and step aside, said he has “thought a lot about” what the role of IT should be in development for India. The state, according to Mayur, should “support projects without profit potential and projects tangential to profits, with long ROIs [returns on investment], like transportation. For everything else, government should keep hands off.” Mayur reimagined state power as taking on infrastructural projects that could not be accomplished by industry because of a lack of profit motive. Meanwhile, the life chances of ordinary Indians will be assured by expanding the reach of the market. I asked Adi and Bipin, who had been listening to our conversation, if they had thought that the IT industry had improved the lives of the lower castes and classes in India. Adi pondered the question a moment, but Bipin provided a ready answer for the both of them: “Yes, definitely, it’s produced opportunity.”

If one asks programmers if they think of themselves as Indian, they will say yes. Ask if they are proud to be Indian, and the answer is just as unequivocal. But they know that being proud to be Indian also includes being cognizant of the failures of national development as well as the hubris of the state’s promises of the same. Ask programmers how they can best develop and serve the nation, and their answers mirror closely the rhetoric of neoliberal globalization. Their job is wealth creation and the creation of opportunities—two things that the government, in all its inefficiency, has been unable to produce.

The programmer’s relationship to the Indian nation-state might be called the attitude of a party to a partially fulfilled contract. Programmers recognize that their very ability to generate wealth is due in large part to “brand India” as an IT powerhouse, yet allegiance to this brand has not yielded the promise of a good life. This good life, evoked but never fulfilled in the Nehruvian vision of industrial growth, was symbolized by the rationalization of technical processes, clean streets, wide avenues, and green spaces—the trappings of an Indian middle-class lifestyle that IT workers try to enjoy in life abroad and in new housing developments at home.⁶⁴ This dance of closeness and distance from the nation-state makes IT workers ambivalent partners in creating an India that like the workers themselves is high tech and highly adaptable.

Different expert lifeworlds produce a diversity of epistemes that only appear to be unified as “science” as an aftereffect of their description as a culture of science.⁶⁵ In the historical relationship that emerged between

expertise, the Indian state, and computer technology, three repertoires of expertise emerged linking the individual expert to the state. In the first, the state needed experts as scientists to produce knowledge and attitudes toward progress that were rational and could be transmitted to all citizens. In the second, the expert and the people were more fully divided, and the expert was needed as a link to international prestige. During Indira Gandhi's and Rajiv Gandhi's times as prime minister the divide between elites and the people devolved in the software industry into protectionism, which led to the elaboration of software and coding skills to be used on local machines, and international collaborations with Indians overseas. Third, the personal success of the computer expert stood in for state expertise, at the same time that success in the private world became the avenue for building national wealth. Rather than these three dominant arrangements of technological expertise and state power simply being divided into separate historical periods, they provide overlapping alternatives for Indian programmers to link themselves to—and distance themselves from—the power of the state.

These repertoires of expertise are mobilized by programmers in several ways. Adi uses the expert as scientist to appeal to older generations to contribute to his business venture. Bipin, on the other hand, makes a less straightforward evaluation of the relationship between India and its citizens. He links the time of Ashoka to an approaching future that is fated to come into being. He thereby both links his own fate to this coming success and delinks himself from active striving on behalf of the state. If the turning of time fails to come, it may even be the fault of the state for holding back the inevitable.

Many commentators on diasporic Indians accuse them of being disloyal to the nation-state for choosing a successful life abroad instead of a life of service in India.⁶⁶ At the same time, in many Indian government publications, the successful programmer abroad is lionized as a model subject for a new India. Meanwhile, surprisingly little has been written on how these experts conceptualize their own relationship to the state. If, in 1973, the review of computers in Asia could begin by asking what a computer was good for, in the new millennium, that question would no longer be posed. Computers were squarely part of the apparatus of a successful India, and the eradication of Indian ills would be solved by IT's thought leaders.⁶⁷ As programmers navigate their relationship to national trajectories of development, they are

able to bring together the story of their own striving with the narrative of national well-being because of the longer histories of technological expertise that subtend both these narratives. As computer-aided statistical and atomic science projects enrolled programmers and other Indian class and caste elites as experts, they consolidated expertise and the representativeness of these very elites as national subjects. In doing so, they established parallels between individual growth and national development. Entrepreneurial projects pursued both within India and transnationally could then filter programmers' experiences abroad through this doubly located Indian national imaginary.